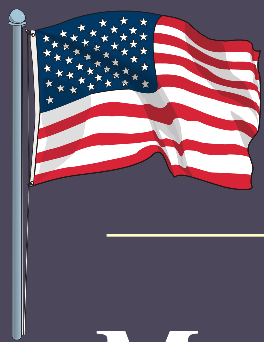

INSPECTORS GUIDE

Material Control and Accountability

SSA

Office of Security and Safety Performance Assurance

Office of Safeguards and Security Evaluations
Office of Independent Oversight and Performance Assurance

June 2004

MATERIAL CONTROL AND ACCOUNTABILITY

INSPECTORS GUIDE

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U.S. Department of Energy
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User Comments

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Foreword

As part of an effort to enhance the inspection process, the Office of Safeguards and Security Evaluations (OA-10) has prepared the Material Control and Accountability Inspectors Guide as one in a series of inspectors guides. The guides incorporate the safeguards and security criteria used by the Department of Energy (DOE) with information gleaned from independent oversight inspection activities to assist inspectors in evaluating safeguards and security protection programs across the DOE complex. Field element and contractor employees may also wish to use the guides to assist in surveys and self-assessments.

However, it must be remembered that as this is a guide, it does not represent DOE safeguards and security implementation policy. Applicable directives, as well as approved local procedures, must be used as the criteria for evaluating DOE and National Nuclear Security Administration safeguards and security programs during inspections, surveys, and self-assessments. A loose-leaf notebook format is used so that sections can be easily removed and copied for reference.

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Acronyms

ANSI	American National Standards Institute
BI	Beginning Inventory
CCTV	Closed Circuit Television
CMPC	Classified Matter Protection and Control
CFR	Code of Federal Regulations
DA	Destructive Assay
DAC	Daily Administrative Check
DNFSB	Defense Nuclear Facilities Safety Board
DOE	U.S. Department of Energy
EI	Ending Inventory
ES&H	Environment, Safety, and Health
FA	IAEA Facility Attachment
FNMC	Fundamental Nuclear Material Control
GAAP	Generally Accepted Accounting Principles
GAO	General Accounting Office
IAEA	International Atomic Energy Agency
ID	Inventory Difference
ISM	Integrated Safety Management
ISO	International Standards Organization
ISSM	Integrated Safeguards and Security Management
LANMAS	Local Area Network Material Accounting System
LE	Limit of Error
LEID	Limit of Error of the Inventory Difference
MAA	Material Access Area
MBA	Material Balance Area
MCAP	Material Control and Accountability Plan
MC&A	Material Control and Accountability
NDA	Non-Destructive Assay
NM	Nuclear Material
NMMSS	Nuclear Materials Management and Safeguards System
NNSA	National Nuclear Security Administration
NNSI	Nonproliferation and National Security Institute
NPT	Non-Proliferation Treaty
NRC	U.S. Nuclear Regulatory Commission
NUREG	NRC Regulatory Guide
OA	Office of Independent Oversight and Performance Assurance
OA-10	Office of Safeguards and Security Evaluations
OJT	On-the-Job Training
OPSEC	Operations Security
PA	Protected Area
PAP	Personnel Assurance Program
PF	Protective Force
PPM	Protection Program Management
PSAP	Personnel Security Assurance Program
PSS	Physical Security Systems
RIS	Reporting Identification Symbol
SNM	Special Nuclear Material

Acronyms (continued)

SO	Office of Security
SPO	Security Police Officer
S/R	Shipper/Receiver
S/RD	Shipper/Receiver Difference
SSIMS	Safeguards and Security Information Management System
SSSP	Site Safeguards and Security Plan
TAG	Technical Advisory Group
TAP	Training and Accreditation Program
TID	Tamper-Indicating Device
TMAA	Temporary Material Access Area
VA	Vulnerability Assessment

Definitions

ACCESS.

a. The knowledge, use, or possession of classified or other sensitive information required by an individual to perform official duties that is provided to the individual on a need-to-know basis.

b. The ability and opportunity to obtain knowledge of classified information.

c. Situations that may provide an individual proximity to or control over special nuclear material.

d. The proximity to a nuclear weapon and/or special nuclear material in such a manner as to allow the opportunity to divert, steal, tamper with and/or damage the weapon or material.

e. Ability and means to communicate with (i.e., input to or receive output from), or otherwise make use of any information, resource, or component in a Classified Automated Information System.

f. Ability to enter a defined area.

ACCESS AUTHORIZATION. An administrative determination that an individual is eligible for access to classified matter or is eligible for access to, or control over, special nuclear material.

ACCESS CONTROL.

a. The process of permitting authorized access or denying unauthorized access to information, facilities, nuclear materials, resources or designated security areas through information security, physical protection, nuclear materials control, personnel security, communications security, technical security, operations security and/or other programs, procedures and means.

b. The process of limiting access to information or to resources on a Classified Automated Information System only to authorized users.

ACCESS CONTROL MEASURES. Hardware and software features, physical controls, operating procedures, administrative procedures, and various combinations of these designed to detect or prevent unauthorized access to classified information, special nuclear materials, Government property, Automated Information Systems, facilities, or materials, or areas containing the above and to enforce utilization of these measures to protect DOE security and property interests.

ACCOUNTABILITY MEASUREMENT. A quantitative measurement of the amount of nuclear material in an item or location made to establish initial book values for the material or to replace the existing book value with a more recent measured value.

ACCURACY.

a. Measure of the agreement between the true value and the measured value. (DOE)

b. Closeness of agreement between the result of a measurement and a true value of the measure. (ISO [International Standards Organization]/TAG [Technical Advisory Group])

c. Concept employed to describe the agreement between a measure of location of measurements and a corresponding correct value. (American National Standards Institute [ANSI])

ACTIVE INVENTORY.

The sum of additions to inventory, beginning inventory, ending inventory, and removals from inventory, after all common terms have been excluded. *Common terms are any material values which appear in the active inventory calculation more than once and come from the same measurement.* (10 CFR Part 74.4)

ACTIVE NON-DESTRUCTIVE ASSAY (NDA). The measurement of radiation whose production has been stimulated by bombardment or irradiation by another source.

ACTUAL INVENTORY DIFFERENCE. The portion of the Inventory Difference that is not Explained Inventory Difference; expressed mathematically as:

Inventory Difference – Explained Inventory Difference = Actual Inventory Difference

ADJUSTMENT. An entry into the nuclear material accounting records to reflect an approved, justified, and documented change.

ADMINISTRATIVE CHECK. A review to determine that no irregularities appear to exist, no items are obviously missing, and no tampering is indicated.

ALARM LIMIT. A control limit established for an inventory difference which, when exceeded, requires immediate action and reporting. (Alarm limits are generally established at the 99 percent confidence level.)

APPARENT LOSS. The inability to physically locate or otherwise to account for any of the following:

a. Any identifiable or discrete item (e.g., batch, lot, or piece) containing nuclear material.

b. A nuclear material inventory difference in which the book inventory is larger than the physical inventory by an amount in excess of the established alarm limit.

c. A shipper/receiver difference involving a discrepancy in which fewer items were received than were shipped.

d. A shipper/receiver difference whose magnitude exceeds the combined limit of error for the shipment and for which the receiver measures less material than the shipper.

APPROVED SECURITY CONTAINER. A security file container, originally procured from a Federal Supply Schedule supplier, that conforms to Federal specifications and bears a "Test Certification Label" on the locking drawer attesting to the security capabilities of the container and lock. Such containers will be labeled "General Services Administration Approved Security Container" on the outside of the top drawer and have a lock meeting Federal Specification FF-L-2740.

ASSESSMENT.

a. An evaluation of the effectiveness of an activity/operation or a determination of the extent of compliance with required procedures and practices.

b. An evaluation of a Material Control and Accountability anomaly or Material Discrepancy Indicator (Material Control Indicators).

c. An appraisal of the credibility, reliability, pertinency, accuracy or usefulness of information.

d. An evaluation of a physical security alarm.

e. A determination of the validity and priority of an incident.

ATTRACTIVENESS LEVEL. A categorization of nuclear material types and compositions that reflects the relative ease of processing and handling required to convert that material to a nuclear explosive device.

AUTHORIZATION. Access rights granted to a user, program, or process.

AUTOMATED ACCESS CONTROL SYSTEM. An electronic or electro-mechanical system used to authorize movement of personnel, vehicles, or material through entrances and exits of a secured area. Authorization is obtained by the user entering personal identification information (e.g., through a magnetic card reader, Personal Identification Number, or biometric scan), a computer comparison of identification data against an authorized user list, and computer activation of the portal unlock mechanism if the requestor's name is on the list of authorized personnel.

AUTOMATED SURVEILLANCE SYSTEM. A logically connected set of mechanized and/or electronic components that may be substituted for direct human surveillance.

BARRIER. A coordinated series of natural or fabricated impediments that direct, restrict, limit, delay, or deny entry into a designated area.

BATCH. A portion of source material or special nuclear material handled as a unit for accounting purposes at a key measurement point and for which the composition and quantity are defined by a single set of measurements. The source material or special nuclear material may be in bulk form or contained in a number of separate items.

BATCH NAME/NUMBER. Material in any one batch may have only one value for each of the following elements:

1. batch identification;

2. number of items;

3. inventory composition code;

4. key measurement point; and

5. measurement identification (i.e., measurement basis, other measurement point, and measurement method).

BEGINNING INVENTORY. The quantity of nuclear materials on hand at the beginning of an accounting period.

BIAS. The deviation of the expected value of a random variable from the corresponding correct or assigned value. (10 CFR 74.4)

BOOK INVENTORY. The quantity of nuclear material present at a given time as reflected by accounting records.

BOUNDARY. The conceptual limiter of a Classified Automated Information System that extends to all intended users of an Automated Information System, both directly and indirectly connected, who receive output from the Classified Automated Information System without a reliable human review by an appropriately cleared authority.

BULK MATERIAL. Material in any physical form that is not identifiable as a discrete item, and thus must be accounted for by weight, volume, sampling, chemical analysis, or non-destructive analysis.

CALIBRATION. The process of determining the numerical relationship between the observed output of a measurement system and the value, based upon reference standards, of the characteristics being measured. (10 CFR 70.57)

CERTIFIED REFERENCE MATERIAL. A reference material, one or more of whose property values are certified by a technically valid procedure accompanied by or traceable to a certificate or other documentation for which each certified value is accompanied by an uncertainty at a stated level of confidence that is issued by a certifying body.

COMPENSATORY MEASURES. Temporary safeguards and security activities (e.g., expenditure of additional resources) designed to afford equivalent protection for safeguards or security interests when a protection system element has failed or new requirement has been identified.

CONFIRMATION MEASUREMENT. A qualitative or quantitative measurement made to verify the integrity of a tamper-indicating item by testing whether some attribute or characteristic of the nuclear material in the item is consistent with the expected attribute or characteristic of the material.

CONSERVATISM. The principle that estimates or errors in judgement should result in an understatement, rather than an overstatement, of net income and /or net assets.

CONSISTENCY. Comparability of entities, time periods, and presentation of accounting data.

CONTINUITY. An enterprise viewed as a continuing operation, possessing the resources to meet its obligations and commitments.

CONTROL LIMIT. The established value beyond which any variation, such as inventory difference, is considered to indicate the possibility of an assignable cause. Control limits established at the 95 percent confidence level are called "warning limits"; those at the 99 percent confidence level are called "alarm limits" (see “Alarm Limit” and “Warning Limit”).

CREDIBLE SUBSTITUTION MATERIAL. Material that can be successfully used in place of accountable special nuclear material. This substitution is possible because of one or more physical properties shared by the substitution material and the special nuclear material.

CUSTODIAN. Any person who has possession of, is charged with, or otherwise has assigned responsibility for the control and accountability of classified matter or other security interest (see “Nuclear Material Custodian”).

DAILY ADMINISTRATIVE CHECK. A daily review to provide timely identification of obvious abnormalities or missing items, or to ascertain that there is no indication of tampering.

DEFENSE-IN-DEPTH. The use of multiple, independent protection elements combined in a layered manner so that system capabilities do not depend on a single component to maintain effective protection against defined threats.

DELAY. The effect achieved by physical features, technical devices, or security measures and forces that impedes an adversary from gaining access to an asset being protected or from completing a malevolent act.

DESTRUCTION.

a. The physical alteration of Classified Automated Information System media or components such that they can no longer be used for storage or information retrieval.

b. Annihilation, demolition, or reduction to pieces or to a useless form.

DESTRUCTIVE ANALYSIS. The quantitative or qualitative determination of the kind and/or amount of nuclear material in a sample where sample aliquots are altered in composition and concentration by the addition of chemical reagents.

DETECTION.

a. The positive assessment that a specific object is the cause of the alarm.

b. Announcement of potential malevolent act through alarm(s).

DETECTION EQUIPMENT. Any equipment or system that is designed to provide high probability of positive assessment of intrusion.

DEVIATION. An approved condition that diverges from the norm that is categorized according to the degree of risk accepted as a variance, waiver, or exception.

DIVERSION. The unauthorized removal of nuclear material from its approved use or authorized location. NOTE: The definition of "authorized location" in the context of diversion of nuclear material is the responsibility of the cognizant DOE field element.

ENDING INVENTORY. The quantity of nuclear materials on hand at the end of an accounting period.

ESTIMATE. A technically defensible approximation of the quantity of special nuclear material (SNM) based on process parameters and/or material attributes. An estimate is used when a direct measurement of the SNM is not possible.

EXPLAINED INVENTORY DIFFERENCE. The portion of the inventory difference accounted for and reported to the Nuclear Materials Management and Safeguards System in one of the following categories: re-determination of discreet items on inventory, re-determination of material in process, process holdup differences, equipment holdup differences, measurement adjustments, rounding, recording and reporting errors, shipper-receiver adjustments, or identifiable item adjustments.

FULL DISCLOSURE. Adequate disclosure of all pertinent data necessary for a fair presentation in conformity with Generally Accepted Accounting Principles (GAAP).

GAIN (PHYSICAL INVENTORY-MC&A). A negative inventory difference (ID), according to the following equation.

ID=Book Inventory - Physical Inventory

=[Beginning Inventory + Receipts- Shipments] - [Ending Inventory]

GRADED PROTECTION. The policies and safeguards and security measures (level of effort and resources) that are applied in a proportional manner toward the protection of safeguards and security interests based on the impact of their loss, destruction, or misuse

GRADED SAFEGUARDS.

a. A system designed to provide varying degrees of physical protection, accountability, and material control to different types, quantities, physical forms, and chemical or isotopic compositions of nuclear materials consistent with the risks and consequences associated with threat scenarios.

b. Providing the greatest relative amount of control and effort to the types and quantities of special nuclear material that can be most effectively used in a nuclear explosive device.

HOLDUP. The amount of nuclear material remaining in process equipment and facilities after the in-process material, stored materials, and product have been removed. NOTE: Justified estimates or measured values of materials in holdup will be reflected in the facility's inventory records.

IN-PROCESS INVENTORY. The quantity of nuclear material in a process area at any specified time, excluding holdup.

INSPECTION. The process of gathering information to determine the effectiveness with which protection programs are implemented.

INSPECTOR. A qualified DOE employee or DOE contractor responsible for inspecting, evaluating and rating a Safeguards and Security Program.

INTERNAL TRANSFER. Transfer of nuclear material within the same reporting identification symbol.

INVENTORY.

a. The quantity of goods or materials on hand. (Webster’s Ninth New Collegiate Dictionary)

b. An itemized list of current assets. (Webster’s Ninth New Collegiate Dictionary)

INVENTORY DIFFERENCE. The algebraic difference between the nuclear material book inventory and the corresponding physical inventory, expressed mathematically as Book Inventory - Physical Inventory = Inventory Difference. The term "total inventory difference" is sometimes used for Inventory Difference.

INVENTORY RECONCILIATION. The process of comparing, investigating discrepancies, and adjusting the book inventory to the corresponding physical inventory

ITEM.

a. A single piece or container of nuclear material that has a unique identification and a known nuclear material mass, and whose presence can be visually verified.

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. (10 CFR 74.4, Material Control and Accounting of Special Nuclear Material)

KEY MEASUREMENT POINT (MC&A). A location where nuclear material appears in such a form that it may be measured to determine material flow or inventory. Includes, but is not limited to, the inputs and outputs (including measured discards) and holdings in material balance areas.

LIMIT OF ERROR. The boundaries within which the value of an attribute being determined lies within a specified probability, usually 95 percent. NOTE: The boundaries are defined to be plus or minus twice the standard deviation of the measured set, unless otherwise stipulated.

LOSS DETECTION ELEMENT. Any component of the safeguards system that can indicate an anomalous activity involving the control of possible loss of special nuclear material.

MATCHING. Revenue and related costs must be matched in determining net income for a specific period.

MATERIAL ACCESS AREA. A type of security area that is approved for use, processing, and/or storage of a Category I quantity or Category II with credible roll-up to a Category I quantity of special nuclear material and which has specifically defined physical barriers, is located within a protected area, and is subject to specific access controls.

MATERIAL BALANCE. The determination of an inventory difference. (10 CFR Part 74.4)

MATERIAL CONTROL ALARM.

GENERAL.

1. Alarm from loss detection elements (e.g., special nuclear material monitors, material surveillance) which may indicate an abnormal situation and/or unauthorized use/removal of nuclear material.

2. Alarm resulting from material control indicators (e.g., shipper/receiver difference, inventory difference, normal operating loss) exceeding established control limits.

SPECIFIC. A situation in which there is –

1. an out-of-location item or an item whose integrity has been violated,

2. an indication of a flow of strategic special nuclear material where there should be none, or

3. a difference between a measured or observed amount or property of material and its corresponding predicted or property value that exceeds a threshold established to provide a detection capability. (10 CFR 74).

MATERIAL CONTROL AND ACCOUNTABILITY PLAN (MC&A). A documented description of a site or facility's material control and accountability program. NOTE: The material control and accountability plan may be presented as a separate document or incorporated as a part of another document.

MATERIAL SURVEILLANCE. The collection of information through devices and/or personnel observation to detect unauthorized movements of nuclear material, tampering with containment, falsification of information related to location and quantities of nuclear material, and tampering with safeguards devices.

MATERIAL SURVEILLANCE PROCEDURES. Procedures to ensure that an area containing special nuclear material is observed by at least two cleared and knowledgeable authorized persons, who may be doing other work, but who can give an alarm in time to prevent the unauthorized removal or diversion of the special nuclear material or an act of sabotage involving special nuclear material. One of the persons must possess a Q access authorization, and the other must possess at least an L access authorization unless the surveillance entails access to Secret Restricted Data, in which case both must possess Q access authorizations.

MATERIALITY. Relevance in informed professional judgement (see "Full Disclosure").

MATERIALS BALANCE AREA. An area that is both a subsidiary account of materials at a facility and a geographical area with defined boundaries, used to identify the location and quantity of nuclear materials in the facility.

MEASUREMENT.

a. The set of operations having the object of determining a value of a quantity. (ISO/TAQG 1992)

b. Includes sampling and means the determination of mass, volume, quantity, composition or other properties of a material, where such determination is used for special nuclear material control and accounting purposes. (10 CFR Part 70.57)

MEASUREMENT ERROR.

a. A deviation from correctness. (ANSI N15.41)

b. The result of a measurement minus a true value of the measure. (ISO/TAG)

c. The difference between an observed measurement and the unknown true value of the property being measured.

MEASUREMENT SYSTEM. All of the apparatus, equipment, instruments, and procedures used in performing a measurement. (10 CFR Part 7.57)

MEASUREMENT UNCERTAINTY.

a. A concept used to describe the inability of a measurement process to measure exactly the correct value. (ANSI)

b. A parameter associated with the results of a measurement that characterizes the dispersion of the values that could reasonably be attributed to the quantity measured. (ANSI)

c. A measure of the possible error in the estimated value of the quantity measured. (ISO/TAG)

d. The spread of values about which the value of the quantity measured may be expected to be found. (ISO/TAG)

NEED FOR ACCESS. A determination that an employee requires access to a particular level of classified information in order to perform or assist in a lawful and authorized function. (Executive Order 12968)

NONDESTRUCTIVE ASSAY. The quantitative or qualitative determination of the kind and/or amount of nuclear material in a sample without alteration or invasion of the sample.

NUCLEAR MATERIALS CONTROL. The part of the safeguards program encompassing management and process controls to:

a. Assign and exercise responsibility for nuclear material

b. Maintain vigilance over the material

c. Govern its movement, location, and use

d. Monitor the inventory and process status

e. Detect unauthorized activities for all nuclear material

f. Help investigate and resolve apparent losses of nuclear material.

NUCLEAR MATERIAL CUSTODIAN. An individual assigned responsibility for the control of nuclear material in a localized area of a facility. NOTE: The localized area should be limited, where practical, to a single material balance area. Generally referred to as the MBA Custodian.

OBJECTIVITY. Data presented in conformity with GAAP and prepared for the common needs of all users.

PASSIVE NDA. Measures the naturally-occurring radiation emitted during the decay process of radioactive materials.

PERFORMANCE TEST. A test to confirm the ability of an implemented and operating system element or total system to meet an established requirement.

PERFORMANCE TESTING. A process used to determine that the security features of a system are implemented as designed, and that they are adequate for the proposed environment. NOTE: This process may include hands-on functional testing, penetration testing, or software verification.

PHYSICAL INVENTORY.

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 will vary depending on the material to be inventoried and the process involved. (10 CFR Part 74.4)

b. The sum of all the measured or derived estimates of batch quantities of nuclear material on hand at a given time within a material balance area, obtained in accordance with specified procedures. (IAEA INFCIRC 153 #113)

c. The quantity of nuclear material which is determined to be on hand by physically ascertaining its presence using techniques such as sampling, weighing, and analysis.

PORTAL MONITOR. Any electronic instrument designed to perform scans of items, personnel, and vehicles entering or leaving a designated area for the purpose of detecting weapons, explosives, and nuclear material .

PRECISION. A quantitative measure of the variability of a set of repeated measurements (DOE); also used to describe the internal consistency of repeated measurements.

PROCESS. A series of actions that achieves an end or result. (10 CFR 76.4)

PROCESS DIFFERENCE. The determination of an inventory difference on a unit process level with the additional qualification that difficult to measure components may be modeled. (10 CFR Part 74.4)

PROTECTED AREA. A type of Security Area defined by physical barriers (i.e., walls or fences), to which access is controlled, used for the protection of Category II special nuclear material and classified matter and/or to provide a concentric security zone surrounding a Material Access Area (Category I nuclear materials) or a Vital Area.

QUALIFIED. A term indicating the satisfactory completion of a training program based on knowledge and skills identified by a position job/function and task analysis.

RANDOM ERROR.

a. The variations encountered in all measurement work, characterized by the random occurrence of both positive and negative deviations from a mean value. (10 CFR 70.57)

b. A deviation from the correct value that is not predictable in direction or magnitude on a given measurement.

c. The result of a measurement minus the mean of a large number of repeated measurements. (ISO/TAG)

REFERENCE STANDARD. A material, device, or instrument whose assigned value is known relative to national standards or nationally accepted measurement systems. (10 CFR Part 70.57)

SAFEGUARDS. An integrated system of physical protection, material accounting, and material control measures designed to deter, prevent, detect, and respond to unauthorized possession, use, or sabotage of nuclear materials.

SCRAP.

a. Various forms of SNM generated during chemical and mechanical processing, other than recycle material and normal process intermediates, which are unsuitable for continued processing, but all or part of which will be converted to usable material by appropriate recovery operations. (10 CFR Part 74.4)

b. Byproducts from chemical and/or mechanical processing, not usable in their present forms, from which nuclear materials can be economically recovered.

SEPARATE ENTITY. Requires operations of each separate entity be segregated from other separate accounting units.

SHIPPER/RECEIVER DIFFERENCE. The difference between the measured quantity of nuclear material stated by the shipper and the measured quantity stated by the receiver.

STATISTICAL SAMPLING. A statistically valid technique used to select elements from a population, including probability sampling, simple random sampling, systematic sampling, stratified sampling, and cluster sampling.

SUBSTANCE OVER FORM. Requires that the economic substance of a transaction be recorded if it differs from the legal interpretation of the transaction.

SURVEILLANCE. The collection of information through devices and/or personnel observation to detect and assess unauthorized movements of personnel and nuclear material, tampering with containment, falsification of information related to location and quantities of nuclear material, and tampering with safeguards devices.

SURVEY. Audit and inspection activities by the DOE field element to evaluate the compliance of a contractor in meeting the intent of the DOE Orders.

SYSTEMATIC ERROR. A constant unidirectional component of error that affects all members of a data set. (10 CFR 70.57)

a. An error that is not determined by chance but by a bias. (Webster's Collegiate)

b. The result of one or more assignable causes.

c. An error that effects all members of a data set. (Jaech)

d. The mean result of a large number of measurement minus the true value. (ISO/TAG)

TAMPER-INDICATING. An item containing special nuclear material that is either protected by a tamper-indicating device, or constructed such that removal of special nuclear material cannot be accomplished without permanently altering the item in a manner that would be obvious during visual inspection.

TAMPER-INDICATING DEVICE. A device that may be used on items such as containers and doors, which because of its uniqueness in design or structure, reveals violations of containment integrity. These devices on doors (as well as fences) are more generally called security seals.

TRACEABILITY. The ability to relate individual measurement results to national standards or nationally accepted measurement systems though an unbroken chain of comparisons. (10 CFR Part 70.57)

TRUE VALUE.

a. Reference value.

b. Certified value.

c. An authoritative or consensus "best estimate."

d. The result of a superior measurement process.

TWO PERSON RULE. As applied to the Materials Control Program, an access control and materials surveillance procedure that requires that at least two authorized people be present in locations with unsecured quantities of nuclear materials in Category I amounts or Category II amounts with roll up potential to Category I. (e.g., situations requiring two person rule application include: (1) when vaults are entered, (2) when transfer of materials across material balance areas is done, and (3) when activities are performed involving the application or removal of tamper-indicating devices from items.) Other situations, such as use of CRYPTO keying materials, also require application of a similar two person rule.

UNCERTAINTY. The extent to which a measurement result is in doubt because of the effects of random error variances and the limits of systematic errors associated with a measurement process, after the measurement result has been corrected for bias. (10 CFR Part 70.57)

VARIANCE PROPAGATION. The determination of the value to be assigned as the uncertainty of a given measured quantity using mathematical formulas for the combination of errors from constituent contributors.

VAULT. A windowless enclosure that is resistant to forced entry and has a DOE-approved system that detects unauthorized entry.

VAULT-TYPE ROOM. A DOE-approved room having a combination-locked door(s) and protection provided by a DOE-approved intrusion alarm system activated by any penetration of walls, floor, ceiling, or openings, or by motion within the room.

VERIFICATION MEASUREMENT. A quantitative re-measurement of the amount of nuclear material in an item; made to verify the integrity of an item that is not tamper indicating.

VULNERABILITY ANALYSIS. A systematic evaluation process in which qualitative and/or quantitative techniques are applied to detect vulnerabilities and to arrive at an effectiveness level for a safeguards and security system to protect specific targets from specific adversaries and their acts.

WARNING LIMIT. A control limit established for an inventory difference which, when exceeded, requires investigation and appropriate action. NOTE: For processing, production, and fabrication operations, warning limits are established with a 95 percent confidence level.

WASTE. Nuclear material residues that have been determined to be uneconomical to recover.

Section 1

INTRODUCTION

Contents

Purpose

The Material Control and Accountability (MC&A) Inspectors Guide provides the inspector with a set of detailed guidelines and references that can be used to plan, conduct, and complete an inspection of a material control and accountability program. This guide serves to promote consistency, assure thoroughness, and enhance the quality of the inspection.

This guide is a sub-tier document to the Department of Energy (DOE) Office of Safeguards and Security Evaluations (OA-10) Safeguards and Security Appraisal Process Guide. The Appraisal Process Guide provides necessary guidance for conducting safeguards and security inspections; it also offers techniques, formats, and sample documents useful in planning for, conducting, and reporting the results of safeguards and security inspections, and inspectors should refer to it for general inspection guidance. The Appraisal Process Guide describes the various activities conducted by the Office of Independent Oversight and Performance Assurance (OA), including comprehensive inspections, special inspections, follow-up reviews, assessments, special studies, and special reviews. While this MC&A Inspectors Guide focuses on comprehensive inspections, the detailed information it provides is useful for other OA activities.

This MC&A guide is intended for novice and experienced inspectors. For the novice, the information can serve as a valuable training tool, and with minimal assistance, the novice inspector should be able to use the guidelines and references to plan inspection activities as well as collect and analyze data more efficiently and effectively. For the experienced inspector, information is organized to allow easy reference and to serve as an aide-memoire when conducting inspection activities.

The information in this guide encompasses the five specific MC&A subtopics. Although the guide covers a variety of inspection activities, it does not and cannot address all protection program variations and systems used at DOE facilities. The inspection guidelines may have to be modified or adapted to meet site-specific needs and, sometimes, inspectors may have to design new activities to collect information not specifically covered in the guide.

This guide is intended to complement the DOE orders, manuals, and guides by providing practical techniques. The guide's focus is on providing assistance in assessing the effectiveness of all elements of an MC&A program. Every attempt has been made to develop specific guidelines in a format offering maximum usefulness to inspectors.

The guide is not a repetition of DOE requirements. The current applicable order is referenced in Section 2 on Program Management/ Administration. However, inspectors should be aware that revisions to the DOE orders may be issued after this guide has been published. Inspectors should always verify that they have the current DOE orders and manuals to reference before each inspection. Inspection data should be collected and analyzed commensurate with any new requirements.

There are terms used in each specific subsection that are frequently encountered during an inspection. These definitions may be useful in resolving potential deficiencies encountered during an inspection. For example, the definition of throughput is absolutely essential when evaluating the magnitude of limit of error of inventory difference (LEID). Definitions are collected at the front of this guide.

Brief Overview of the MC&A Inspection

When OA selects a facility for an inspection, the determination is made at that time as to which of the MC&A topics will be inspected and the number of MC&A inspectors that will be conducting the inspection. If several MC&A inspectors will be used during an inspection, a Topic Lead will be appointed. The OA Inspection Chief may also identify areas that require specific emphasis (e.g., an issue highlighted in the Annual Report to the President or recent concerns at a similar site). OA will have previously sent a document request list that includes MC&A documentation. Points of contact will have been established to coordinate inspection logistics. For MC&A the points of contact could include personnel from the field elements, the MC&A department, and/or facilities.

The lead MC&A inspector will routinely contact the site MC&A points of contact to coordinate activities for the first visit. The points of contact will assist in any additional logistic arrangements for the inspection such as access to material access areas (MAAs), additional MAA-specific training, facility tour logistics, etc. Since the inspection may occur at a time when the facility is performing certain activities, e.g., a physical inventory, it is appropriate to discuss the timing of the inspection with the points of contact. It is important that the facility provides a prepared briefing during the planning period that describes the MC&A program. This presentation should include: the approval status of MC&A documents, a listing of approved deviations, and the status of corrective action plans formulated to address findings from MC&A surveys and from other OA inspections. The briefing should also describe the current MC&A organization structure (including funding), any changes to the MC&A system, and the operational status of the facility (including any process activities that may have changed the characteristics of existing material types or produced new material types). It is very important that the briefing include the results of recent assessments and key issues currently being addressed by the MC&A program.

Observing facility personnel performing MC&A activities minimizes the impact of the inspection on the facility and provides valuable performance assessment information to the inspection team. Thus the inspection team leader should expect the facility to provide an updated daily schedule of MC&A activities scheduled to occur during the inspection. This provides the inspection team with opportunities to either conduct or observe performance tests, allows an inspector to observe routine MC&A activities, and provides a baseline from which to conduct a comprehensive, yet low-impact, inspection. These activities provide a baseline from which the MC&A inspection schedule can be developed.

During the planning process, the inspectors must decide how the inspection effort will be divided between each of the five subtopics and, within each subtopic, how the level of effort will be expended between compliance reviews and performance reviews. When the planning is complete, a detailed inspection schedule will be prepared. The schedule must include time for document review, scheduling of interviews, conduct of performance tests, facility tours, etc. This schedule is reviewed by the OA Inspection Chief to ensure that it meets the overall OA inspection objectives.

Other key elements of the inspection process such as daily validation meetings, summary validations, report writing, final inspection closure, and followup are described in the OA-10 Appraisal Process Guide.

Organization of This Guide

This guide is organized as follows:

- Section 1–Introduction
- Section 2–Program Management/ Administration
- Section 3–Accounting
- Section 4–Measurement and Measurement Control
- Section 5–Inventory
- Section 6–Containment and Surveillance
- Section 7–Interfaces
- Section 8–Analyzing Data and Interpreting Results
- Appendix A–Performance Tests
- Appendix B–Statistical Sampling
- Appendix C–Tabletop Exercises

Section 1 (Introduction) describes the inspection approach; characterizes the MC&A topic; describes the relationship of OA MC&A inspections to other MC&A programs; overviews the importance of four key activities of the MC&A inspection (tours and observations, interviews, document reviews, and performance testing); and discusses the concept of integrated safeguards and security management.

Sections 2 through 6 provide detailed guidance for inspecting each of the five major MC&A subtopics. Section 2 (Program Management/ Administration) pertains to the management of the MC&A program, including documentation, training, internal reviews and assessments, and occurrence reporting. Section 3 (Accounting) addresses the methods used at a facility to account for nuclear material. Section 4 (Measurement and Measurement Control) examines the methods and systems used to determine quantities of nuclear material. Section 5 (Inventory) discusses the process of taking a physical inventory and reconciling inventory records. Section 6 (Containment and Surveillance) addresses the various methods used to ensure that material is appropriately maintained in authorized locations, and that movement of material is controlled.

Section 7 (Interfaces) contains guidelines to help inspectors coordinate their activities both within subtopics and with other topic teams. Information is provided on the integration process that allows topic teams to align their efforts and benefit from the knowledge and experience of other topic teams. The section identifies common areas of interface for the MC&A team, rationale for why this coordination is important, and how the integration effort contributes to the quality and validity of inspection results.

Section 8 (Analyzing Data and Interpreting Results) discusses how to evaluate identified deficiencies, evaluate overall MC&A system effectiveness, and assign ratings.

Appendix A (Performance Tests) is a compilation of performance tests commonly used during evaluation of MC&A programs.

Appendix B (Statistical Sampling) addresses the selection of statistical samples. The relationship between sample size and detection probability and the assumptions used in determining statistical samples are also discussed.

Appendix C (Tabletop Exercises) discusses how to use tabletop exercises to evaluate various MC&A elements that sometimes could take days or weeks to simulate. Tabletops also allow the testing of larger groups of individuals in a more timely manner.

Using the MC&A Subtopic-Specific Sections

Sections 2 through 6 are further divided into the following standard format:

- References
- General Information
- Common Deficiencies/Potential Concerns
- Data Collection Activities.

References

The references identify articles and books that apply to the subtopic. Policy memoranda are normally found in the policy supplement appendix; however, references to pivotal memoranda of a permanent nature, procedural guides, and certain manuals may be found in the reference sections. References can provide additional supplemental information that could be useful during an inspection. For example, if an inspector is reviewing measurements and a concern arises as to the impact of a particular impurity on a specific chemical method, the references in the measurement section would provide the answer to the concern.

General Information

This section of each inspection subtopic presents the objectives that must be accomplished through the element being inspected and summarizes the key elements of that subtopic**.** It is useful for the novice inspector to review the objectives described in this section before beginning the inspection. It is also useful during the analysis portion of the inspection since it helps the inspector gain perspective on deficiencies identified during the conduct of the inspection. A facility's failure to meet the objectives of a particular subelement may indicate a less than satisfactory rating.

Common Deficiencies/Potential Concerns

This section addresses common deficiencies and concerns that OA has noted on previous inspections. Information in this section is intended to help the inspector further focus inspection activities. By reviewing the list of common deficiencies and potential concerns before gathering data, inspectors may focus on these elements during interviews, tours, and other data gathering activities. General guidelines are provided to help the inspector identify site-specific factors that may indicate the likelihood of a particular deficiency and its potential impact.

Data Collection Activities

This section provides guidance for performing the bulk of the inspection activities. Sections 2 through 6 each contain a section that describes the information needed to inspect the subtopic.

In Section 2, Program Management/ Administration, the data collection and evaluation activities are organized according to the integrated safeguards and security management approach, described later in this section.

For Sections 3 through 6, the data collection and evaluation sections are divided into three sections: (1) Information Needed; (2) Compliance Review; and (3) Performance Review. A specific inspection approach for each of these four MC&A subtopics is found on a flowsheet within each section. The flowsheet describes the information needed, the compliance review, and the performance review aspects of the inspection.

Information Needed. The discussion of information needed provides a ready reference of the documents and interviews an inspector must request, review, and/or conduct in order to acquire the information necessary to adequately accomplish the inspection. Some of this documentation may have been provided by the facility in advance of the inspection; other information is reviewed during planning, and some is reviewed during the actual inspection. The Information Needed section can serve as a checklist for the inspector to use during facility discussions to ensure that the necessary documentation is available for review. Interviews are conducted during the inspection to validate that personnel know and understand MC&A procedures, ensure that personnel training has been effective, and ascertain the degree of management commitment to the MC&A program.

Compliance Review. The discussion of compliance review provides a structured approach within each subtopic to areas that an inspector should review to ensure that DOE requirements are being addressed at the facility. It is a "go, no-go" evaluation of the implementation of specific requirements. For the compliance review, the inspector must tailor the inspection to the type of facility. For example, shipments/receipts are reviewed as part of the accounting system inspection. However, at some facilities, there may be only minimal shipments or receipts, and so this area may not warrant detailed inspection.

An inspector must prioritize the compliance evaluation areas based on available inspection time. During the planning process, the inspector should coordinate with facility personnel to select specific times for the compliance reviews. This coordination ensures that the individual being interviewed has had time to assemble the necessary documentation.

Performance Review. Each subtopic inspection area has a list of applicable performance tests that an inspector can choose to validate a facility's ability to meet MC&A performance objectives. Applicable performance tests are described in each subtopical area, summarized in the inspection flow diagram for that subtopic, and described in detail in Appendix A. This list provides the basis from which the inspector can fully develop performance tests that will evaluate the effectiveness of a facility as it performs MC&A functions. Scheduling of performance tests is done during planning, and approximate times are identified to the facility. For example, the inspector will tell the facility representative that an emergency physical inventory will be conducted Wednesday afternoon. However, the material balance area (MBA) to be inventoried will be not be identified until late Wednesday morning to ensure a reasonable test of facility performance, and the emergency inventory might not begin until 3:00 PM.

Characterization of the MC&A Program

An MC&A program is designed to provide an information and control system for nuclear material. MC&A encompasses those systems and measures necessary to establish and track nuclear material inventories, control access, detect loss or diversion of nuclear material, and ensure the integrity of those systems and measures. Administrative controls include program and materials management, personnel training, system reviews and audits, and the combination of hardware and procedures to ensure that all nuclear material is accounted for.

An effective MC&A program includes:

- A current, approved, site-specific MC&A Plan that defines the approach and methods used in the MC&A system to achieve the site safeguards goals. As subsets of this, the site has: (1) identified the threats that MC&A protects against; (2) defined the roles and responsibilities of individuals performing MC&A activities; (3) documented the training, qualifications, and procedures used to implement the identified protection methods; and (4) developed a program to evaluate the effectiveness of the system in meeting the defined goals. The plan must effectively represent the MC&A activities observed during the inspection. The MC&A Plan may be part of the Site Safeguards and Security Plan (SSSP).

- Material accounting functions in which information is collected, analyzed, summarized, and reported. As subsets of this: (1) an audit trail exists from reported information to the source documents; (2) data is protected against tampering; and (3) documentation of the methods used for accounting is available.

- Measured values for all special nuclear material (SNM), unless identified in the MC&A Plan as not amenable to measurement, or unless an approved deviation exists. All measurement methods are under a measurement control program. As subsets of this: (1) measurement methods shall be selected and qualified for use based on the types and quantities of materials to be measured; (2) measurement control programs shall ensure ongoing validity of measurement data; and (3) measurement methods shall have established control limits and documented estimates of current measurement uncertainties.

- A physical inventory program to ensure that all materials are inventoried, that no material is inventoried more than once, and that inventory results are reconciled with the accounting records. As subsets of this: (1) authorized locations for nuclear material within the facility are identified; (2) procedures are documented for each area of the facility; and (3) reconciliation of the accounting records with the physical inventory is documented and evaluated.

- Material movements controlled to provide assurance that nuclear material is maintained in authorized locations by authorized personnel. As subsets of this: (1) transfer paths are defined, and protection measures (including secure storage, barriers, locks, doors, and surveillance) are implemented to ensure that material is only moved by way of authorized paths; (2) portal monitors and surveillance are used on authorized paths to ensure that only authorized movements occur; (3) restrictions, administrative controls, and internal controls are implemented to ensure that movements are authorized and controlled; and (4) records are maintained of all nuclear material received, shipped, or transferred between MBAs.

Relationship of OA Inspections to Other MC&A Programs

Nuclear Regulatory Commission Licensees

The Nuclear Regulatory Commission (NRC) is responsible for administering the MC&A regulations for the facilities under its jurisdiction. These facilities are referred to as licensees. DOE and its contractors are license-exempt.

The NRC MC&A regulations are promulgated in 10 CFR 70 and 10 CFR 74. There are similarities between the NRC and DOE requirements that are beyond the scope of this MC&A guide, but some particulars are noteworthy. The NRC requires its licensees to prepare a Fundamental Nuclear Material Control (FNMC) and Accountability Plan. This document, when approved by the NRC, becomes a legal agreement between the NRC and the facility. If this plan is violated, the facility may be subject to administrative and criminal penalties. The FNMC is similar to a DOE facility MC&A Plan. It includes requirements for inventories, accounting, measurement and measurement control plans, vulnerability analyses, and material control activities.

The NRC has also developed regulatory guides (NUREGs) to assist both inspectors and facilities in implementing MC&A programs (see references in Section 4). The NUREGs describe measurements and measurement control, holdup measurement, process monitoring, etc. The NRC has also developed a NUREG that discusses acceptance criteria, which form the basis for accepting the MC&A programs facilities have promulgated in their FNMC. DOE inspectors can use these documents as references to assist in determining MC&A system effectiveness.

In some ways, the OA inspection at DOE facilities is similar to an NRC inspection of a licensee. DOE MC&A inspectors can be used to support NRC activities after a minimal review of the facility plan and refresher briefing on NRC requirements. Thus, many of the inspection methods and tools in this plan can also be applied on NRC inspections.

International Atomic Energy Agency Member States

The Nuclear Non-Proliferation Treaty (NPT) is an agreement by signatory countries (referred to as member states) with the International Atomic Energy Agency (IAEA) to use nuclear material only for peaceful purposes. The IAEA reports to the United Nations General Assembly and, under special circumstances, to the Security Council of the United Nations.

Member states that sign the NPT agree to an inspection program of their nuclear materials to verify that material is being accounted for and used properly. Each facility subject to inspection completes a Design Information Questionnaire. Subsequently, the IAEA prepares a Facility Attachment (FA) that is approved by the member state and facility, and becomes the basis for conducting IAEA inspections. This FA defines the inspection criteria, inventory frequency, measurements, and measurement control program. The FA is similar to a DOE facility MC&A Plan. Quantities of nuclear material (plutonium, uranium, and heavy water) are subject to IAEA reporting. The IAEA uses routine inspections and physical inventory verification inspections to verify material accounting. The IAEA makes periodic statements about the facility MC&A program and prepares an annual MC&A report for activities in the member states. Physical security is not included in IAEA inspections.

IAEA inspections are similar to OA MC&A inspections. In IAEA inspections, the MC&A program is evaluated, MC&A transfers are reviewed, measurements are performed, and the physical inventory is not only observed, but it is also physically tested by IAEA inspectors.

Since 1977, the U.S. has been reporting nuclear material data to the IAEA for its non-weapons program. Since 1994, the U.S. has placed excess nuclear material under IAEA safeguards. Currently, IAEA inspections are being conducted at the Y-12 Plant, Savannah River Site, and Hanford. MC&A inspectors need to be sensitive to these agreements and must note that some nuclear materials may not be readily available for inspection without advance notification to the IAEA. Thus, inspectors may need to review the existing FA and recent IAEA inspection reports. Nuclear material under IAEA safeguards does not routinely comprise a significant portion of the OA inspection.

DOE/NNSA MC&A Surveys

OA has included DOE/NNSA MC&A surveys in the Protection Program Management Inspectors Guide. Section 2 of the MC&A Inspectors Guide, Program Management/Administration, discusses field element MC&A surveys. DOE/NNSA requires field elements to periodically inspect the nuclear material holdings of its contractor facilities. These surveys are very similar to OA inspections, but are intended to be comprehensive and take place over longer periods of time. Some DOE/NNSA field elements use this MC&A Inspectors Guide as a reference for conducting their MC&A surveys.

The MC&A inspector reviews the most recent MC&A surveys for the facility being inspected. All open survey findings are also reviewed. This review can include the Safeguards and Security Information Management System (SSIMS) report, a presentation by the field element, or a presentation by the facility.

These reports could demonstrate that the field element places emphasis on compliance reviews that are very comprehensive in nature. In this case, the inspector would focus attention on performance reviews. In some cases, the survey report may have a rating that does not appear consistent with the findings. Thus, the MC&A inspector will interview field element personnel and report the results to the protection program management team.

OA Inspection Information Gathering Approaches

There are several techniques used to collect information on the performance of a site's MC&A program. These include: tours and observations, interviews, document reviews, and performance testing. The types of information gained from each are discussed in the following paragraphs.

Tours and Observations

Tours and observations of operations help inspectors gain an understanding of MC&A operations and MC&A process interfaces. Entry into MAAs may require 24-hours' advance notice, issuance of dosimeters, facility orientation briefings, and being placed on the "Plan of the Day." Coordination to ensure compliance with entry requirements is essential. In most cases, key areas will be visited more than once, so ongoing facility access will be required. Tours allow inspectors to:

- Familiarize themselves with the site and facility

- Observe the MC&A systems, especially MBAs, storage vaults, process data gathering equipment, analytical measurement equipment, computer equipment, access control, and containment

- Observe how procedures (such as inventory procedures) are implemented

- Verify that the MC&A systems are implemented and functional.

The inspection team should attempt to minimize impact on the facility. This is accomplished by asking the facility what MC&A activities will be occurring during the inspection and planning the inspection accordingly. Observation of ongoing MC&A activities is cost-effective and has low facility impact. Typical facility activities include observation of measurements, vault openings, or nuclear material transfers. However, if specific MC&A activities are not scheduled during the inspection, inspectors may request that these activities be performed for the purpose of conducting performance tests. Additionally, when possible, MC&A inspectors should coordinate tours and visits to vault openings with other inspection team members to minimize intrusion on the facility's work routine.

Interviews

A key element of the inspection process is interviewing the site personnel responsible for essential program elements. Interviews are not necessarily formal, and frequently take the form of discussions during tours or performance tests. Inspectors are encouraged to take advantage of every opportunity to ask questions of appropriate personnel. These individuals can usually provide the inspection team with essential information that will frequently support or clarify the documentation. Specifically, inspectors may wish to interview:

- Senior program managers with funding responsibility

- Safeguards and security managers

- Tamper-indicating device (TID) administrators, applicators, and custodians

- MC&A auditors, including assessment personnel

- MBA custodians and material handlers
- Process operators and operation supervisors
- Inventory and measurement personnel
- Accounting/accountability specialists
- MC&A training coordinators and instructors
- Vulnerability assessment personnel
- Security police officers (SPOs) who implement MC&A functions.

Interviews with personnel at all levels are recommended. Frequently, discussions with personnel involved with "hands-on" operations indicate whether the policies and directives of management are effectively communicated and implemented.

Document Reviews

Document review constitutes a significant portion of an inspection. Documents must be current, approved at the appropriate management level, readily available for personnel to use, periodically updated, and most importantly, representative of the actual practice that they document. Inspectors frequently validate these characteristics during tours and interviews with MC&A personnel. When a deficiency or discrepancy is found, it is important to determine whether it is a single occurrence or a generic problem. If it is a generic problem, a root cause analysis must be conducted.

Performance Testing

Performance testing is an important element of an OA MC&A inspection. Performance testing is the preferred method for evaluating system effectiveness; however, it must be used cautiously for several reasons. First, performance testing is the most labor- and time-intensive of all data collection activities. Second, performance testing places the greatest demands on the resources of the inspected site and requires the highest degree of coordination and planning. Third, performance testing offers the greatest potential for generating safety or security problems. Thus, performance tests (or exercises as they are commonly called) should be employed judiciously when the desired data can be gathered using other data collection tools. To minimize the impact of facility resources and avoid the potential of safety and security problems, performance testing in some cases may be conducted using tabletop exercises. Appendix C outlines the format for conducting tabletop exercises.

Performance tests must always be carefully planned and coordinated with appropriate facility personnel before the inspection team arrives on site. Careful planning ensures the most efficient use of time and resources. This planning and coordination process continues after arrival up to the moment the test is administered. Some performance tests require that the personnel being tested remain unaware that a test is being conducted. Particular care must be exercised to ensure that these types of tests are coordinated and that all relevant safety factors are carefully considered. Appropriate personnel can be informed that equipment or procedural performance tests are being conducted without compromising the validity of the test.

The tests performed by the MC&A inspection team may involve equipment, personnel, procedures, or any combination of these. Ideally, the performance test will stress the system under examination up to the established limits of the site-specific threat. Tests should simulate realistic conditions and provide conclusive evidence relating to the effectiveness of the security system. Unfortunately, safety concerns, time and resource constraints, and the heightened security posture that results whenever an inspection is under way frequently minimize the ability to establish and simulate totally realistic conditions.

Performance testing of equipment and personnel is an essential part of an effective inspection. Equipment performance testing is designed to determine whether equipment is functional, has adequate sensitivity, and will meet its design and performance objectives. It is not sufficient for a component to meet the manufacturer's standards if the component proves ineffective during testing. Personnel performance tests are intended to determine whether personnel know and follow procedures, whether procedures are effective, and whether personnel and equipment interact effectively.

Determining which, how many, and what type of MC&A performance tests to perform is usually based on information uncovered during document reviews, interviews, and other data collection activities. If this information leads inspectors to believe a weakness may exist in a particular area, or if the documentation or policies indicate a potential weakness, the suspected areas of weakness should be tested. When testing, it is important not to concentrate solely on one particular aspect of a system or program at the expense of an overall perspective, nor is it normally required to test all elements of a system or program. When a problem is detected, the inspector must investigate in sufficient depth to determine whether it is an isolated error or a trend symptomatic of poor training, improper procedures, management (perceived importance of safeguards activities), etc.

In each MC&A exercise, the following functions should be exercised to the extent possible, with the goal of assessing MC&A system effectiveness rather than a specific component:

- Command and control
- Use of information resources
- Defense-in-depth or redundancy of components, such that the loss of one element of the MC&A system does not result in defeat of the system
- Ability to follow existing plans and procedures
- Effectiveness of existing plans and procedures
- Interface with physical protection systems and protective forces.

OA inspectors may develop exercise scenarios that test the DOE/NNSA field element and not the contractor. Such a test might include requesting the field element to perform inventory verification to evaluate the contractor's system.

A set of commonly used exercises/performance tests is provided in Appendix A. These tests can be applied directly or modified to address site-specific conditions or procedures. Since performance testing is one of the most important data collection activities used in evaluating MC&A and the information on testing is extensive, it is addressed in detail in Appendix A and in each of the subelement sections in this guide.

Integrated Safeguards and Security Management

The Department is committed to conducting work efficiently and securely. DOE Policy 470.1, *Integrated Safeguards and Security Management (ISSM) Policy*, is designed to formalize a framework that encompasses all levels of activities and documentation related to ISSM.

The framework is made up of seven components to facilitate the orderly development and implementation of ISSM. Included in the components is the objective of ISSM, guiding principles and core functions.

The seven guiding principles of ISSM are:

- Individual responsibility and participation
- Line management responsibility for safeguards and security
- Clear roles and responsibilities
- Competence commensurate with responsibilities
- Balanced priorities

- Identification of safeguards and security standards and requirements

- Tailoring of protection strategies to work being performed.

The five core functions of ISSM are:

- Define the scope of work.
- Analyze the risk.
- Develop and implement security measures.
- Perform work within measures and controls.
- Provide feedback and continuous improvement.

OA has designed this MC&A Inspectors Guide to reflect certain aspects of the ISSM concept. Specifically, OA has organized the relevant section of the MC&A Inspectors Guide (i.e., Section 2, Program Management/Administration) to parallel certain aspects of the ISSM principles and core functions. Also, Section 8, Analyzing Data and Interpreting Results, includes a brief discussion of the use of the ISSM concepts as an analytical tool.

For the purposes of this MC&A Inspectors Guide, OA has established four general categories that encompass the concepts embodied in the guiding principles and core functions of ISSM:

Line Management Responsibility for Safeguards and Security. This category encompasses the corresponding ISSM guiding principles that relate to management responsibilities (i.e., line management responsibility for protection of DOE assets, clear roles and responsibilities, and balanced priorities).

Personnel Competence and Training. This category encompasses the ISSM guiding principle related to competence of personnel (i.e., competence commensurate with responsibilities). It also encompasses DOE requirements related to ensuring that personnel performing safeguards and security duties are properly trained and qualified, and the need for sufficient training/certification requirements and an appropriate skill mix.

Comprehensive Requirements. This category encompasses the corresponding ISSM guiding principles and core functions that relate to policies, requirements, and implementation of requirements (i.e., identifying safeguards and security standards and requirements, tailoring protection measures to security interests and programmatic activities, providing operations authorization, defining work, analyzing vulnerabilities, identifying and implementing controls, and performing work within controls).

Feedback and Improvement. This category encompasses the corresponding ISSM core function (i.e., feedback and improvement) and DOE requirements related to DOE/NNSA line management oversight and contractor self-assessments.

It is important to note that the categories above are only used to organize information in the inspectors guide in a way that will help inspectors gather data about management performance in a structured and consistent manner. OA has identified general categories of information that would be expected to be in an integrated ISSM program.

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Section 2

PROGRAM MANAGEMENT/ADMINISTRATION

Contents

References

DOE Order 151.1B,
DOE Notice 471.3DOE Order 470.1
DOE Order 472.1C
DOE Order 474.1A
DOE Manual 474.1-1B
DOE Manual 474.1-2A
DOE Order 5480.20A
DOE Order 473.1
DOE Manual 473.1-1
Classification Guide for Safeguards and Security Information (CG-SS-4)
Performance Assurance Program, Protection Program Supplement (Office of Safeguards and Security, 1996)

General Information

Program management of the MC&A function is referred to as Administration in the MC&A orders and manuals. The Administration subtopic addresses the MC&A organization and its established MC&A program using the graded safeguards approach. The administrative element defines and documents the roles and responsibilities for all individuals having MC&A responsibilities, institutionalizes the MC&A program by developing and approving written plans and procedures, allocates sufficient resources to manage and operate the MC&A program, and monitors the performance of the MC&A activities.

MC&A activities must be supported by adequate documentation. These documents include a description of the MC&A organizational structure and define the roles and responsibilities of individuals performing specific MC&A functions. There should be a set of approved procedures that institutionalize these responsibilities, as well as an approved training program that ensures that personnel are appropriately trained or otherwise qualified to perform their duties. Within the MC&A organizational structure there should be elements that are responsible for monitoring and testing the performance of the MC&A program elements, including the identification and reporting of unusual events. There should also be a corrective action program that monitors the status of MC&A improvements designed to eliminate deficiencies identified by both internal and external reviews. DOE Manual 474.1-1B allows the field element considerable flexibility and requires the field element manager to approve numerous MC&A elements. A list of these, with the appropriate reference, is shown in Table 2-1**.** Each of these elements must be reviewed. In addition, the DOE field element must document the mechanism by which the approval of the field element manager was obtained. If, for example, the branch chief approves these MC&A elements, then a clear line of delegation to the branch chief from the field element manager must be established.

Table 2-1 summarizes the inspection activities that are most commonly performed by the MC&A topic team for each Program Administration subtopic area.

Common Deficiencies/Potential Concerns

Line Management Responsibility for Safeguards and Security

MC&A Programs Compromised. The DOE complex has experienced several safety, operational, production, environmental, and material stabilization concerns during the past decade. As facilities had to develop plans to recover from these concerns, there have been instances where the MC&A requirements were compromised, often without adequate compensatory measures, assessments, and/or appropriate levels of approval. Failure to take physical inventories, perform measurements, and conduct internal reviews represents some examples. Without an adequate MC&A system, there is no assurance that all material is accounted for. While an inspector must be sensitive to safety and operational issues, the facility MC&A program must demonstrate a proactive approach to these issues. Requests for deviations, additional vulnerability assessments (VAs), and increased performance testing are examples of activities that can be performed when MC&A systems have the potential for compromise. In addition, facilities must have plans to restore the system to normalcy. Issues of compromise can be detected by reviewing DOE MC&A surveys, internal assessment reports, and occurrence reports, and through general interviews with management.

Inadequate Staffing. Some facilities simply do not have enough experienced and qualified staff to accomplish MC&A functions. A related problem occurs when a facility's MC&A managers cannot effectively manage the program, either because they supervise too many people (excessive span of control), or because they have other duties that deflect their attention from their MC&A responsibilities. In some cases, the site may have adequate numbers of staff but may have a non-optimal skill mix, resulting in shortages in certain areas and/or delays in performing certain functions.

Lack of MC&A Participation in Vulnerability Assessments. A comprehensive VA of MC&A functions must be approved by the DOE field element MC&A organization before it can be included in the SSSP. Often VA teams do not include an MC&A-oriented individual to properly assist in assessing MC&A functions. MC&A activities that support VAs must have assigned detection probabilities based on performance testing. Often, to have VAs approved, the probabilities may be assigned subjectively. However, this results in a VA that may not indicate the full implication of risk at the facility. Such a situation is generally identified during review of VA data and interviews with personnel responsible for completing the VA**.**

Deficient MC&A Documentation. Documentation describes the implemented MC&A program and ensures that all changes to the program are properly recorded and reflect the current operating mode. It is not uncommon for an inspector to find that the MC&A Plan is incomplete, lacks depth or references, or cites

Table 2-1. Approvals Required by the Cognizant Field Element

Item	DOE Manual 474.1-1B Reference
DOE/NNSA field elements must approve the MC&A Plan.	Ch.I, 1, e , Page I-3
DOE/NNSA field element manager may require applicable measures be implemented for waste with VA resulting in unacceptable risk.	Ch.I, 1, h, Page I-3
DOE/NNSA field element must determine material is discardable for safeguards termination.	Ch.I, 1, i, 1, b, Page I-4
Head of the responsible DOE program office must approve safeguard termination for attractiveness D or higher nuclear materials.	Ch.I, 1, i, 2, Page I-5
Head of the responsible DOE program office must receive the risk assessment for Category II before approval of safeguards termination.	Ch.I, 1, i, 2, Page I-5
DOE/NNSA field element must approve reductions in safeguards for retained waste.	Ch.I, 1, j, 4, Page I-7
Physical inventories must be conducted at a frequency approved by the DOE/NNSA field element manager (source and other nuclear material).	Ch.I, 3, a, 2, Page I-11
The DOE/NNSA field element manager will determine all other MC&A requirements (source and other NM).	Ch.I, 3, a, 4, Page I-11
The head of the DOE/NNSA field element MC&A organization must approve the vulnerability assessment.	Ch.I, 4, a, Page I-12
The DOE/NNSA field element should review and approve the control limits (inventory confirmation/verification measurements). The DOE/NNSA field element manager may require tighter limits.	Ch.I, Table I-6, Page I-14
The specified percentage and maximum quantity must be approved by the DOE/NNSA field element manager.	Ch.I, Table I-6, Page I-14
The scope and extent of the testing (access control and material surveillance) must be approved by the DOE/NNSA field element manager.	Ch.I, 4, c, 1, c, Page I-15
The DOE/NNSA field element must independently evaluate the significance of the incident.	Ch.I, 5, Page I-16
The assessment program must be approved by the DOE/NNSA field element manager.	Ch.I, 6, Page I-16
The DOE/NNSA field element manager must approve the frequency of these audits (independent MC&A internal audits).	Ch. I, Page I-17, last paragraph
Parameters for statistical sampling plans must be approved by the DOE/NNSA field element.	Ch.II, 3, a, 1, Page II-3
Each facility must perform physical inventories of Category I and II MBAs other than processing, at a frequency determined by the DOE/NNSA field element manager but at least semiannually.	Ch.II, 3, a, 2, Page II-4
In such cases (process controls provide equivalent detection), the DOE/NNSA field element manager must approve a processing plan before starting the campaign.	Ch.II, 3, a, 2, Page II-4
Physical inventories for Category III and IV must be performed at a frequency to be determined by the DOE/NNSA field element manager but at least biennially.	Ch.II, 3, a, 2, Page II-4

Item	DOE Manual 474.1-1B Reference
Category IV material in Category 1 and II MBAs must be inventoried on a schedule defined by the DOE/NNSA field element manager, but at least biennially.	Ch.II, 3, a, 2, Page II-4
Source and other materials outside Category I and II MBAs must be inventoried at a frequency approved by the DOE/NNSA field element manager.	Ch.II, 3, a, 2, Page II-4
Extensions to inventory frequencies must be approved by the DOE/NNSA field element.	Ch.II, 3, a, 3, Page II-5
The DOE/NNSA field element manager may extend inventory periods >2 years $\leq$ 5 years for Category III and IV storage areas that have alternate inventory control measures.	Ch.II, 3, a, 3, Page II-5
Physical inventories performed during IAEA inspections may, with the concurrence of the DOE/NNSA field element manager, serve in place of a scheduled physical inventory.	Ch. II, 3, c, Page II-6
Facilities must develop sampling plans that the DOE/NNSA field element manager must approve.	Ch.II, 3, d, 1, Page II-7
The DOE/NNSA field element manager may establish a material quantity threshold for verification and confirmation measurements.	Ch.II, 3, d, 1, Page II-7
The specific measurement and measurement control requirements for Category III and IV nuclear material are to be determined and approved by the DOE/NNSA field element.	Ch.II, 4, Page II-8
Precision and accuracy requirements must be approved by the DOE/NNSA field element.	Ch. II, 4, b, Page II-8
Statistical control limits must be monitored to ensure that they are consistent with target values approved by the DOE/NNSA field element manager.	Ch.II, 4, e, 8, Page II-11
The control measurement frequency must be at least one of every five measurements unless otherwise approved by the DOE/NNSA field element manager.	Ch.II, 4, e, 9, Page II-11
Use of confirmatory measurements in lieu of verification measurements requires a shipper/receiver (S/R) agreement approved by both DOE/NNSA field element managers.	Ch.II, 5, a, 4, Page II-13
For Category III and IV transfers, DOE/NNSA field element managers may require measurements.	Ch.II, 5, a, 4, Page II-13
Measurements for transfers when required by the DOE/NNSA field element manager must be according to Table II-2.	Ch.II, 5, a, 4, b, Page II-14
A S/R agreement approved by both DOE/NNSA field element managers is in effect for the transaction (for S/R safeguards closure).	Ch.II, 5, a, 4, e, 3, Page II-16
Limited processing is acceptable for materials not amenable to NDA receipt measurements as approved by both DOE/NNSA field element managers.	Ch.II, 5, a, 4, f, Page II-16
Confirmation/verification measurement requirements for internal transfers must be approved by the DOE/NNSA field element, including when measurements are not required.	Ch.II, 5, b, 5, Page II-17

Item	DOE Manual 474.1-1B Reference
The receiving facility must not process SNM …unless a S/R agreement has been approved by both DOE/NNSA field element managers.	Ch.II, 6, a, 7, Page-19
Other methodologies (ID evaluation) may be used, but they must be approved by the DOE/NNSA field element manager.	Ch.II, 6, b, 2, Page II-20
For Category IV control limits may be based on professional judgment with the approval of the DOE/NNSA field element.	Ch.II, 6, b, 2, Page II-20
SNM in use or process must be under material surveillance, under alarm protection, or (with the approval of the DOE/NNSA field element manager) protection by alternative means.	Ch.III, 3, b, 1, f, Page III-3
The material surveillance program for Category IV must be approved by the DOE/NNSA field element manager.	Ch.III, 3, b, 3, Page III-3
DOE/NNSA field element-approved listing of all containers considered to be intrinsically tamper-indicating.	Ch.III, 5, a, 14, Page III-6
The plan (waste discharge response plan) which must be approved by the DOE/NNSA field element manager.	Ch.III, 5, c, 2, Page III-7
The DOE/NNSA field element manager must determine and approve the scope and extent of the checks (DACs).	Ch.III, 5, d, Page III-7

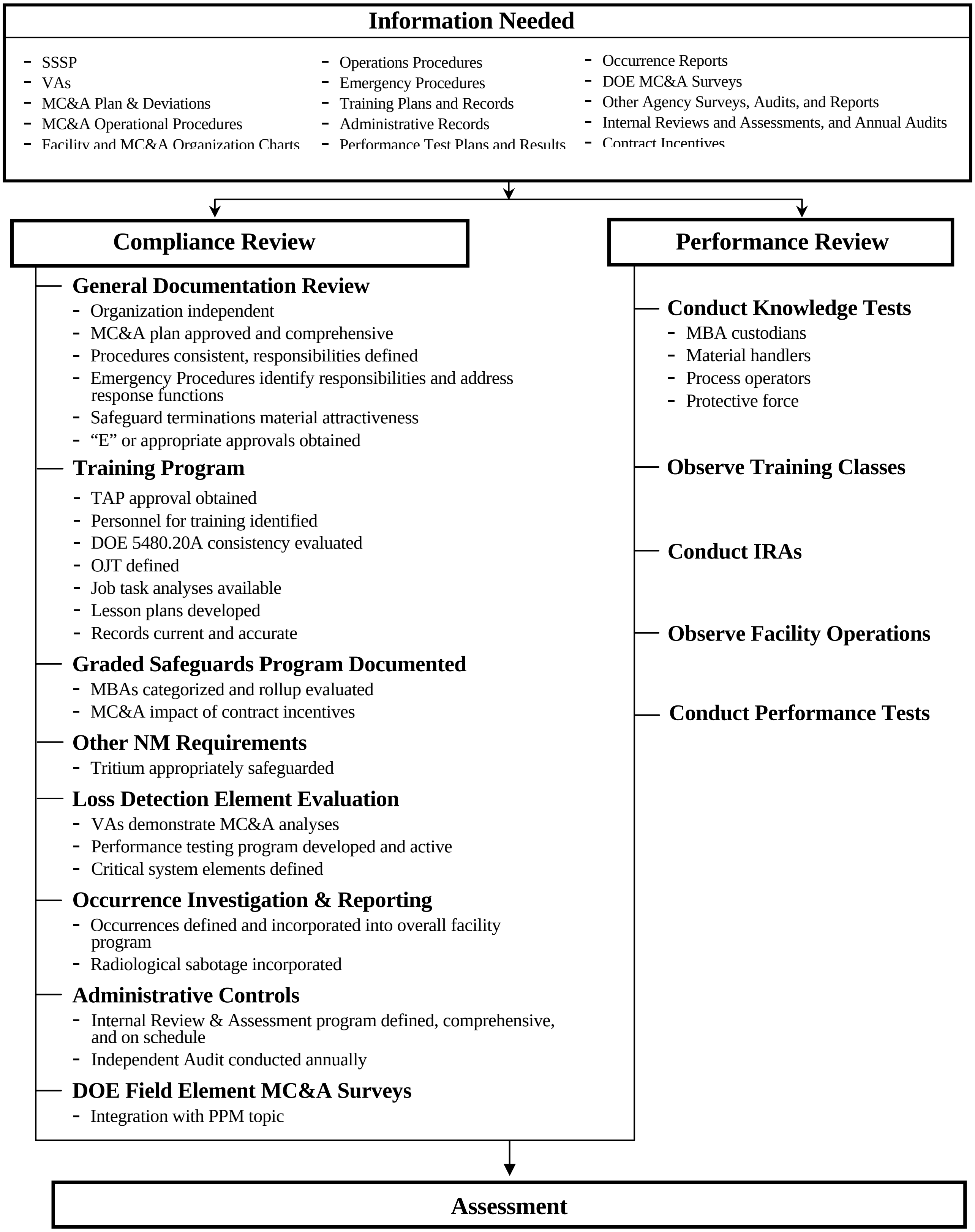

Figure 2-1. Inspecting MC&A Program Administration

supporting documents that are not consistent with the plan. Occasionally, the MC&A Plan has not had final approval. These deficiencies in the MC&A Plan may be caused by a lack of understanding of this important base document. The deficiencies may also be caused by the field element's failure to interact with the facility to ensure that the MC&A Plan is comprehensive, kept current, and approved.

Other documentation problems may be caused by operations personnel being unfamiliar with MC&A requirements or MC&A personnel lacking sufficient familiarity with operational processes to assure that MC&A requirements are adequately addressed. Either problem may result in improper nuclear material transfers, not obtaining appropriate measurements, improperly conducting nuclear material inventories, or not applying other safeguards measures as required. Any deficiencies in the documentation should be identified as part of the compliance reviews performed under this administrative element.

Deficient Authority Approvals. DOE Manual 474.1-1 delegates substantial authority to the cognizant DOE field element in a number of areas by requiring the field element manager or other official to approve specific MC&A criteria. There have been instances where facilities have neglected to obtain appropriate documented approval for the specific criteria (see Table 2-1). Failure to have this approval allows the facility to implement MC&A criteria without adequate oversight. Compliance reviews should always verify that the facility has a fully approved MC&A program.

Deficient Contract Incentives for MC&A. Facility contracts contain incentives for motivating contractors to perform work requested by DOE. Contractors often prioritize work effort in the areas with the potential for the largest incentive fee. If contract incentives are not included for MC&A activities, (or for meeting DOE requirements in general), the MC&A program may be weakened. The facility may also have a weak MC&A program if the MC&A incentive fee is not large enough relative to the other incentive fees. Equally important, if senior contract management perceives that MC&A requirements negatively impact achieving the operational or production goals, a weak MC&A program may result. During data collection activities, a review should be made to determine contract incentives influencing contractor MC&A performance both positively and negatively.

Personnel Competence and Training

Deficient Training Program. Each facility is required to maintain training and retraining programs to assure that personnel performing MC&A functions are trained and qualified to perform their duties and responsibilities. Deficiencies that have occurred include the failure to conduct proper job task analyses, provide adequate training or retraining, maintain training records, and provide meaningful testing and retraining. These deficiencies are usually caused by a lack of management attention and an assumption that "once trained, always trained." A deficient training program results in personnel not performing MC&A activities correctly, thus minimizing the protection of SNM provided by the MC&A program. Interviews with personnel performing MC&A functions will generally reveal the quality of the MC&A training program. As a data collection point, knowledge-testing of personnel assists in determining the effectiveness of the training program.

Comprehensive Requirements

Deficient MBA Categorization. MBA categorization is important because of the different levels of protection required for each category. The general deficiency is the misapplication of the definition for determining category and attractiveness levels of materials. Material descriptions are particularly important. In order to affect MBA categorization, a facility may mix non-nuclear material with nuclear material to reduce the attractiveness level of items so that when a large number of items are combined in an MBA, the Category of the MBA is lessened (e.g., from Category I to Category II). The security posture is reduced commensurately. An inspector needs to ascertain if this type of activity masks the true categorization of the MBA in which the material resides. Failure to understand the categorization and attractiveness level requirements may cause the facility to misapply MC&A and protection requirements for the involved MBA. This problem becomes evident when inspectors review and compare MBA inventories, MBA categorizations, and material descriptions.

Failure to Follow Safeguards Termination Requirements. DOE nuclear facilities will continue to be in transition for many years from production sites to material consolidation and storage sites, or undergoing environmental restoration. Consequently, safeguards for some SNM will be terminated. The attractiveness level of the material for which safeguards are to be terminated must be documented, and the categorization must be supported. In some cases, the field element manager and the cognizant secretarial office must approve the safeguards termination. Concerns arise when categorization criteria are misapplied and material disposition is not properly handled or VAs are not conducted when termination is considered for Category II or greater quantities of SNM. Failure to adhere to the specific termination of safeguards requirements could place SNM at risk by permitting a Category I quantity outside an MAA or a Category II quantity outside a Protected Area (PA). Reviewing approved write-offs and supporting documentation will indicate the types and quantities of nuclear materials involved so that inspectors can determine whether safeguards were terminated properly.

Feedback and Improvement

Deficient Performance Testing Programs. Performance testing is a major tool in evaluating the effectiveness of the MC&A program and assuring that it maintains integrity. Deficiencies in performance testing may include poor quality tests, failure to test all critical system elements, failure to integrate tests to ensure overall protection of SNM, and failure to conduct an adequate number of tests. These deficiencies may be caused by a lack of management attention, a failure to obtain or allocate knowledgeable personnel, or minimizing the importance of performance testing. Deficiencies in performance testing can invalidate VAs or misidentify potentially critical MC&A system elements. These problems can often be identified during review of facility performance testing data, or by performance tests conducted by the inspection team.

Deficient Occurrence Investigation and Reporting. Each facility must identify MC&A loss detection elements and establish a program for monitoring these elements to determine the status of nuclear material inventories and identify reportable occurrences. Facilities tend to delay reporting due to optimistic views that internal review and investigations will identify and correct anomalies. Delays in reporting occurrences preclude the field element from independently evaluating the significance of the occurrence and thus delay the reporting to the Office of Safeguards and Security and the Federal Bureau of Investigation, should it be necessary. The MC&A organization must receive all Incident Reports to determine whether SNM was at risk.

Deficient Review and Assessment Program. Assessments are necessary to assure that all elements of the MC&A program are functioning as required. Typically, deficiencies in the assessment program are: a lack of comprehensiveness in the assessments, a lack of sufficient or properly qualified staff to conduct the reviews, a failure to conduct adequate performance tests, and inadequate follow-up for identified deficiencies. A common deficiency is the facility's lack of commitment to the approved schedule. Failing to conduct performance tests when new operations are started or significant changes in operations are made, or conducting improper tests, often results from the inability of staff to fully comprehend the complexities of performance testing. These noted deficiencies often result in a degradation of the MC&A system and become evident during document reviews and personnel interviews. In many cases, the document reviews will reveal the lack of comprehensiveness in the program and the lapses in the assessment schedule. It is important that assessment personnel be competent, and that they have auditing type training and certification by a credible auditing entity. A review of training records and interviews with assessment personnel will indicate whether personnel are adequately qualified. The lack of an effective self-assessment program can result in deficiencies going undetected and uncorrected for extended periods.

Inadequate Corrective Action Plans. This is a somewhat common and potentially serious problem that can result in deficiencies not being corrected. Organizations frequently fail to effectively accomplish one or more of the following actions: (1) analyzing (root cause and cost effectiveness) and prioritizing deficiencies so that resources can be used to correct the most serious first, (2) establishing a corrective action schedule with milestones so progress can be monitored and slippages identified early, (3) assigning responsibility for completion to specific organizations and individuals, (4) continually updating the plan as known deficiencies are corrected and new ones are identified, (5) ensuring that adequate resources are applied to correcting deficiencies and (6) ensuring that corrective actions have been completed and fully implemented. Frequently, facility managers devote their resources to correcting symptoms rather than the root causes of systemic deficiencies. In some cases operations performance incentives have overridden MC&A requirements.

No Root Cause Analysis of Deficiencies. Another potentially serious management deficiency is the failure of organizations to determine the underlying cause of deficiencies. This usually results in the same deficiencies recurring. Many times, the organization corrects the surface problem or symptom rather than identifying and correcting the underlying cause—the root cause. If performed correctly, a root cause analysis may reveal the causes of errors (e.g., ambiguous procedures or insufficient training). Unless management accurately determines the root cause of identified deficiencies, it is likely that similar deficiencies will recur.

Data Collection Activities

Information Needed

A. During inspection planning, inspectors should interview points of contact, review available documentation, and participate in plant tours. The results often define how the balance of the inspection will be conducted.

B. The SSSP defines the overall site posture and should be reviewed by the MC&A inspector to ensure that MC&A is fully integrated and considered in the SSSP. The SSSP is compared to the MC&A Plan for consistency in defining targets, threats, and responses.

VAs analyze the facility safeguards posture and identify the risk of theft or diversion of nuclear material. The inspector should review the SSSP/VA to determine the MC&A input into this document and, where probabilities of detection are assigned for MC&A activities, should validate those probabilities and provide input to the protection program management topic team.

C. The MC&A Plan, facility and MC&A organization charts, and MC&A procedures define the overall facility MC&A program and organization. These documents form the basis for determining how MC&A is implemented, what personnel may be interviewed, and areas to focus on during the inspection.

Inspectors should include interviews with the following personnel as identified from the facility organization charts (each site may have different titles):

- Selected top management
- Safeguards & Security Director
- MC&A manager
- MC&A manager's supervisors

- MC&A section leaders
- MBA custodians
- Assessment coordinator
- Training coordinator
- Procedures coordinator
- Process Area managers
- DOE MC&A administrators.

The mangers should be interviewed specifically for their commitment to MC&A and their ability to obtain sufficient resources to maintain an effective MC&A program.

D. Inspectors should examine approved deviations (exceptions, waivers, and variances), and any special conditions for approval should be verified during data collection to ensure that the conditions of the approval are being met. Pending deviations should also be reviewed so their impact on the current inspection can be assessed.

E. Inspectors should review operations procedures to determine the degree of integration of the MC&A program with day-to-day facility operations. Intra-plant memos may be reviewed to determine how MC&A is integrated into the operation on an ongoing basis and to evaluate the facility's reaction to ongoing MC&A concerns.

F. Inspectors should review emergency procedures to evaluate the facility's plans for responding to potential emergency situations, such as an inadvertent criticality alarm, safety evacuation, or threat.

G. The training program is an integral part of the MC&A administration subtopic. Facilities typically have a formal training program that outlines the requirements for all personnel involved in MC&A and that requires Training Accreditation Program (TAP) approval. Inspectors should review training records to ensure that the facility is complying with the commitments made in the training program.

H. Inspectors should review performance test plans and results to determine how ongoing MC&A effectiveness is assessed through routine tests.

I. Inspectors should review occurrence reports for applicability to MC&A anomalous conditions.

J. Inspectors should review DOE MC&A surveys: (1) to provide feedback to the protection program management topic on survey effectiveness; and (2) to provide a focus for the current OA inspection for areas that may be particularly weak.

Other agency surveys, audits, and reports may be applicable to MC&A. In particular, the DOE Inspector General, the General Accounting Office (GAO), the Defense Nuclear Facilities Safety Board (DNFSB), or facility financial audits may have identified MC&A issues that could require OA follow-up. Inspectors, after reviewing these reports, may identify situations for other topical areas or to other MC&A inspectors.

K. Inspectors should review the plans, procedures, assessments, and follow-up that are part of the program.

L. Inspectors should review MC&A program assessments, DOE surveys, and special audits, which indicate the level of compliance and performance of the various elements of the MC&A program. The review may also identify any systemic issues that may be prevalent at the facility as well as any specific area that should be included as part of the inspection.

Line Management Responsibility for Safeguards and Security

M. General Documentation Review. SNM can be received, processed, or stored only at a facility that has been granted written facility approval in accordance with DOE Order 470.1, *Safeguards and Security Program*. In addition, a facility is required to implement a program for the control and accountability of all nuclear materials for which it is responsible in accordance with the provisions of DOE Manual 474.1B, *Manual for Control and Accountability of Nuclear Materials*. In accordance with these requirements, a management official must be designated for MC&A who is organizationally independent from other facility programs. This individual, while responsible for all the MC&A activities, is also personally involved in the activities covered by the Administration subtopic. Therefore, in this role, this person is responsible for assuring that a graded safeguards program is established with appropriate MBAs, and that the MC&A Plan, procedures, and other pertinent documents are prepared and maintained. This person must also establish programs for training, internal review and assessment, performance testing, and the plans and procedures for emergency response and occurrence investigation and reporting.

N. The facility is also required to have a fully staffed MC&A organization with trained and qualified personnel who administer and oversee the MC&A functions of the facility. In addition, operations units performing MC&A functions must maintain trained support personnel.

O. The facility must have a current and approved MC&A Plan that addresses all the basic MC&A functions. Since the MC&A Plan defines the operating policies for the various MC&A functions conducted at the facility, the procedures that implement the policies must be in place. Inspectors should verify that each policy has a procedure and that the MC&A Plan and implementing procedures are consistent in their requirements. Procedures should define the authorities and responsibilities of the MC&A personnel. In addition, procedures should address the implementation of all the MC&A elements.

P. The facility is required to have an emergency plan and procedures outlining how to respond to and resolve the conditions that indicate a possible loss of control of nuclear material. Emergency plans should exist and address credible MC&A emergencies. The emergency plan must outline all responsibilities for those personnel who respond to emergencies. Emergency plans must address command and control functions and nuclear material alarm evaluations, and define the interface with other organizations, such as environment, health, safety, security, and operations.

Q. Operations procedures that supplement the MC&A procedures must be consistent with all MC&A documentation and detail how to perform the MC&A functions for which they are responsible. These procedures should be readily available to employees for reference. At many facilities, all procedures, instruction, and other documentation may be available only on computers. Therefore, it is important that computers are readily available to all employees.

R. Inspectors should review any nuclear material for which safeguards were terminated. Inspectors should verify that the material was identified as attractiveness Level E and, for higher attractiveness levels, should assure that the facility obtained the concurrence of the cognizant secretarial office and SO.

S. MC&A Management Approach. Inspectors should determine whether the persons responsible for the MC&A program are in a position to ensure compliance. This may involve reviewing the facility's policies and procedures to determine whether the manager has the authority to enforce compliance and resolve issues identified during self-assessments or other similar activities. Additionally, interviews with managers in the MC&A department and operations and production departments should be conducted to determine whether the MC&A organization has any problems getting the operations or production personnel to implement required procedures. If initial interviews indicate questions about the operations or the production organization's commitment to implementing required MC&A measures, inspectors may elect to conduct more detailed interviews and document reviews to identify problems. These detailed reviews may involve examining findings identified in self-assessments, surveys, and inspections to determine whether corrective actions were implemented in a timely manner, or whether repeated memoranda from the security organization were necessary before the operations or production personnel took action. Additionally, the inspectors may want to interview members of the facility's top management to assess their commitment to MC&A and share with them any preliminary evaluations of the facility's MC&A program. The inspector(s) should address positive as well as negative evaluations.

T. Inspectors should determine how management communicates its goals and objectives while emphasizing the importance of MC&A. Inspectors should also determine what incentives are used to encourage good performance and what programs are used to maintain an appropriate level of safeguards and security awareness.

Personnel Competence and Training

U. Training Program. The facility training program must be approved under TAP that is administered by the DOE Nonproliferation and National Security Institute (NNSI) (formerly the Central Training Academy). Generally, TAP approval can be obtained if the training program meets the applicable criteria in DOE Order 5480.20A, *Personnel Selection, Qualification, and Training Requirements at DOE Facilities*. The criteria require the facility to include a training plan that stipulates how the training needs of the organization are being addressed, and outlines the training requirements for all personnel who are involved in MC&A functions. It should define formal classroom instruction, on-the-job training (OJT), computer-based, and any specific offsite training. It should also define re-qualification or retraining needs and schedules. Instructors must be qualified for the subject matter they are teaching and must be able to demonstrate their proficiency. Records should show that job analyses have been performed for each MC&A activity. In addition, comprehensive lesson plans must be available for each training topic. These lesson plans should include statements of objectives, materials needed, and teaching method—e.g., lectures, demonstrations, and hands-on practice. Regardless of method used, there should be mechanisms for determining whether trainees have mastered the objectives and are qualified to perform MC&A activities. The training profile maintained for each employee must indicate the specific training, training date, and results of any administered tests. Any retraining or offsite training and results should also be included in the records. These records may be filed in a central training office, the MC&A department, or the employee's departmental office. The training program must also include a system that identifies those individuals who require retraining or re-qualification on a periodic basis prior to the lapsed period. Personnel who should typically be included in the training program are:

- MC&A personnel
- MBA custodians
- TID applicators and verifiers
- MC&A accounting personnel
- Measurement personnel
- Process operators
- Material handlers
- Certain protective force personnel.

V. Depending on the scope of the inspection, inspectors should request and review the training records for several personnel who have MC&A responsibilities. Inspectors may also evaluate the training programs to determine whether or not they are achieving their stated objectives. The exact scope of this effort depends on the status of the facility and the results of prior inspections. Typically, if prior assessments found that the training program met its stated objectives, the current assessments might consist of a few interviews and a limited records review. A similar approach would be taken for the review of training materials. If new personnel were assigned to an MC&A function or new training materials were developed, these would be logical targets for the current oversight assessment.

W. Inspectors may elect to review sample position descriptions for specific individuals who have responsibilities for the MC&A program and to verify that responsibilities are actually reflected at the individual's level. Inspectors can also review individual position descriptions and performance goals of custodians or other persons in the operations and production departments who perform MC&A functions. Such a review would determine whether individuals are held accountable for their MC&A performance and whether there are provisions for rewarding good and sanctioning poor performance in MC&A-related areas.

X. Inspectors should review actual versus authorized staffing levels for MC&A positions to determine whether the program is operating short-handed. Inspectors must be especially watchful for non-MC&A responsibilities that are assigned to key program personnel, thus detracting from their ability to perform their MC&A duties.

Y. Knowledge Tests. Several candidate groups within a facility can take knowledge exams. These include MBA custodians, material handlers, process operators, and protective force personnel. Inspectors may randomly select a statistical sample of personnel and request that the training instructor administer the written test. Inspectors may also administer written tests with questions from the facility training library or prepare questions from procedures and other training materials that are used by the facility for actual training. When inspectors administer their own knowledge and/or performance tests, they should prepare knowledge and performance tests based on facility plans and procedures, and administer tests to individuals whose work includes the subject matter. Care must be taken to validate the test with knowledgeable facility personnel to ensure that the questions are valid and meaningful, and that an acceptable pass/fail criterion has been established. For this reason, inspectors usually will have the facility administer a subset of its existing test questions.

Z. Observation of Training Activities. As part of planning, the training plan and schedules should be reviewed. Inspectors should select a class and request that the facility conduct the class during the inspection. Alternatively, the facility may have already scheduled a class during the inspection and the inspector would observe the training. This allows the inspector to evaluate instructor qualifications, comprehend-siveness of the training, adherence to the lesson plan, and in some cases, application of remedial training. This performance test is particularly important if there are indications that a facility has poor training.

Comprehensive Requirements

AA. Loss Detection Element Evaluation. A facility possessing Category I quantities of material must develop and perform VAs to assure that the facility has the capability to adequately detect losses of material. The VAs must address the same points established for the preparation of the SSSP. The site is required to annually review and update the VAs in order to incorporate changes in safeguards systems or risks. Additionally, the head of the field element's MC&A organization must approve the vulnerability assessment before it can be submitted as part of the SSSP.

BB. Another required aspect of loss detection element evaluation is the internal performance testing program. It should be a comprehensive program that fully supports and verifies the VAs. It should also be a major tool in support of the assessment program and any other special performance evaluation situations. The performance tests must be designed to demonstrate that the MC&A systems are functional and that the systems perform as intended. The tests should be effective evaluations of the MC&A components and should be conducted at a frequency consistent with a performance test program plan. The program design must focus on testing individual detection elements. The results of the element tests should be integrated into the safeguards and security VAs. The facility must take corrective actions for any vulnerability identified during system testing. The requirements for design, planning, and documentation of performance tests are specified in DOE Order 470.1. The program should define MC&A critical system elements and as a minimum must include the following:

- Access controls
- Material surveillance
- TIDs
- Portal monitoring
- Accounting record system
- Inventory confirmation/verification measurement
- Inventory difference control limits.

CC. Graded Safeguards. The facility must establish and follow a graded safeguards program for all of its nuclear materials. This requires the facility to establish MBAs based on categorization of material so that appropriate protection levels are maintained. Nuclear material categories are shown in DOE Manual 474.1-1B, Table I.4. Occasionally, categorization is difficult due to mixed types of nuclear materials, and inspectors must make independent calculations to validate the MBA category.

DD. To evaluate the adequacy of the graded safeguards program, inspectors should request a physical inventory listing and internal transfers for several MBAs, and validate that the types and quantities of material in the MBAs are consistent with their categorizations.

EE. Requirements for Other Nuclear Materials. Except for tritium, separated neptunium-237, and separated americium, source and other material are generally subject to minimum protection requirements. Inspectors should determine that the facility has provided the minimum MC&A safeguards required, i.e., they are in the accountability records, and are periodically inventoried and included in Nuclear Material Management and Safeguards System (NMMSS) reporting. Inspectors should ascertain if the field element manager has determined other specific requirements for these materials. Since tritium, separated neptunium-237, and separated americium are strategic nuclear materials, inspectors should assure the facility has complied with the safeguards requirements that are stipulated in DOE Manual 474.1-1B.

Feedback and Improvement

FF. Incident Investigation and Reporting. The facility is required to identify MC&A loss detection elements for each MBA and establish a program for monitoring these elements and the associated data in order to determine the status of physical inventories and to identify occurrences. An incident involving nuclear material must be reported in accordance with DOE Notice 471.3**.** The field element must independently evaluate the significance of incidents, in addition to any other evaluations or investigations by other DOE organizations or the Federal Bureau of Investigation. Reporting and investigation may also be required for nuclear materials in events involving radiological sabotage.

GG. Administrative Controls. Each facility possessing nuclear materials is required to have a documented program to periodically review and assess the quality and integrity of the MC&A system. The assessment program is the core of administrative control. The frequency and content of MC&A system assessments must be approved by the field element manager. The assessment program must address both normal and emergency conditions and must identify the system elements, components, procedures, and practices that require periodic review and assessment. The facility should have documented assessments for the start-up of new facilities and change in operations. In addition, there should be documented assessments when significant changes occur in operating status of facilities, operations, or the MC&A system. Assessment documents should identify the MBA, elements assessed, interviews and performance tests conducted, deficiencies identified, root cause analyses performed, and corrective actions required. The facility must have a tracking system for follow-up. The field element must approve the assessment plan. The assessments should be completed as scheduled and all assessment reports should be issued in a timely manner. MC&A assessment personnel should be competent, knowledgeable of MC&A, and qualified. The auditor must not overlook one important aspect of the assessment program, namely, the identification of personnel who should be included in the Personnel Security Assurance Program (PSAP). Results of this review should be provided to the inspectors of the personnel security topic.

HH. The facility must have documented evidence that an annual independent audit of its MC&A function to assess compliance with internal plans and procedures has been conducted. This audit must have been conducted by individuals who are independent of any facility MC&A responsibilities.

II. DOE MC&A Surveys. OA inspects the field element safeguards and security survey program and incorporates the results of the inspection into the protection program management topical section of the overall report. MC&A survey inspection assesses the DOE field element's management and oversight of contractor activities. Since OA inspections do not occur as frequently as field element surveys, the MC&A topic team assesses the field element's performance, based on how well the contractor complies with DOE requirements.

The evaluation of the field element MC&A survey group should be based on the performance of the following activities:

- Surveys were current and reports were issued in a timely manner.
- Surveys were sufficiently comprehensive to adequately rate the facility MC&A program.
- Survey findings were tracked and resolved in a timely manner.
- Survey ratings were consistent with survey report narrative and work papers.
- Surveys included independent performance testing.
- Surveys included obtaining independent measurements.
- Surveys included status of previous OA MC&A findings.
- Survey results were provided to the facility in a timely manner so that corrective actions could be implemented.

The field element evaluation should address whether the status of the contractor's system has been accurately communicated to Headquarters.

JJ. A facility may propose an alternative or equivalent means of providing adequate safeguards and security to meet a specific requirement of safeguards and security program directives. The following are descriptions of the three levels of deviations. Any extensions of the approved period of time for deviations requires reapplication for approval.

Variances are approved conditions that technically vary from a safeguards and security directive's requirement, but afford equivalent levels of protection without compensatory measures. Variances may be approved for an indefinite period.

Waivers are approved non-standard conditions that deviate from a safeguards and security directive's requirement that, in the absence of compensatory measures, would create a potential or real safeguards and security vulnerability. Waivers therefore require implementation of compensatory measures for the period of the waiver (e.g., expenditure of additional resources to implement enhanced protection measures). A waiver shall not exceed two years.

Exceptions are approved deviations from a safeguards and security directive's requirement that create a safeguards and security vulnerability. Exceptions should be approved only when correction of the condition is not feasible and compensatory measures are inadequate to preclude the acceptance of risk. Exceptions shall not exceed three years.

Deviations should be reviewed for appropriateness and whether concurrence was needed and obtained from Headquarters.

KK. Conduct of Assessments. Inspectors can request a facility to conduct an assessment, which would allow the inspectors to validate assessment personnel qualifications as well as to observe the response of the area being evaluated. Inspectors could also review the assessment schedule and identify an assessment that is scheduled during (or near) the inspection. Inspectors would then evaluate facility personnel conducting the assessment.

LL. Observe Facility Conduct of Performance Tests. Since performance testing is included in the administration subtopic, inspectors may request that the facility conduct one of its preapproved tests for OA to evaluate. They can also review the tests conducted as part of the facility VA and request that one of these be executed to validate detection probabilities.

MM. Most organizations have some type of central, integrated system to identify and follow the status of deficiencies identified during self-assessments, field element surveys, and inspections. Inspectors should determine what system or systems are being used. Sometimes it is a comprehensive system that includes all safeguards and security-related deficiencies. Other times, each area, such as MC&A, has a separate tracking system.

NN. Inspectors should review the self-assessment program in detail and determine whether self-assessments are performed regularly and whether all aspects of the MC&A program should be reviewed. Selected self-assessment reports should be reviewed to determine whether root causes are identified when deficiencies are found. It is helpful to compare the results of facility self-assessments to inspection findings or other audit results to learn whether the self-assessments are as effective as the audits.

OO. Inspectors should determine who actually performs the self-assessments. At the field element, the security survey staff might perform the self-assessment as part of the annual survey. If the persons who actually perform MC&A functions conduct the self-assessments, there should be some form of independent verification or evaluation of the results. Inspectors should determine whether deficiencies identified during self-assessments are entered into a tracking system, and how corrective actions are selected and achieved.

PP. Inspectors should determine whether an organization has a tracking system and how it operates. In conjunction with the survey program topic team, they should determine whether the tracking systems have a means of monitoring the status of all inspections, surveys, self-assessments, and other similar activities. In addition, inspectors should determine whether there is a formal system to independently verify that corrective actions have been completed and that the original problem has been effectively resolved. They may elect to select a sample of MC&A deficiencies from several sources and determine whether they were entered into the tracking system. Finally, inspectors can select a sample of deficiencies indicated as closed to verify that they have in fact been adequately corrected.

QQ. Inspectors should determine whether corrective action plans exist for deficiencies and whether deficiencies are analyzed and prioritized. Inspectors should also determine whether schedules and milestones have been established, and whether specific responsibilities to ensure completion have been assigned down to the individual level. Finally, they should determine whether root cause analyses are being performed. If so, they should request documentation on root cause analyses for significant deficiencies listed in the tracking system and the rationale for the chosen course of corrective actions. As a related activity, inspectors may elect to review how additional resources required for corrective actions are introduced into the budget process.

RR. Inspectors should review the role of DOE oversight by interviewing selected DOE field element personnel to determine how DOE implements its responsibilities. Specific items to cover include how DOE reviews the contractor MC&A program functions on surveys, how DOE tracks the program status, and how DOE and the facility interact on a day-to-day basis. Additionally, key facility managers should be interviewed to gather their views on the same subjects.

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Section 3

ACCOUNTING

Contents

References

Miller's Comprehensive GAAP Guide, Martin A. Miller, 1985
DOE Order 200.1
36 CFR 1220
DOE Order 142.2

General Information

The Accounting subtopic addresses the various methods used to maintain records of and account for nuclear materials at a facility. The inspection addresses selection of MBAs, records systems, source document preparation, data reporting to the NMMSS, data traceability, and documentation of transfers.

Facility Reporting Identification Symbol (RIS) codes are the starting points for the accounting inspection. Facilities may have more than one RIS code to accommodate transfers of waste, IAEA inspections, financial accounting, and emissions to the environment. Each RIS code must report to NMMSS by material type code. Each facility has its own unique system, mostly computerized, that the inspector must review and evaluate.

The facility should maintain a record and reporting system that provides a database for tracking nuclear material inventories and for documenting nuclear material transfers. The inspection should determine whether the contractor has established an auditable records system containing sufficient information to demonstrate that all commitments in the MC&A Plan have been met and that the MC&A system complies with the intent of DOE orders. The number and types of records inspected will vary with the reviews and audits performed by the facility and the extent of DOE field element nuclear material surveys.

The records system must provide for: (1) retention of key material accounting data (internal/external transactions), original source data, relevant reports, and applicable documentation; (2) TID records; (3) physical inventory listings, reconciliations, and work sheets; (4) records of IDs, other inventory adjustments, and calculations of LEIDs; and (5) reports of investigations and resolution of alarms, excessive IDs, and S/RDs on an individual and cumulative basis.

A typical records system will have sufficient redundancy to allow reconstruction of lost or missing records so that a complete knowledge of the SNM inventory is available. The capability for reconstructing records may be provided by a subsystem retained in a separate secure location so that a single individual or a single event cannot alter both accounting and source records. To a lesser extent, inspectors should be aware of the project management requirements for nuclear material accounting. This is an important component of nuclear materials management within the DOE complex, but it is not a major focus of an inspection unless special direction has been received.

It is essential that appropriate safeguards be implemented to prevent loss, misplacement, or accidental destruction of the inventory and item location records. The record system will typically be complete and sufficiently detailed to permit auditing of all parts of the MC&A system, with records and reports readily traceable to source documents.

Becoming familiar with the facility terminology and records can be a difficult task in accounting systems inspections. For example, each facility has its own set of material description codes and the inspector should obtain a copy. A list of these codes will assist the inspector in evaluating proper material attractiveness levels. Most facility general ledgers are in the M742 format and the ledgers are organized by Material Type Code. OA inspections routinely focus on high enriched uranium and plutonium, but the inspector must also pay attention to significant activities in other accounts such as Pu-238, depleted uranium, and neptunium. Using the ledger as a basis, the inspector can determine which backup data to examine for shipments, receipts, inventory differences, and other accounting adjustments.

Figure 3-1 summarizes the inspection activities that are most commonly performed by the MC&A inspection topic team for each of the Accounting subtopic components.

Common Deficiencies/Potential Concerns

Deficient Internal Material Transfer Practices

Common deficiencies in internal material transfer practices include failure to document nuclear material movements, deficient transfer checks, failure of the receiver to make required confirmatory measurement checks, and failure to have documented acceptance and rejection criteria for internal transfers. The deficiencies can result from lack of line management MC&A expertise, MC&A personnel's lack of understanding of the chemical process operations involved in the transfer, failure of the internal review and assessment program to review this aspect of the operation, or lack of management priority to provide the required overcheck. Such deficiencies result in a non-compliant system that could provide an active insider the opportunity for the theft or diversion of SNM. This problem is typically detected by identifying deficiencies in documentation or during interviews with MC&A personnel and MBA custodians.

Inadequate Shipping/Receiving System

The facility program for shipments and receipts must be monitored. When material is received from off site, the shipping/receiving agreement should be in place and should specify the methods for safeguards closure (that is, quantitative measurements by both the shipper and receiver or safeguards closure using comparable confirmatory measurement systems). Deficiencies in this program can be caused by inadequate shipper/receiver agreements (for example, no defined acceptance and rejection

Information Needed

- MC&A Plan
- General Ledger
- Accounting Procedures
- MBA Operating Procedures
- Subsidiary/MBA Ledgers
- Analytical Data
- Nuclear Material Computer System Security Plan
- Contingency Plan
- NMMSS Records
- S/R Agreements
- Source Documents

Compliance Review

Accounting Structure
- MBA reporting defined/authorized locations addressed
- Multiple material types accounted for
- Mixed material type items
- Attractiveness levels determined for MBAs
- Material description codes accurately used
- Procedures accurate and current
- Audit trail comprehensive
- Material control indicators documented
- GAAP compliance reviewed

Shipments/Receipts
- Data accurate and timely
- Measurement/accounting interface auditable
- Limits of error calculated
- S/RAs appropriate
- DOE/NRC 741s examined

Record Comparisons with NMMSS
- MBR M742s reviewed for accuracy
- TJ-14 transactions selected for shipments and receipts
- COEI 733 data reviewed for timeliness and accuracy
- TJ-8 S/R differences agree
- TJ-26 samples used for records audit

Internal Adjustments
- IDs are reviewed by technical and accounting personnel
- NOLs supported by technical data/approved by MBA custodian
- Other adjustments reviewed (nuclear production, decay, etc.)

MBA Custodian Records
- IDs are reviewed by technical and accounting personnel
- Inventory reconciliations fully supported
- NOLs supported by technical data/approved by MBA custodian
- Other adjustments reviewed (nuclear production, decay, etc.)
- Consistency with internal transfer journal
- TID records maintained
- Transfers timely; checks/measurements completed
- Records for Cat I/II capable of daily update

Nuclear Material Computer System
- Access controls separate custodian/nuclear material clerks/systems analysts
- Contingency plans in place

Accounting/Measurements Interface
- Data from measurement systems is accurately and timely entered into the accounting system by analytical lab/MBA custodian/nuclear material accounting
- Bias corrections coordinated

Performance Review

- **Perform front/back checks of items on inventory/TIDs**
- **Generate SNM inventory lists**
- **Test computer system access control and change controls**
- **Nuclear material clerks and MBA custodians/alternates enter transactions**
- **Test by falsifying transfer data or measurement data**
- **Execute contingency plan for nuclear material computer system**
- **Observe generation of audit trails, including laboratory audit trails**
- **Perform tests to violate MBA categorizations**

Assessment

Figure 3-1. Inspecting Accounting

criteria for the comparable confirmatory measurements) and failure of management to monitor shipments and receipts to ensure timely closure. These deficiencies result in a large number of DOE/NRC Form 741s remaining open, and failure to have material on the physical inventory at measured values. Inspectors can identify the problem by requesting a list of open transactions from NMMSS, by reviewing the facility's unmeasured inventory, or by reviewing the basis for the accountability values for items on the physical inventory.

Inadequate Accounting Procedures

Common deficiencies in accounting procedures include lack of formalized documentation of the accounting system, outdated procedures, and inconsistent procedures between accounting functions, or between the MC&A organization accounting system and the MBA accounting activities. These deficiencies may result from insufficient staff (existing personnel are performing the functions and do not have enough time to write necessary procedures), lack of qualified staff to write the procedures, or failure of senior management to allocate sufficient resources to accomplish required tasks. These deficiencies result in numerous accounting system errors, including abnormally high NMMSS error rates, MBA custodians who are dissatisfied with the MC&A accounting system, high personnel turnover rates, and personnel who are trained by "doing" without any formalized documentation to assist them. Indications of this problem often become evident during interviews with MC&A accounting system personnel, discussions with MBA custodians, and review of the detailed accounting records.

Accounting Adjustments Not Approved by Knowledgeable Personnel

Sometimes, accounting adjustments are not reviewed as required, or personnel who are not trained to detect potential abnormal conditions approve a transaction. An MBA custodian prepares accounting system adjustments and submits them to the MC&A organization for approval. Personnel knowledgeable of the MBA should determine whether the adjustment is technically supported. Otherwise, an MBA custodian could transfer attractive nuclear material out of an MBA as waste, or create a large inventory difference due to re-measurement and divert the difference. Inspectors may get indications of the problem during the accounting system review of inventory differences and other accounting system adjustments. The accounting mechanism for entering adjustments requires approvals from MC&A accounting and a knowledgeable MC&A technical oversight person. Failure to have the appropriate approvals indicates a potential problem.

Excessive NMMSS Error Rates

As older computer systems are upgraded, facilities tend to implement a Local Area Network Material Accounting System (LANMAS), and upgrade their NMMSS systems; such changes provide a potential to significantly increase the errors in reporting transactions. Failure to resolve system deficiencies will result in the continuance of excessive error rates. Excessive error rates increase the effort required for reconciliation, lengthen the time to records closure, and have the potential to misstate quantities of nuclear material reported by the national system to Congress and international organizations. These rates are reviewed by examination of facility records.

No Traceability for Nuclear Material Values

All nuclear material values must be traceable to an approved measurement system. In some cases, material is very old and it is not possible to determine whether the material was originally measured by an acceptable analytical chemistry method or if the value was determined using by-difference accounting. The facility records system must be able to validate that all nuclear material is based on measured values. Without traceable values, there is no assurance that the nuclear material quantities are as stated. This can be tested by selecting a random sample of inventory items or, at some facilities, by reviewing a date field that shows when the item was generated/received at the facility.

No Measurement Methods/Uncertainty Data for Nuclear Material Items

As the nuclear material management functions place material in longer term storage, the importance to DOE of knowing the method for measurement of material and the associated measurement uncertainty becomes more evident. At some facilities, material was received so long ago that the facility has no current standards to measure the material. In some cases, the material may have been measured, but the uncertainty data may not be available. As DOE increases its reporting requirements, failure to have this information may result in a misstatement of the physical inventory quantity and uncertainty, and may lack credibility from the international MC&A community. Selecting a random sample of inventory items and reviewing the backup documentation can test this.

MBA Categorizations Controlled by Accounting Systems

Deficiencies arise when transfers into an MBA have the potential to increase the category of an MBA (for example, Category III to Category II or Category II to Category I). Frequently, a facility depends on the accounting system to flag potential problems and inform MC&A and operations management that a problem might exist. If this communication breaks down, a Category I quantity of SNM could be placed outside an MAA, or a Category II MBA could be established outside a PA. Inspectors may get indications of these problems during tours, while watching transfers of material, or when the MBA categorization list is compared with routine facility transfers.

Holding Accounts Not Reviewed

Occasionally, holding accounts are not reviewed, numerous personnel are authorized to enter and alter holding account data, or untrained personnel have access to holding accounts. These conditions usually result from a failure to conduct proper reviews before establishing the holding account. This deficiency would allow the facility to place material quantities that cannot be physically inventoried into the official nuclear material accountability records. Inspectors get indications of this problem when they encounter incomplete accounting procedures that do not describe the role of holding accounts, a failure of the MC&A program to review holding accounts, or inadequate knowledge or training in the purpose and function of holding accounts.

Data Collection Activities

Information Needed

The key information needed to conduct a comprehensive review of the Accounting subtopic includes the MC&A Plan, general ledger, accounting procedures, MBA operating procedures, subsidiary/MBA ledgers, analytical data, nuclear material computer system security plan, contingency plan, NMMSS records, shipper/receiver (S/R) agreements, and source documents.

A. Inspectors should begin by reviewing the MC&A Plan. It will provide a general description of the accounting function and identify individuals (by title) who are responsible for maintaining the accounting system and entering data into the accounting system. The MC&A Plan may identify sub-tier documents that will further describe the accounting system.

B. Inspectors should review the general ledger, which shows the overall facility balance by RIS and material type. Ledgers may be reconciled with the physical inventory monthly, bimonthly, and/or cumulatively. DOE's accounting period for national reporting is for six months with reporting periods that end March 31 and September 30.

C. Inspectors should review accounting procedures. They are specific to the MC&A organization and detail how transactions are entered into the accounting system. They should discuss details of routine inventory adjustments (e.g., decay, transmutation), and requirements for approval authority for these adjustments.

D. Inspectors should review MBA operating procedures. Some facilities have MBA operating procedures that detail how each MBA maintains its records. Frequently, the MBA operating procedures will detail how all MC&A requirements are met within the MBA and contain only minor discussions of the accounting system. A specific set of MBA operating procedures that only discusses accounting is rare.

E. Inspectors should review subsidiary/MBA ledgers. Although a central MC&A accounting system routinely has ledgers for all MBAs, subsidiary/MBA ledgers may be kept in some MBAs. For example, an MBA could have a stand-alone, PC-based accounting system that would interface with the central MC&A system. A standards laboratory could have a records system that uses more significant digits in reporting than NMMSS requires. If a facility has several MBAs, each with its own ledger system, inspectors might have time to examine only one or two of the MBA ledgers during an inspection.

F. Inspectors must review analytical data to ensure that correct nuclear material values are entered into the accounting system. Data from all laboratories that generate accounting values must be reviewed and the flow path of the data from the laboratory through the MBA custodian to the records system must be examined. The non-destructive assay (NDA) laboratory could be separate from the chemistry laboratory and data flow could be different. These data flows are extremely important to examine if the measurement results are delayed and applied to an item after it has left its originating MBA (such as a transfer to a storage vault) since correcting transfers might be required. It is not uncommon for an item to be transferred between MBAs with incomplete measurement information. For example, the weight or volume of material being transferred might be determined and entered into the accounting system and the SNM concentration entered as "0." As part of the transfer procedure, one or more samples are taken and sent to the analytical laboratory for destructive analysis. The laboratory results will then be sent to one of the MBA accountants and the "0" in the accounting records replaced with the SNM concentration obtained from the laboratory. It is very important that all the "0" values get replaced with the correct analytical result. Coordination with inspectors examining measurement systems will minimize duplication during an inspection.

G. Inspectors should review the nuclear material computer system security plan, which details how data integrity is maintained. The plan describes the different levels of access (e.g., systems analyst, nuclear material accounting, nuclear material measurements, MBA custodian, and laboratory personnel). Coordination of the MC&A inspector with the computer security topic is frequently required.

H. Inspectors should review the contingency plan for the nuclear material computer system, which describes how backup information is maintained and how frequently the backup system is tested. This plan may be incorporated into the computer security plan.

I. Inspectors should review NMMSS records, which are the facility copies of documentation received from NMMSS. Each facility maintains these records as a means of reconciling the national system with the facility system. Inspectors should select a time period for review and ask to have the NMMSS and facility records available for review. Only a cursory examination is required since these data are routinely examined by the field elements during MC&A surveys.

J. Inspectors should review S/R agreements, which are facility-to-facility agreements that specify typical conditions and measurements that will be done on planned shipments between two facilities. Both shipper and receiver facility field elements must approve the agreements. The agreements describe the measurements that will be made, time frames for completion, and whether or not safeguards closure will be invoked. S/R agreements are proactive in nature but are not required. If such agreements exist, they will assist in facility reconciliation of any S/RDs.

K. Inspectors should interview several facility personnel including:

- MC&A manager
- MC&A accounting supervisor
- MC&A accounting personnel
- MBA custodian
- MBA personnel who enter accounting data
- Computer system administrator
- Computer system analysts.

Since some of these same individuals are also interviewed as part of the management review, these interviews should be coordinated with the inspector responsible for assessing the effectiveness of the administrative systems. Joint interviews are effective and minimize the impact on the facility operating staff.

Compliance Review

As shown in Figure 3-1, the compliance review of the accounting system can be divided into reviews of the accounting system structure, shipments/receipts, records comparisons with NMMSS, internal adjustments, MBA custodial records, nuclear material computer system, and the accounting/measurements interface.

The reviews performed in each of these areas will be briefly summarized in the following subsections. While the major focus of the reviews will be the facilities accounting system, inspectors should also verify that the field element is performing sufficiently detailed audits on the accounting system and provide this feedback to the PPM topic for input into an analysis of the field element survey program.

Accounting System Structure

L. Facilities must maintain accountability data by MBA that reflect quantities of nuclear material received and shipped, adjustments to inventory, and remaining quantities on inventory. Inspectors should determine whether the system is structured to allow reporting for all material types and whether it has mechanisms for recording internal, external, and adjustment transactions. The accounting system must address mixed material types (e.g., plutonium and highly enriched uranium) and multi-container packages.

A table that lists MBA, custodian, category, and a brief description of the MBA may be part of the MC&A Plan, or it may be requested as part of the accounting structure review. This table can be used to select MBAs for additional record evaluations or to select MBAs to tour or custodians to interview. Inspectors should examine several MBA transactions by either reviewing documentation or observing personnel entering actual data.

The facility should explain how the accounting system identifies the attractiveness level of each MBA and in some cases, how the attractiveness level of each item is determined. Based on this explanation, rollup should be evaluated.

M. Inspectors should evaluate the written accounting procedures, verify that they are approved by management, and determine whether they are consistent with the MC&A Plan. Organizational responsibilities should be clearly defined, the documents distributed to the correct personnel (a field verification of the currency of the documents should be performed if time permits), and the documents adequately controlled. Inspectors should note the date when the procedures were last revised, how often they must be reviewed, and whether they are periodically reviewed in accordance with facility established time frames. In particular, inspectors should evaluate the adequacy of the written procedures for reconciling the book and the physical inventory. This process should be evaluated for at least two inventories to ensure that written procedures are being followed and that the procedures are current. The procedures should specify report frequency, distribution, timeliness, and retention requirements for all accountability records, reports, and supporting documentation, specifically for process data that could be used for validating data at some future time.

It is important that the facility maintains records, submits data, and issues reports describing nuclear material transactions and inventories. The records and report system must be capable of generating a listing of items within 3 hours for Category I MBAs and within 24 hours for other MBAs. Category I and II MBAs require that the system be capable of daily updates. For manual systems, it may be necessary to interview the MBA custodians to verify the MC&A response or select an MBA for a performance test.

Audit trails must be available. For computer systems, this is straightforward inquiry. All transactions should be uniquely identifiable. A simple check would be to try to enter a duplicate number for a transaction. In a manual system, procedures must describe the mechanism for unique identification. Forms control is an issue in manual systems; and periodic inventories of forms, as well as physical control of used and unused forms, are important. It is essential that the facility verify that physical control of forms is adequate.

Controls (checks and balances) are required to ensure accuracy and to detect errors (for example, math errors) in records. Computer edit checks are the most common. Facility personnel should describe potential errors made by data entry personnel and how these are detected by the accounting system.

Manual systems require additional review by trained personnel who understand the forms, are familiar with the data characteristics, and can perform any necessary mathematical calculations required.

Nuclear material accounting personnel should be aware of and trained in the fundamentals of generally accepted accounting principles (GAAP). While reviewing transactions, GAAP should be employed. For example:

- Separate entity should be evident from facility MBA structure.
- Matching should be demonstrated by having transactions entered and reconciled in the accounting period in which they are sent to NMMSS.
- Substance over form entries are exemplified when an ID is taken if there was a shipper/receiver difference created from an RIS that is no longer in existence.
- Materiality is demonstrated when reconciling significant shipper/receiver differences of “insignificant” amounts.
- Conservatism should be evident when inventory adjustments are reviewed by accounting management personnel.
- Continuity is demonstrated through the records retention program and through demonstrated nuclear material accounting as new contractors assume management of older facilities.
- Full disclosure is demonstrated when procedures fully document methodologies and all adjustments are thoroughly explained.
- Consistency is demonstrated when similar transactions receive similar treatment, e.g., when the explanation codes for IDs (a NMMSS A-I transaction) are consistently assigned.
- Objectivity is demonstrated when accounting adjustments are rationally examined and appropriately entered into the system.

Shipments/Receipts

N. Inspectors should have the facility describe the mechanism for transferring nuclear material off site. Inspectors should also verify that written documentation exists to support the statements and, if a shipment is planned during the inspection, observe the procedure being followed. Similarly, inspectors should request facility representatives to describe the procedure for receiving material from off site and then review the written documentation. If a receipt is expected, inspectors can observe the unloading and unpacking.

O. If a central shipping/receiving facility is used, inspectors should be able to determine exactly what activities are done at the facility and review the procedures. For the most recent Forms 741, inspectors can review the packaging and shipping data to verify adherence to internal procedures. They should also review the documentation to verify that the shipments have been examined within 24 hours of arrival and that the number of containers, serial numbers, and TIDs has been verified. The total amount of SNM may or may not be known by the shipment/receipt facility since item identification may be all that is required (e.g., assembled weapons or weapons parts).

P. Inspectors should review the DOE/NRC Form 741 files. Most facilities maintain Form 741 by RIS codes, and it is easy to identify who are the most common recipients of nuclear material. These files should be reviewed to determine whether the 741 form was dispatched within 24 hours and was correctly filled out, e.g., includes limits of error (LEs). The backup data should be reviewed to verify that the calculation was correctly performed and that it considered systematic and random, bulk, sampling, and analytical errors. If the measurements were performed by NDA, inspectors should review the method for appropriateness. The inspector for accounting systems should coordinate inspection activities with the measurements inspector.

Q. When reviewing receipt data, inspectors should verify that measurements were made in a timely manner and that the receiver's measurements and LE were booked. A list of outstanding 741s that still require the receiver's measurements (a NMMSS A-E transaction) should be requested. To ascertain whether this file is complete, inspectors should note which is the common shipper for most of the outstanding 741s and review the entire file for closure. Also, inspectors should ask how the facility tracks open 741s. This system should be reviewed to ensure its integrity. Inspectors should ascertain how the facility assures that material on open 741s does not enter the process until the 741 has been closed and all significant shipper/receiver differences have been resolved. If time permits, inspectors can select several open 741s and request an inventory listing. If all the items selected are still on inventory, it is considered evidence that the system is working. It may also be necessary to physically verify the presence of each item.

R. For planned shipments, inspectors should review the documentation specifying the procedure to follow to determine how MC&A personnel are notified of a "final release" of shipments. Inspectors should ask what mechanism is in place to ensure that the receiver is authorized to receive the planned shipment.

S. Inspectors should review Category III and IV shipments of SNM and nuclear materials. The facility should provide assurance that the MC&A organization is fully integrated with facility operations for preparing accountability documentation for shipments of smaller and less attractive quantities of nuclear materials.

T. Inspectors should review the documentation that the facility has for determining and resolving S/RDs to determine whether the procedures allow for evaluation, investigation, report, closure, and followup of S/RDs. Material must not be entered into the process until the S/RD is resolved (unless an approved deviation exists). When a significant S/RD is determined, the notification and report must be made within 30 days. Resolution could involve one facility's values being adopted or each facility accepting its own values. Inspectors should review procedures or shipping/receiving agreements. The inspector should validate that the field elements involved must concur on all significant S/RD resolutions.

U. Inspectors should review the program for monitoring S/RDs to determine whether individual and cumulative trend analyses were performed and whether the methods are statistically valid. The methods must be documented. As part of this review, LEs should be reviewed to determine whether they are properly calculated and whether measurement uncertainties are current and appropriate. The cumulative S/RD for each like material type must be routinely monitored and action taken to identify and correct measurement biases when they are determined to be statistically significant.

V. Inspectors should determine whether any alarm conditions were created since the previous inspection due to an incorrect number of items in a shipment. If so, they should determine whether a nuclear material alarm was indicated and what investigation and documentation were performed. All such alarms should be reviewed during the inspection.

Records Comparison With NMMSS

W. The facility issues accounting reports that include nuclear material transactions, material balances, inventory adjustments, and external shipments. Inspectors should review timeliness and availability of an audit trail to the accounting records. For reports to the NMMSS, the inspection will normally include a review of the NMMSS error rates for appropriateness.

X. Inspectors should determine and evaluate the mechanism that the facility uses to report data to NMMSS, especially the interface between the inventory records and the general ledger. These two functions are independent and require reconciliation. The facility should explain how this occurs and have procedures to describe the activity. Inspectors should consider using the following NMMSS reports during the inspection:

- TJ-26 Statistical Sampling of Transactions
- TJ-26A Transaction Series Detail
- TJ-8S/R Difference Report
- TJ-14 Transaction Activities
- M-742 Material Balance Report.

Y. Inspectors should ask in advance for the facility to have these reports available (specifying RIS, time frame, and material types) for the inspection. The reports are compared to the facility ledger. If the field elements survey shows evidence of a strong NMMSS review and reported NMMSS error rates are low, inspectors may wish to focus efforts in other areas.

Internal Adjustments

Z. Localization of losses is an important function of the accounting structure. Inspectors should determine whether this is done on an MBA basis or whether localization of IDs by process units is obtainable. This is verified by examining the MC&A Plan and accounting records, and during facility discussions.

AA. Inspectors should review inventory adjustments to determine who is authorized to make adjustments and how they are made. Adjustments must be made on an MBA basis, and the MBA custodian must approve all changes. No MBA custodian should be authorized to uniquely enter an ID. (This arrangement would provide a potential vulnerability path allowing the custodian to "remeasure" a single item and submit an ID.) It is especially important that accounting and clerical personnel are not uniquely approving ID transactions submitted by a custodian unless they are appropriately trained, authorized, and qualified. At some facilities, MC&A personnel from an independent measurement group are required to approve all IDs. For each ID, a NMMSS A-I transaction is required. Inspectors should review A-I transactions to ensure that the information has been properly reported at NMMSS. Improper reporting could result in deficiencies in the subsequent data analyses at Headquarters.

BB. Inspectors should evaluate other inventory adjustments such as routine tests, degradation to other materials, radioactive decay, fission and transmutation, normal operating losses, accidental losses, and approved writeoffs. The goal of this evaluation is to ensure the complete and accurate accounting of SNM with the intention of minimizing the influence of these activities on material control indicators (IDs and S/RDs). Copies of the two most recent DOE/NRC Form 742s should be requested and significant inventory adjustments selected. The facility should be requested to provide supporting data for each of the selected adjustments.

CC. Inspectors should review the effect of prior period adjustments on the accounting system. Prior period adjustments must be taken into account before the significance of the current period ID is assessed. To modify the ID quantity, add or subtract the quantity of the adjustment before assessing the significance of the current period ID. In addition, inspectors should review the site's methods for evaluating prior period adjustments and determine whether the evaluation of IDs for prior periods is appropriate.

DD. Inspectors should review documentation dealing with stack, liquid waste, and other waste monitoring systems used to determine nuclear material values. Also, associated measurement and measurement control information should be reviewed to determine whether reporting is appropriate.

EE. Inspectors should determine whether the facility has a program for evaluating IDs associated with the physical inventory-taking and whether evaluation procedures are current and approved. The program typically includes response procedures and specifies a chain of command to respond to significant IDs. This activity should be coordinated with the inspector who is reviewing physical inventories.

MBA Custodial Records

FF. It is important that a program be established to control and account for inter- and intra-facility transfers of nuclear material. The objective of transfer control is to document an approved procedural system that will deter or detect diversion or theft of nuclear material during transfers; to ensure that no nuclear material is transferred without the knowledge and concurrence of the custodians; to provide needed information concerning the location or disposition of material; and to provide proof and an audit trail for verifying that all requirements have been met. Inspectors should review the facility documentation that specifies the requirements for authorization, documentation, tracking verification, and response to abnormal situations. Also, inspectors should interview personnel who routinely perform these activities, and verify that they are familiar with and follow the procedures.

GG. For internal transfers of nuclear material, inspectors should review the documentation that specifies the procedure to follow. The procedures must be current, define responsibilities, and have appropriate approval.

HH. Inspectors should select one or two MBAs and review the file of internal transfers to determine whether procedures are being followed. They should also determine how internal transfer checks are verified. Inspectors should review the material flows within and between the MBAs to determine whether it is a documented system. No marks may be made in pencil, and single line correction and initials are required for transfer error correction.

Nuclear Material Computer System

II. Inspectors should review the computer systems related to MC&A data. This activity should be coordinated with the computer security topic team. Inspection of computer systems combines data verification and system review. The site's audit program must verify that changes to the computer software have been made in accordance with specified change controls of the software quality assurance program, and that the software quality assurance program performed the appropriate tests. Inspectors should review those audits and select specific elements for testing.

JJ. Inspectors should review the software quality assurance program at the site. Computer security personnel may conduct tests of controls to prevent or detect unauthorized access to the data base and data processing systems.

KK. It is essential that the facility establish controls limiting access to the accounting system and nuclear material accounting data. Systems assurance for computerized accounting systems is typically described in the computer security plan and may have certain features described in a users manual. Inspectors should determine whether the system has the required access controls (for example, password or physical key control/special rooms). Inspectors should consult with the computer security topic team or review the foregoing plans/procedures and conduct simple performance tests (for example, log on with incorrect passwords).

LL. A contingency plan for the accounting system is usually described in the security plan or similar document. It must be described in writing and be a viable option. Inspectors should ascertain if records are vulnerable to a common mode failure.

Accounting/Measurements Interface

MM. Inspectors should review how measured data is entered into the accounting system and by whom. NDA and destructive assay (DA) measurement results might follow different paths. At the time of the transfer, operators may enter weight or volume data, take a sample for laboratory analysis, and record the sample number. Subsequently, the analytical result is matched to the transfer and the actual nuclear material transfer quantities are calculated and recorded. All measurement data must be funneled into the accounting system. During briefings, the facility should describe how this is accomplished. During the inspection, inspectors will validate that procedures and practices are in agreement.

Data verification includes checking arithmetic accuracy when source documents contain data combinations. If the quantity of data is large, sampling plans are used to select data for verification. If the data processing is computerized, data verification is limited to source documents and their entry into the computer system. In addition to data verification, the audit should consider the activities routinely performed by other functions of facility operations. For example, the quality assurance or quality control function checks material characteristics against engineering specifications, the production function checks the analytical and quality assurance results, and the finance function checks the MC&A data and reports.

Performance Review

This section provides a brief overview of the performance tests shown in Figure 3-1. Details of these performance tests can be found in Appendix A. Since many of these performance tests compare the book listing with the physical inventory, the reviews described below should be coordinated with the inspector responsible for verifying the accuracy of the physical inventory.

Front/Back Checks of Items on Inventory

NN. Inspectors should conduct a front check of inventory items, which consists of recording the unique serial numbers of items observed during a facility tour/walkdown and validating that these items are listed in the accounting records. They should record the item identification, TID (if applied), MBA, material type, material description, location, gross weight, and grams of nuclear material in the container. At some facilities, a local computer terminal can be accessed to do an immediate validation that the selected items are properly accounted for by the accounting system.

A back check would consist of selecting items at random from the accounting system records and going to the respective MBAs to validate that the item and its values are as stated in the accountability records.

Front and back checks should be done in several MBAs unless there is reason to believe that a single MBA should be tested. This will assist in differentiating generic accounting system problems from MBA-specific problems.

Inspectors typically select items containing Category I or II quantities; however, if rollup is a potential issue, items containing Category III or IV quantities could be selected.

Generate SNM Inventory Lists

OO. The accounting system must be able to generate lists of NM by MBA. Requesting the facility to generate this list and then validating the accuracy and timeliness of generating the list is a valid performance test.

This test can be done in conjunction with an emergency physical inventory. A permutation of this test would involve having a trusted agent (computer system analyst or MC&A accounting personnel) generate an extra item on the inventory list and evaluating the facility response. Another permutation would use the MBA custodian as a trusted agent who intentionally reports an item missing when it is not. This evaluates the MC&A organization response to a missing item.

Validate/Test Computer System Access Control and Change Control

PP. Inspectors should determine the facility access controls and using a trusted agent, attempt to violate the access control restriction. Nuclear material computerized accounting systems typically have various levels of access controls. Examples of access control include: nuclear material accounting clerks may not have access to SNM; MBA custodians may not have authority to make ID adjustments; TID custodians may be prohibited from making measurement adjustments; systems personnel may not have MBA access; and laboratory personnel may not be permitted to enter SNM values for specific items. This type of performance test validates the defense-in-depth posture.

Nuclear Material Clerks and MBA Custodians/Alternates Enter Transactions

QQ. Inspectors should observe nuclear material clerks and MBA custodians as they enter routine transaction data. This can be a mechanism for validating the training program, ensuring that the data being generated has a high degree of integrity, ensuring that performance agrees with the supporting procedures for the transaction, and that the data elements being entered provide a comprehensive nuclear material accounting system. Typical transactions include: internal transfers, entry of measurement data, entry of inventory adjustment data, and entry of receiver's measurements of a recent off-site shipment.

Falsification of Transfer Data or Measurement Data

RR. Evaluation of defense-in-depth can be accomplished by attempting to input incorrect data to determine the level of oversight provided as data is entered into the nuclear material accounting system. Inspectors must first ascertain when the data entry error should first be detected (and by whom) and that the facility agrees that this is a valid test of the accounting system. For example, a 1-2 gram entry error might never be detected, a 1-2 kg error would be detected at the time of physical inventory, and a 10-20 kg error might be detected at day's end.

Execute Contingency Plan for Nuclear Material Computer Systems

SS. Computerized accountability systems must have backup and contingency plans to ensure long-term data integrity and to ensure the capability to support the facility in an emergency. The MC&A inspector will coordinate this test with the computer security team to maximize the amount of information gleaned from this test. The inspector should define what successful execution of the contingency plan involves (e.g., generation of inventory lists or material balance reports and reconciliation with hard-copy records) and must read the contingency plan to determine the estimated time frame for generating the backup data.

Examine Generation of Audit Trails

TT. Nuclear material computer systems generate audit trails that record who made what changes and when the changes were made. Using a trusted agent, inspectors should enter easily detectable incorrect data, and determine how long it takes the system to identify the person who had made the incorrect entry.

Validate MBA Categorization

UU. The objective of this test is to attempt to violate the category of an MBA by attempting to transfer items that would increase the category to one that is not authorized. For facilities with Category III and IV MBAs outside PAs, inspectors should determine whether rollup to a Category II quantity is credible (check SSSP or VA). For facilities with Category II MBAs that are not in MAAs, inspectors should determine whether rollup to a Category I quantity is possible. This is done by reviewing the physical inventory list and selecting items for movement that would create the anomaly. An attempt should be made to transfer the items that would violate the receiving MBA's approved category level. However, no actual material would be moved in this case.

Section 4

MEASUREMENT AND MEASUREMENT CONTROL

Contents

References

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General Information

The objectives of measurement and measurement control programs are to establish values for nuclear materials and assure the quality of the data. The measurement systems provide nuclear material values for inventories and transactions while the measurement control programs assure the effectiveness of measurement systems and the quality of measured values used for accountability purposes. Measurement control programs also provide the data for estimating the precision and accuracy of measured values that are used to quantify the measurement uncertainty of nuclear material quantities on inventory and to evaluate the significance of S/RDs and IDs.

Measurement and measurement control programs are graded based on the quantities and attractiveness of the nuclear material in an MBA. More stringent requirements apply to Category I and II MBAs and those with a Category I or II throughput over a six-month period. Requirements for Category I and II MBAs address:

- Organization: Measurement and measurement control programs must be independent from operations
- Selection and qualification of measurement methods
- Training and qualification of measurement personnel
- Measurement systems, including sampling
- Measurement methods
- Measurement control.

Due to the diversity and complexity of DOE facilities, approval for specific elements of the programs is delegated to the DOE field element manager. Target values for precision and accuracy of nuclear material measurements endorsed by recognized national and international nuclear organizations must be considered performance goals for facility measurement systems. The field element is responsible for approving:

- The precision and accuracy goals for measurement methods used for accountability (must be included in MC&A Plan).
- The facility list of materials that have been determined to be not amenable to measurement (must be included in MC&A Plan).

The measurement and measurement control programs for Category III and IV inventories of nuclear material are not defined in DOE requirements. The scope and content of these programs are developed by the facility and are approved by the manager of the field element. The guidance provided in this section is primarily applicable to Category I and II inventories of nuclear material. For Category III and IV inventories, inspectors should focus on the elements approved by the field element.

Figure 4-1 provides an overview of the entire inspection activity to evaluate a facility's measurement and measurement control programs respectively. This figure applies to facilities and MBAs with Category I and II quantities of SNM, but may be used for reference for other inventories.

The guiding principle for measurement and measurement control programs is to implement graded safeguards while minimizing the uncertainty of the nuclear material inventory and inventory differences. Facilities should choose the most accurate and precise measurement methods for the largest nuclear material flows (the largest quantities with the greatest amount of throughput and inventory). Methods that are less accurate and less precise may be used for nuclear material flows that do not significantly impact the uncertainty of the total inventory or inventory difference. In addition to achieving the most accurate estimate of the inventory difference, it is also desirable for the facility to perform frequent and timely material balances. Since the most accurate methods are destructive methods that are not timely and generate scrap and waste, increased focus has been placed on nondestructive methods that are quick and enable the facility to maintain a continuously updated inventory balance of nuclear material within an MBA.

For each measurement system used by a facility, the measured values must be traceable to a national measurement base. This traceability provides the basis for estimating the accuracy of measured values. Repeated measurements of process materials are necessary to estimate the precision of measured values. Laboratory intercomparison programs using realistic samples or cross

Information Needed

- MC&A Plan
- Measurement Procedures
- Method Selection/Qualification Program
- Measurement Control Methodology
- List of Materials Not Amenable to Measurement
- Inventory Difference Control Limit Calculations

Compliance Review

Measurement Methods
- Compare inventory and measurement method
- Calibration traceable
- Measurement uncertainty defined

Selection and Qualification
- Methodology defined
- Accuracy and precision goals maintained
- Qualification documented

Procedures
- Approved and current
- Prerequisites defined
- Out-of-control actions defined
- Calibration

Standards
- Traceable
- Uncertainty less than process material

Training
- Plan documented
- Proficiency defined
- Qualification and re-qualification identified

Sampling
- Representativeness assured

Data Evaluation
- Control limits established, trends and outliers analyzed

Not Amenable to Measurement Defined

Performance Evaluation

Observe Verification Measurement
- Select verification methods
- Introduce anomaly in item
- Introduce anomaly in records
- Validate verification measurement with remeasurement

Observe Confirmation Measurement
- Select confirmation methods
- Introduce anomaly

Observe Training

Make Independent Determination of Measurement Uncertainty

Assessment

Figure 4-1. Inspecting Measurement and Measurement Control

comparisons of measurements using different methods provide a basis for estimates of measurement bias or accuracy.

Common Deficiencies/Potential Concerns

Inadequate Measurement Methods and Equipment

Facilities may have nuclear material that has not been approved as "not amenable to measurement" and for which they do not have a qualified measurement method. Throughout the history of DOE and its predecessor agencies, numerous scientific and research projects have created materials that are unique. Other materials require additional processing before they can be measured, but no appropriate method for processing has been developed. In some cases, measurement methods are not qualified for the material because of a lack of standards. The existence of nuclear material that does not have an accountability value, or for which the facility can not reproduce the measured value, reduces the facility's ability to detect and quantify the theft or diversion of nuclear material. Indications of this deficiency are: unresolved S/RDs; IDs that exceed control limits; and lack of current estimates of accuracy and precision values for measurement methods.

Accountability Measurement Methods Not Qualified

Many facilities have not formally qualified their accountability measurement methods as required by DOE. These facilities have not assured that measurement methods used for accountability are capable of measuring the material in question to the desired levels of accuracy and precision, consistent with a graded safeguards approach.

Causes for this deficiency include:

- Standards do not exist for the material.
- The certification for existing standards has expired.
- There is a limited amount of the material, and it is not considered cost effective to qualify a method.
- The facility does not have personnel or the equipment to implement a measurement method.
- The material form is no longer produced, and the facility does not have standards for the calibration of the measurement.
- The facility staff does not know how to measure the material.

Using unqualified measurement methods negates the facility's ability to determine the significance of an ID. It also limits the assurance that nuclear material has not been stolen or diverted. Indications of this deficiency are: IDs that exceed control limits; unresolved S/RDs; open transactions; and confirmation and verification measurements that do not meet acceptance criteria. This lack of qualified measurement methods may be detected during interviews with measurement control or internal review and assessment personnel. Accounting system checks can also assist in the detection of unqualified measurement systems. Methods that are not qualified can be detected during a review of the measurement qualification and control programs.

Measurement Uncertainties Not Quantified

A common problem detected during inspections is a failure to quantify or correctly calculate measurement uncertainties. Some facilities do not quantify measurement uncertainties, and do not use the appropriate data or methodology to estimate uncertainties. The common causes are:

- Lack of formally documented measurement control program
- Lack of statistical training by staff responsible for implementing the program

- Lack of management attention to requirements
- Measurement responsibilities spread among varying groups at the facility, with no group comprehending the total measurement system used to obtain an accountability value
- Failure of error estimation models to consider all sources of error.

Inaccurate determinations of measurement uncertainty limit the detection capability provided by alarms for shipper/receiver difference and inventory difference evaluations. Inaccurate measurement uncertainties limit the ability of the measurement system to detect the theft or diversion of nuclear material. Indications of the inaccurate determination of uncertainties are: the facility does not perform repeated measurement of standards and process materials, standards are not available for measurement systems, control limits exhibit unexpected variation, control limits vary with time, and an excessive number of IDs and S/RDs that exceed control limits.

Sampling Methods Not Qualified

The sampling of bulk materials for the analytical or NDA determination of accountability values is a measurement method, and DOE requires that each such measurement method be qualified before being used for accountability purposes. In many cases, facilities have been taking samples of their bulk material since processing activities were initiated. In general, facilities qualified their sampling techniques during startup activities for the process and may not have supporting documentation available. When facilities cannot validate the qualification and can not quantify the uncertainty of the sampling technique, the most common causes for this deficiency are the cost of a qualification program for sampling and the loss of production. Some facilities consider the sampling techniques to be "grandfathered," because the technique has been used for a long period of time. Another significant cause of this deficiency is the failure to identify changes in processing techniques or equipment that impact the quality of the sampling technique. The lack of qualified sampling techniques limits the ability of the facility to detect the theft or diversion of nuclear material since a potential bias could exist. When the uncertainty of the sampling technique is not known and is not incorporated in the determination of control limits for inventory and shipper/receiver differences, the control limits do not reflect reality. The limits will be either too large, in which case theft or diversion may not be detected, or too tight, in which case false alarms may be generated. The lack of qualified sampling techniques is identified during documentation reviews, interviews with MC&A and operations staff, and evaluation of inventory and shipper/receiver difference programs (especially long-term trends).

Lack of Standards

Some facilities are unable to calibrate their measurement methods because they do not have standards for calibration, or their certification for standards has expired. In both cases, the facility cannot perform a measurement that is traceable to the national measurement system and can not evaluate the accuracy of the measurement system. Without an estimate of the accuracy, the facility should not use measurement results for the accountability of nuclear material. Indications of this lack of standards are: IDs that exceed control limits, unresolved S/RDs, and lack of current estimates of accuracy.

Deficient Measurement Control Programs

At some facilities, the measurement control programs are inadequately implemented or nonexistent. This deficiency results from the failure to select, qualify, and validate measurement methods capable of providing desired levels of accuracy and precision. Some facilities do not monitor their measurement systems on a continuing basis to assure current performance. Measurement control program deficiencies can be the cause of S/RDs and IDs exceeding control limits. These deficiencies limit the ability of the MC&A system to localize and resolve IDs. Inspection activities that should detect inadequate measurement control programs include interviews with measurement and measurement control personnel, reviews of measurement data, control charts, trend analyses for measurement systems, and estimates of accuracy and precision. The facility's internal review and assessment program should identify deficiencies in the measurement control program.

No Audit Trail for Measurement Uncertainties

Facilities are often unable to support their calculated measurement uncertainties. The measurement control data are not documented or the documentation does not identify the type of measurement, the person performing the measurement, the material measured, or the calibration used. These types of deficiencies usually result from a lack of procedures, lack of training, or lack of management attention. In some cases, only minimal processing is occurring and insufficient data are available to estimate the uncertainty. They can result in an incorrect evaluation of IDs and S/RDs, poor measurement quality, and the misuse of resources to resolve alarms. These deficiencies are generally detected by interviewing personnel responsible for statistical analyses, reviewing the analysis of statistical data, evaluating propagation of variance calculations for inventory differences, reviewing the calculation of limits for S/RDs, examining the repeatability of measurement results, and auditing the measurement and measurement control programs.

Trends and Biases Not Evaluated

Many facilities only evaluate IDs and S/RDs. They determine the significance of single values and do not evaluate the long-term trends of the differences. While the evaluation of the single event is important, the facility must evaluate the differences over time. Such evaluations can identify trends and biases that are insignificant for a single difference, but which can mask the trickle theft or diversion of nuclear material. The most common causes of this deficiency are the lack of knowledgeable staff to perform the analysis and lack of management attention. Facilities do not recognize the significance of trends and biases in detecting the loss or diversion of nuclear material. Other causes include: lack of statistical data due to changes in processing methods that impact the steady state operation of the facility; lack of data due to an inadequate statistical evaluation program; and difficulty in identifying and making corrections when trends and biases are identified. Failure to identify and correct for trends and biases could limit the assurance that the trickle theft or diversion of nuclear material is detected. Indications of an inadequate program to identify and correct for trends and biases are: IDs and S/RDs that do not fluctuate randomly, and cumulative differences that grow in a consistent direction (either positive or negative).

Data Collection Activities

Information Needed

A. The primary sources of information for the inspection of a facilities measurement program are the MC&A Plan, interviews with MC&A staff, and measurement procedures. Inspectors must identify the measurement methods that the facility uses for the accountability of nuclear material. These measurements should be identified in the MC&A Plan. In conjunction with the measurement methods, inspectors must identify the types and forms of nuclear material that are in the inventory. While some information is available in the MC&A Plan, inspectors should interview the accounting staff to identify the nuclear materials that are included in the accounting records. Additionally, they should identify the individuals responsible for selecting and qualifying measurements systems. The procedures that govern the use of the accountability measurement systems should also be identified. Of special significance is the list of nuclear materials that are not amenable to measurement.

The primary sources of information for the inspection of the measurement control program are the MC&A Plan, measurement control procedures, measurement control data, measurement standards documentation, training and qualification documents, material sampling plans, and documentation of the statistical evaluation of measurement control data. The MC&A Plan should specify the measurement control coordinator and describe how the coordinator is independent from personnel performing measurements. The plan should identify the methodology for estimating the accuracy and precision of each measurement method. The measurement control procedures should ensure that only calibrated measurement systems, for which control has been demonstrated, are used for accountability. The statistical evaluation documentation should address the quantification of biases and should state the methodology used for the evaluation of trends. The measurement control procedures will frequently specify the performance of the measurement system. Measurement control is frequently monitored using a control chart. The control chart plots the measurements made on a standard on the ordinate and the date the measurement was made on the abscissa. Also plotted on the graph are the horizontal lines representing the 2σ and 3σ limits for the measurement system.

Compliance Review

B. Inspectors should evaluate compliance for eight key areas of the measurement and measurement control program. These areas are:

- Measurement methods
- Procedures
- Selection and qualification
- Standards
- Training
- Sampling
- Data evaluation
- Not amenable to measurement.

For each of these areas, the DOE orders and manuals contain the minimum requirements for a satisfactory measurement program.

Measurement Methods

C. The facility should identify minimum requirements for each measurement method used for accountability. The inspector's duties include:

- Comparing the qualified measurement methods with the inventory of nuclear material to determine that either the facility has a qualified measurement method for the material or the material is listed and approved as "not amenable to measurement."

- Identifying the methodology employed by the facility to ensure that the measurement uncertainty contribution to the ID control limits is minimized. When verification measurements are used for accountability, the uncertainty of the verification measurement method should be better than or equal to the original accountability measurement. The facility should have documented evidence, e.g., control charts showing that the measurement method meets accuracy and precision goals under in-plant conditions. Confirmation measurements should be capable of determining the existence of an attribute of the nuclear material and the facility should have acceptance/rejection criteria for the measurement.

Table 4.1 is a brief description of common destructive measurement methods used for accountability of plutonium and uranium. Table 4.2 is a brief description of common NDA methods used for accountability of plutonium and uranium. The tables provide brief descriptions, standards typically used, applicable materials for which the method is used, and potential inspection concerns. Details of techniques will vary from facility to facility since few of the techniques are standardized.

The measurement calibration should be traceable to the national measurement base. Standards used for calibration should be certified and the period of certification should be specified. The facility should have documentation that the accuracy and precision of the measurement system meet goals approved by the field element. Documentation of measurement results should provide an audit trail from the measurement to the accounting records and should be sufficient to determine the calibration used for the measurement, the person performing the measurement, and the date and time of the measurement. Coordination is required with the inspector who is reviewing the accounting procedures.

The facility should require that the scales are in good working order and specify the evaluation criteria. The scales should be recalibrated on a scheduled basis and checked on each day of use for accuracy and linearity. The accuracy can be checked by the measurement of a single standard, but the linearity check requires that the calibration be checked over the range of items measured.

For destructive analysis methods, routine measurements must be used to estimate measurement uncertainty. The variability introduced by measurement personnel must be quantified for all methods unless the variability has been shown to be insignificant.

For sampling methods, the measurement uncertainty resulting from the taking of a sample must be quantified. Sufficient analysis should have been performed to identify the parameters that must be controlled to obtain a representative sample. The number of samples, sample size, and agitation time are parameters that must often be controlled. For liquid samples, it might be important, for example, to specify how much material must be drawn out of the sampling port before the sample is taken. The analysis results from such studies form the basis for estimating the method's uncertainty in the sampling method. To simplify the propagation of errors, the sampling uncertainty may be combined and incorporated with the estimate of uncertainty for the companion analytical method. This will provide a single analytical uncertainty estimate that would then be used in propagation of error calculation. When combining the sampling and analytical errors this way, remember not to use the sampling error twice when propagating errors.

Selection and Qualification

D. The methodology for selecting and qualifying a measurement system for accountability use should be documented in a procedure. The procedure should define the basis for choosing a measurement system and should identify criteria for the qualification of measurement systems. The methodology should require a capability demonstration by the personnel who will be performing the measurements.

Inspectors should verify that all measurement systems used for accountability have been qualified and that the qualification is documented. The qualification documentation should validate that the measurement system meets accuracy and precision goals during in-plant use. Attainment of accuracy and precision goals should be demonstrated daily for the DA of nuclear material and for at least one of each five measurements for NDA.

Procedures

E. Procedures provide a mechanism to assure that measurements are performed in a consistent manner and the measurement results are in control. To ensure quality and repeatability, measurement procedures must be documented, controlled, and approved. Each procedure should identify prerequisites for the performance of measurements and training requirements for the individual performing measurements. The procedure should define methods for recording the results of a measurement and should ensure that only qualified measurement methods are used for accountability.

The procedure for each measurement method should include measurement control requirements for calibration and calibration checks of the measurement system. The procedures should identify out-of-control results and, if results exceed alarms limits, should preclude use of the method until control is reestablished. The investigations required for results exceeding warning limits and the notification requirements for results exceeding control limits should be stated in the procedures. The procedure should specify actions required to recover from an out-of-control situation. The procedure should define outliers and specify actions to be taken when an out-of-control situation is detected.

A measurement control procedure should define the methodology for estimating the random and systematic error variance for the measurement (these may be included in the MC&A Plan or in a separate procedure).

The inspector should select key procedures that the facility uses for measurements and measurement control to ensure that they are current and comprehensive, and that they can be carried out successfully by the facility operators. Procedures can also be performance tested.

Standards

F. Standards are required to calibrate a measurement method and to monitor the quality of the measurement results. To evaluate the quality of the standards, inspectors should review the documentation of the standards. There should be objective evidence that the standard represents the material to be measured in all attributes that affect the measured results. The standards should be traceable to the national measurement base and the nuclear material content of the standards should be certified. All standards used for calibration should have a smaller uncertainty than the measurement method that they are used to calibrate.

Training

G. The requirements for training individuals to perform measurements should be stated in a measurement training plan or similar document. Inspectors should determine whether the plan is documented and reviewed annually. The training plan should state qualification and re-qualification requirements for personnel performing measurements, and should require individuals to demonstrate proficiency in the measurement techniques before performing accountability measurements. The facility should have a program to evaluate the training of measurement personnel and the results of the evaluation should be used to continually improve the measurement and measurement control programs.

H. Training is an essential element in the program to assure the quality of measurements. As such, inspectors should evaluate the training for measurement personnel to assure that it addresses the measurement and measurement control programs. The training should specify:

- Basic equipment operation
- Method capability and potential interferences
- Calibration and recalibration requirements
- Actions to be taken when out-of-control situations are detected
- Documentation requirements for measurement results.

I. Inspectors should review the qualifications for measurement control personnel to determine their training requirements. Their training for measurement control should be documented and reviewed annually. Not all facilities have personnel dedicated to measurement control, but they do have the responsibilities combined with other functions.

Sampling

J. The MC&A Plan should identify each point of bulk processing operations where an accountability sample is taken. For each point the methodology should be qualified by a study that evaluates mixing and sampling techniques to ensure that the sample represents the process material. The sampling technique should be based on valid technical and statistical principles, which are validated by the mixing and sampling study and documented in a procedure. The procedure should specify the sampling procedure, the number and size of samples, mixing times, provisions for retained samples and estimates of measurement variance (accuracy and precision). The procedure may state that the measurement variance is determined in conjunction with the analytical variance for the measurement.

The inspector should determine how samples are taken at each key measurement point, review the procedure for taking a representative sample, and if possible conduct a performance test by observing a sample being taken.

Data Evaluation

K. The objective of all measurement control activities is to ensure quality results. One major tool is the statistical analysis and trending of the measurement data.

For repeated measurements on standards or process items, this assurance is accomplished by evaluating measured results against control limits. The control limits are set at two standard deviations for warning and three for alarm limits. The limits are based on estimates of accuracy and precision. Accuracy is a measure of the variation between the measured result and the true value for the item. Precision is an estimate of the variation in the result for repeated measurement of the item.

In evaluating data, inspectors should:

- Evaluate the estimates to determine whether they meet or exceed target values approved by the field element.
- Examine the basis for the estimates, determine that estimates are based on current data, and determine that a program exists to update the uncertainty limit values.
- When analyzing trends in repeat data, plot the data on control charts that identify the relationship of an individual measurement to the population of measurements being used to identify a trend. The control chart will show the statistically established warning and alarm limits; any data exceeding limits will be readily identified.
- Evaluate the methodology used by the facility to analyze for trends (e.g., number of points above/below the center line, number of times the center line is crossed, or trend up or down).

Repeat measurements, intercomparisons, counting of standards, etc. will be used to establish the precision and bias estimates for each measurement technique. As noted above, these values must be reviewed and updated. These values are used to assign precision and bias estimates for all items measured by the specific technique. The facility can handle accuracy or bias in various ways, so it is important for inspectors to know how the facility handles biases. One technique is to correct all the measurements performed between calibrations by the observed bias in measuring the standards. If the correction is made, the bias should not be included in the control limit calculation. The second approach, also a valid statistical method, is to not correct for the bias but include it in the uncertainty estimate.

L. For confirmation measurements, inspectors should determine whether the acceptance/ rejection criteria are based on a statistical evaluation of data.

M. If the facility identifies outliers, inspectors should validate the facility assumptions. Out-of-control results should not be routinely identified as outliers. For each outlier, the facility should investigate the measurement and document the basis for classifying the result as an outlier.

Materials Not Amenable to Measurement

N. Inspectors should identify the materials that are not amenable to measurement during the review of the MC&A Plan. For each material, they should determine the basis of the accountability value for the material and evaluate whether the basis is technically defensible. Inspectors should compare the material to similar materials in the DOE complex, to ensure that safeguards goals are being attained for the materials. If other facilities measure the material, inspectors must determine why the facility supports identifying the materials as "not amenable to measurement."

Performance Review

Observe Verification Measurement

O. To evaluate the performance of measurement methods, inspectors should select items for measurement, witness the normal operation of the measurement system, and review documentation of measurement results. Inspectors can request the measurement of a calibration standard to validate the calibration of the measurement method. Additionally, inspectors can use the facility training evaluation methodology to test the individuals performing measurements.

During the measurement of a selected item, inspectors should determine that procedures are being followed and documentation requirements are implemented according to procedural requirements. If the item has been previously measured, inspectors should compare the results to determine whether the measurement system is operating correctly. The two results should agree within the uncertainty of the measurement method.

P. By reviewing the documentation of measurement results, inspectors can determine whether the documentation requirements are being met and can determine whether the audit trail is sufficient to determine the following:

- Person performing measurement
- Date and time of measurement
- Calibration of measurement method
- Reflection of measured results in accountability records.

This test can be conducted using scales and balances, tank calibrations, analytical methods, or NDA methods.

It is also possible to introduce an anomaly into the test by having a facility switch labels or falsify accounting information. In such cases, inspectors should evaluate the facility response to the anomalous condition.

Observe Confirmation Measurement

Q. If the facility performs confirmation measurements, inspectors should witness a confirmation measurement. Confirmation measurements are typically easier to make and thus several items may be selected. Inspectors should compare the results to the acceptance/rejection criteria for the confirmation measurement. If the attribute is confirmed, inspectors should evaluate the measurement to determine that the measurement provides adequate assurance that the nuclear material in the container is in agreement with accountability records.

It is also possible to introduce an anomaly into the test by having a facility switch labels or falsify accounting information. In such cases, inspectors should evaluate the facility response to the anomalous condition.

Observe Measurement Personnel Being Trained

R. To assess the effectiveness of the training program, inspectors may request the facility to conduct a training session for a specified measurement system. In some cases, facilities that use OJT can be easily observed. Inspectors should evaluate the training content and the instructor's conformance to the lesson plan.

Make Independent Determination of Measurement Uncertainty

S. The performance of a measurement control program is difficult to evaluate. Therefore, inspectors should consider performing the following tasks as part of the evaluation:

- Request a series of measurements to evaluate the random error variance or request the measurement of items by an independent method, when available. In both cases, inspectors should attempt to independently determine the uncertainty of the measurement.

- When calculated, compare results to the operator-determined values for the subject measurement method. (Note: Due to the smaller sample sizes the inspector selects, the inspector must exercise caution if statistical extrapolation to an entire population is planned.)

- If the results disagree, inspectors should identify the reason for the difference.

- Inspection schedules may not permit this level of a performance test since the measurement of several items may be necessary to obtain valid statistical results.

- During an initial visit, inspectors could select a series of items for measurement and ask that the results be available for a subsequent inspection visit. Inspectors must then determine the requirements to ensure a continuity of knowledge for the measurement results.

Facilities may participate in laboratory intercomparisons. These data will provide an indication of measurement bias and, combined with estimates of precision, can be used to estimate overall measurement uncertainty.

Table 4-1. Plutonium and Uranium Destructive Assay

INSTRUMENT/ TECHNIQUE [material]	BRIEF DESCRIPTION	STANDARD[(a)]	Measurement Error, %[(b)] Random [Systematic]	MATERIAL TYPES MEASURED	INSPECTION CONCERNS
Ceric Titration (Amperiometric Titration) [Pu]	The sample to be analyzed is put into solution, treated and titrated against a standard solution.	Standardized iron sulfate solution, NBL certified	0.09 [0.045]	Metal, oxide, salts	Sample has several points for the introduction of errors. Duplicate samples, standard samples, operator training, and routine operator testing are critical.
Coulometry [Pu]	A type of redox titration in which electric current is used as the titrant.	Known plutonium solution, NBL certified	0.34 [0.2]	Oxide, salts	Sample has several points for the introduction of errors. Duplicate samples, standard samples, operator training, and routine operator testing are critical.
Mass Spectrometry [Pu, U]	A small sample of the material is ionized and accelerated electrostatically through a magnetic field where it is separated by mass and detected.	Certified reference material of similar isotopic composition	0.02-0.8 [0.007-0.19]	Metals, salts	The material analyzed must be of high chemical purity to avoid mass (e.g., Pu-238 and U-238) and ionization interference. The starting solution must be of high purity, and suitable standards must be run through the system routinely.
Isotopic Dilution Mass Spectrometry (IDMS) [Pu, U]	A known amount of tracer isotope of Pu or U is added to a measured amount of sample and analyzed by mass spectrometry.	Known amount of trace isotope (Pu-242 or 244 for Pu and U-233 or 236 for U) NIST traceable sources	0.2-0.8 [0.09-0.6]	Metals, salts, solutions	The material analyzed must be of high chemical purity to avoid mass (e.g., Pu-238 and U-238) and ionization interference.

(a) NBL = New Brunswick Laboratory
NIST = National Institute of Standards and Technology
(b) The quoted errors are for a 95% confidence level. Most were taken from the May 1993 “Safeguards Measurement Technology Survey” conducted by the DOE Materials Control and Accountability Branch. Measurement errors will vary with the material, its purity, quantity, form, container, etc., and the numbers should be considered informational.

Table 4-1. (Continued)

INSTRUMENT/ TECHNIQUE [material]	BRIEF DESCRIPTION	STANDARD[a]	Measurement Error, %[b] Random [Systematic]	MATERIAL TYPES MEASURED	INSPECTION CONCERNS
X-ray Fluorescence [Pu, U]	The sample (after preparation) is irradiated by a source (usually X-rays) that stimulates the emission of characteristic X-rays of the element in proportion to the quantity present.	An internal standard is used such as yttrium (for Pu) or strontium (for U).	0.15-9 [1-1.5]	Solutions, salts, scrap	Running standards and splitting samples are important to ensure the quality of the data.
Gravimetry [U]	The uranium sample is chemically converted to U_3O_8 and weighed. The U_3O_8 is not affected by loss or gain of weight that can provide erroneous mass measurements.	The procedure is standardized with standard reference materials from NIST and control of the scales.	0.013-0.4 [0.025-0.03]	Metals, oxides, salts, organics	It is important that the method is calibrated with standard reference materials and that duplicates of typical samples are run routinely.
Davies-Gray Titration (Dichromate Titration) [U]	The U (VI) in solution is reduced to U (IV) and then the quantity is determined by titration with potassium dichromate.	The procedure is standardized with standard reference materials, and a standardized potassium dichromate solution is used.	0.003-0.4 [0.0015-0.4]	Uranium nitrate solutions or materials that can be dissolved to form aqueous solutions	The procedure should be under routine quality control by routinely running standardized materials throughout the process. The presence of some elements will interfere with the quality of results; impurities should be eliminated.

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Table 4-2. NDA Measurements

INSTRUMENT/ TECHNIQUE [material]	BRIEF DESCRIPTION	STANDARD[a]	Measurement Error, % [b] Random [Systematic]	MATERIAL TYPES MEASURED	INSPECTION CONCERNS
Scales/Balances [Pu, U]	The material is accurately weighed on a precision balance or scale.	NIST traceable weight standards	0.00016 (Uncertainty) 0.003-0.01 [0.0011-0.1]	Metals, oxides, compounds; packages or compounds containing SNM material (e.g., fuel elements or other containers that can be considered tamper-indicating.)	The instrument must be routinely checked with standards covering the useful range and not used outside the calibrated range. Instrument performance must be documented and tracked. If the material is in a container, the values must be corrected for the tare weight. Weights must be corrected for density, purity, and chemical form as appropriate. Many factors can affect measurement uncertainty, including instrument leveling, water loss/gain, and reactions (e.g., oxidation). For use as a verification tool, the correction should be small and have a small associated uncertainty.

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Table 4-2. (Continued)

INSTRUMENT/ TECHNIQUE [material]	BRIEF DESCRIPTION	STANDARD[a]	Measurement Error, %[b] Random [Systematic]	MATERIAL TYPES MEASURED	INSPECTION CONCERNS
High Resolution Gamma Spectrometer [Pu, U]	Precision spectrometers are used to measure the energy and intensity of the natural gamma rays emitted during the radioactive decay of the SNM. The spectrometers consist of a Ge detector, signal processing electronics (amplifiers), a multichannel analyzer, and a computer for data reduction. Such measurements are often part of a verification measurement (isotopic composition measurement to be used in conjunction with calorimetry for Pu mass determination). Can be used for verification in the instance of SNM material in a known, low-density matrix of fixed geometry.	NIST traceable photon standards for energy. For photon intensity measurements (to infer SNM mass), standards are fabricated to be similar to the item(s) measured and are independently verified (measured by independent techniques).	0.2-13 [0.3-2]	Containers of SNM materials in various forms: oxides, metals, wastes liquids	The instrument must be routinely checked for energy calibration using known sources. When used for intensity measurements, traceable standards of similar composition are needed. Instrument performance must be documented and tracked (a control chart of the measurements on the standards). If the material to be measured is in a container, the attenuation effects of the container must be considered. The detector must be properly shielded, and additional sources or samples stored to avoid interference.
Neutron Counters (signature, SNM monitors or SNAP detectors) [Pu, HEU]	Materials that spontaneously fission emit neutrons, which can be used as an indication of their presence and quantity.	Materials of known quantity and similar nature are used as standards.	2-10 [4-20]	Pu in various forms and matrices	The composition of the material is important because the presence of materials such as F, Li, Be, etc., will lead to (α,n) reactions that produce neutrons that cannot, in this case, be discriminated from the fission neutrons.

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Table 4-2. (Continued)

INSTRUMENT/ TECHNIQUE [material]	BRIEF DESCRIPTION	STANDARD[a]	Measurement Error, %[b] Random [Systematic]	MATERIAL TYPES MEASURED	INSPECTION CONCERNS
Photon Counters (SNM monitors) (gamma signature monitors) [Pu,U]	The photon counters use the same physical principle as the high resolution counters, but are usually self contained and may be designed for a specific purpose. Typical instruments are designed as portal monitors to detect SNM, or as photon detectors to identify specific energies associated with a material for identification. NaI is generally used as the detector and some units may be designed to also detect neutrons.	Typical SNM materials are generally used to calibrate the instrument. They are not traceable since only a typical spectrum is needed.	N/A	SNM materials in various forms and containers	The instruments should be tested on a routine basis, and in some cases the instrument can be tested with a non-SNM source to confirm energy calibration. In some cases, mixtures of SNM cannot be reliably evaluated and the operator should use other techniques, including looking at the raw spectrum or using a high resolution detector.
Enrichment Meters [U]	The counters use the same physical principles as the high resolution counters and may use either a low resolution detector or a high resolution detector. The unit operates by rationing the 186 keV photon of U-235 to the higher energy continuum or to one of the U-238 photons. The ratio of the intensities is proportional to the percentage of U-235 in the sample (enrichment).	The instrument is calibrated with a series of samples of different enrichments that have been verified by independent methods. Samples are developed internally or obtained from NBL.	0.2-2 [0.5-2]	Metals or oxides that may be in various containers	Corrections must be made for the wall thickness of the container, and the unit should be routinely calibrated and tested against standards with enrichments similar to the samples.

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Table 4-2. (Continued)

INSTRUMENT/ TECHNIQUE [material]	BRIEF DESCRIPTION	STANDARD[a]	Measurement Error, %[b] Random [Systematic]	MATERIAL TYPES MEASURED	INSPECTION CONCERNS
High Level Neutron Coincidence Counters [Pu]	Materials that spontaneously fission emit a few neutrons in coincidence that can be measured in a neutron coincidence counter as a measure of fissionable mass (SNM). Self-multiplication from induced fissions contributes to the fission (coincidence) neutrons and is usually corrected for during the analysis. This depends on mass and composition, but occurs in relatively small masses.	Standards having SNM mass and composition similar to the material to be assayed, covering the mass range of interest and verified by independent techniques are fabricated. Some standards are available from NBL. A Cf-252 source is used to verify stable operation.	0.5-2 [13-25]	Containers of Pu metal, oxide, carbides, fuel rods, assemblies, solutions, scrap, waste	The mass, isotopic composition, material homogeneity, size, shape, container, etc., must be similar to the standards to produce acceptable uncertainties. Data verifying the usefulness of the counter for the materials measured should be reviewed along with estimated uncertainties. Instrument performance must be documented and tracked (a control chart of the measurements on the standards). To use the counter results for verifications, the isotopic composition must be known (mass spectrometry, gamma spectrometry) since the spontaneous fission rate varies among the isotopes and is usually dominated by Pu-240 content.

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(b) The quoted errors are for a 95% confidence level. Most were taken from the May 1993 “Safeguards Measurement Technology Survey” conducted by the DOE Materials Control and Accountability Branch. Measurement errors will vary with the material, its purity, quantity, form, container, etc., and the numbers should be considered informational.

Table 4-2. (Continued)

INSTRUMENT/ TECHNIQUE [material]	BRIEF DESCRIPTION	STANDARD[a]	Measurement Error, %[b] Random [Systematic]	MATERIAL TYPES MEASURED	INSPECTION CONCERNS
Neutron Multiplicity Counter	Multiplicity counting is a passive NDA technique for plutonium analyses. It uses three measured parameters: singles, doubles, and triples data is obtained. These are used to determine: Pu-240-effective mass, self-multiplication, and (α,n) reaction rate. Multiplicity counters are designed to maximize neutron counting efficiency and minimize neutron die-away time. They also have much lower electronic deadtimes, and their detection efficiencies are less dependent on neutron energy.	Standards having SNM mass and composition similar to the material to be assayed, covering the mass range of interest and verified by independent techniques are fabricated. Some standards are available from NBL. A Cf-252 source is used to verify stable operation.	0.25-2 [7-25]	Containers of Pu metal, oxide, carbides, fuel rods, assemblies, solutions, scrap, waste	The mass, isotopic composition, material homogeneity, size, shape, container, etc., must be similar to the standards to produce acceptable uncertainties. Data verifying the usefulness of the counter for the materials measured should be reviewed, along with estimated uncertainties. Instrument performance must be documented and tracked (a control chart of the measurements on the standards). To use the counter results for verifications, the isotopic composition must be known (mass spectrometry, gamma spectrometry) since the spontaneous fission rate varies among the isotopes and is usually dominated by Pu-240 content.

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Table 4-2. (Continued)

INSTRUMENT/ TECHNIQUE [material]	BRIEF DESCRIPTION	STANDARD[a]	Measurement Error, %[b] Random [Systematic]	MATERIAL TYPES MEASURED	INSPECTION CONCERNS
Active Well Coincidence Counters, (AWCC) [U]	The AWCC irradiates the fissionable material, causing fissions that emit a few neutrons in coincidence that can be measured in a neutron coincidence counter as a measure of fissionable mass (SNM).	A series of U standards of similar composition and mass covering the range of the analysis must be fabricated. Such standards are available from NBL.	1-10 [2-20]	U metal, oxide, scrap in various containers	The mass, isotopic composition, material homogeneity, size, shape, container, etc., must be similar to the standards to produce acceptable uncertainties. Data verifying the usefulness of the counter for the materials measured should be reviewed, along with estimated uncertainties. Instrument performance must be documented and tracked (a control chart of the measurements on the standards).

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(b) The quoted errors are for a 95% confidence level. Most were taken from the May 1993 “Safeguards Measurement Technology Survey” conducted by the DOE Materials Control and Accountability Branch. Measurement errors will vary with the material, its purity, quantity, form, container, etc., and the numbers should be considered informational.

Table 4-2. (Continued)

INSTRUMENT/ TECHNIQUE [material]	BRIEF DESCRIPTION	STANDARD[(a)]	Measurement Error, %[(b)] Random [Systematic]	MATERIAL TYPES MEASURED	INSPECTION CONCERNS
Calorimetry [Pu]	Energy from the radioactive decay of isotopes is released in the form of heat that can be measured in a calorimeter. The heat released by Pu is enough to provide accurate measurements of a few grams of materials in the proper calorimeter.	A series of certified masses of plutonium with known heat output are required and should be in containers similar to those used during the measurements. The heat output is generally certified by specialists at Los Alamos National Laboratory and provides traceability to national standards.	0.3-0.8 [0.2-0.6] for isotopics by gamma 0.3-0.4 [0.15] for isotopics by mass spec	Plutonium in all forms with known isotopic composition and enough mass to provide an acceptable uncertainty	The calibrated range of the calorimeters should be verified and routine standardization and control charts reviewed. Samples should fall into this range. If end point projection is used instead of allowing the calorimeter to come to equilibrium, the basis for the projection and test results should be reviewed.

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Table 4-2. (Continued)

INSTRUMENT/ TECHNIQUE [material]	BRIEF DESCRIPTION	STANDARD[(a)]	Measurement Error, %[(b)] Random [Systematic]	MATERIAL TYPES MEASURED	INSPECTION CONCERNS
Cf Shuffler [U, Pu]	A Cf-252 source is repeatedly shuffled in and out of the measurement cavity where the sample is placed. The neutrons from the source induce fissions in the fissionable nuclear material in the sample, and some of the fission products decay soon after production yielding neutrons. When the source is in the storage position, these delayed neutrons are measured, providing a measure of the fissionable material.	Standards produced with independently verified quantities of SNM in configurations simulating the types of items to be measured are produced.	0.2-4 [0.6-10] [4-50] for scrap and wastes	Metals, ingots, scrap, oxides, etc. in containers up to 55-gallon drums The ability to handle large samples is an advantage of the shuffler.	The shuffler is sensitive to the matrix (neutron penetration) and material position, and the standards used in the calibration need to closely resemble the samples and be in the same type of containers.

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Table 4-2. (Continued)

INSTRUMENT/ TECHNIQUE [material]	BRIEF DESCRIPTION	STANDARD[(a)]	Measurement Error, %[(b)] Random [Systematic]	MATERIAL TYPES MEASURED	INSPECTION CONCERNS
Segmented Gamma Scanner [U, Pu]	In the segmented gamma scanner, the photons from the decay of the SNM are measured with a collimated high resolution detector. The sample is rotated and translated in front of the detector to permit measurements from progressive segments of the sample. A source with photon energies close to those of the measured photons (transmission source) is also used to measure the attenuation in each segment and to correct for loss of photons from the SNM due to attenuation.	Standards should consist of independently verified materials placed in containers and matrices similar to the items to be measured.	2-9 [0.5-20]	Metals, ingots, scrap, waste (usually in metal cans)	The transmission source (usually Yb-125) has a short half-life and must be replaced periodically. The standards must be similar to the measured matrix, and the unit must be under periodic quality control with routine counting of standards (or control samples) and tracking of results on a control chart.

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Table 4-2. (Continued)

INSTRUMENT/ TECHNIQUE [material]	BRIEF DESCRIPTION	STANDARD[(a)]	Measurement Error, %[(b)] Random [Systematic]	MATERIAL TYPES MEASURED	INSPECTION CONCERNS
Barrel Scanner [Pu, U]	The barrel scanner is a specialized segmented gamma scanner designed to handle large samples (barrels).	Standards should consist of independently verified materials placed in containers and matrices similar to the items to be measured. Generally, the standard consists of a specially designed barrel filled with material simulating the matrix and with positions for the insertion of known sources.	2.5 [1-30]	Generally wastes in a low-density matrix	The transmission source (usually Yb-125) has a short half-life and must be replaced periodically. The standards must be similar to the measured matrix, and the unit must be under periodic quality control with routine counting of standards (or control samples) and tracking of results on a control chart. For Pu measurements Se-75 and Co-57 are used for the transmission measurement. Several positions must be tested to estimate the uncertainty for a range of situations.

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Table 4-2. (Continued)

INSTRUMENT/ TECHNIQUE [material]	BRIEF DESCRIPTION	STANDARD[a]	Measurement Error, %[b] Random [Systematic]	MATERIAL TYPES MEASURED	INSPECTION CONCERNS
Nuclear Materials Identification System (NMIS) [U,Pu]	NMIS measures the time sequence of decay neutrons and photons from a sample and may use a decay time measured source to cause the emission of fission neutrons and photons. By looking at the time-correlated signals, the system can accurately discriminate among several nuclear materials types.	NMIS requires calibration usi ng a known material sample similar to the material of interest. Many materials of interest have already been measured.	N/A	Weapons components, metal, waste, hold-up in ducts, etc., in matrices permitting measurement of the signature radiation	This is a specialized system and must be operated by an experienced individual or someone trained by one of the users/developers of the system.
Hold-up Measurement System [U,Pu]	This is a specialized gamma photon measuring system designed to measure photons emitted by SNM materials "held up" in ducts and pipes in the process system. The system consists of a detector (NaI, CdZnTe, Ge), a multi-channel analyzer, and a computer and software to analyze the data.	The system must be calibrated for the geometry and material. Software for typical geometries is available.	10-100% accuracy	Material in process piping, air ducts, etc.	The operator must properly evaluate and select the geometries and should be using the latest version of available software. Interference can occur from materials in nearby structures when the collimator or shielding is not properly set up.

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Table 4-2. (Continued)

INSTRUMENT/ TECHNIQUE [material]	BRIEF DESCRIPTION	STANDARD[a]	Measurement Error, %[b] Random [Systematic]	MATERIAL TYPES MEASURED	INSPECTION CONCERNS
Solution Assay System for Uranium [U]	The system measures the intensity of the 186 keV gamma from U-235 in a liquid and makes a correction for attenuation using a transmission source (Yb-169). Systems performing measurements on high concentration solutions use gamma absorption (K-edge densitometry) in which the transmission of a photon near the K-edge of the material is measured and compared to transmission below the K-edge.	The system is calibrated using a series of solutions of independently known concentration in sample containers similar to the measurement containers	0.2-1.0 [0.4-2.0]	Process solutions contained in a standard-geometry container	Sample uniformity is important since the system only measures the concentration in a small volume of the sample. Precipitation of solids in samples can also be a problem.
Solution Assay System for Plutonium [Pu]	Measurements on solutions use gamma absorption (K-edge densitometry) in which the transmission of a photon near the K-edge of the material is measured and compared to transmission below the K-edge. Sources of Se-75 or Co-57 are used.	The system is calibrated using a series of solutions of independently known concentration in sample containers similar to the measurement containers.	1.0 [0.4-2]	Process solutions contained in a standard-geometry container	Sample uniformity is important since the system only measures the concentration in a small volume of the sample. Precipitation of solids in samples can also be a problem.

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Section 5

INVENTORY

Contents

References

ANSI Standard 15.3, Physical Inventories of Nuclear Material

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General Information

The purpose of the physical inventory is to determine the quantity of nuclear materials on hand at the time of the inventory, to compare the nuclear materials on hand to the book inventory, and to investigate and resolve differences between the physical inventory and the book inventory. Determining the physical inventory involves observations and measurements of materials present at the time of inventory. The book inventory lists all materials from the previous physical inventory and is adjusted for materials that were shipped and received from the MBA. The book inventory or accounting records indicate what materials should be on hand at the time of the physical inventory. Some of the materials will be present as discrete items that can easily be traced to individual entries in the records. Other materials may be present as bulk quantities that result from entries in the accounting records based on processing activities.

Since all materials must be measured, the book inventory is a combination of many measurements. Each measurement has an associated uncertainty, and thus, there is an inherent uncertainty in the inventory. It follows that a non-zero inventory difference can be attributed to measurement errors alone. This inventory difference or ID is represented mathematically by the equation:

ID = Book Inventory - Physical Inventory

or

ID = BI + A – R – EI,

where:

ID = Inventory Difference

BI = Beginning Inventory (previous period physical inventory),

A = Additions to the MBA during the period,

R = Removals from the MBA during the period,

EI = Ending Inventory (current period physical inventory).

The BI, A, and R terms represent the book inventory. The final term, EI, is the physical inventory. To verify that no material has been lost from the facility, the ID must be an acceptably small value. While it is desirable to set the ID limit based on some goal quantity of SNM, if it is set too low, the ID will frequently exceed the limit based on measurement uncertainty alone. Thus, it is important to establish not only the allowable ID but also the limit of error associated with this difference, typically its 2σ value (σ represents the uncertainty or standard deviation of the ID). This value is obtained by statistically propagating the measurement errors associated with all the terms in the ID equation. The ability of the system to detect differences between the book and physical inventories is a measure of loss detection capability. Ideally, during a physical inventory, all materials, in item and bulk forms, are located and quantitatively measured to assure their presence and quantity, and all areas are inspected to assure that there are no materials present that are not reflected in the records. However, it may be impractical to locate and perform verification measurements for every item at facilities with large numbers of items or with items that require significant effort to retrieve due to storage configurations. In such cases, the DOE allows the use of statistical sampling methodologies. Further, the DOE also allows the use of confirmation measurements instead of verification measurements when items have been affixed with tamper-indicating devices.

For most facilities the amount of nuclear material is determined by either verification measurements to validate the stated value or by confirmation measurement of a material attribute when the item is tamper indicating and has been under a material surveillance program. Separate samples are used for the inventory taking, verification measurements, and confirmation measurements. If items are protected by tamper-indicating devices and were present in both the BI listing and the EI listing, the quantity of SNM present in these items cancels out of the ID calculation. When estimating the limit of error for the ID, it is important that the facility not include the measurement uncertainty associated with these items. For such items, the facility procedures may specify that the TIDs be inspected on a statistically determined sample of these items.

In principle, the physical inventory of bulk materials should be straightforward. For most processing operations, the materials are removed from the process line and measured, or the material is moved to a location where the amount of nuclear material can be determined. Solid materials are weighed and sampled; liquid solutions are placed into an accountability tank where the weight or volume is determined, and a sample is taken. The samples are analyzed for nuclear material content, isotopic composition, and the quantity of material present in the tank to be calculated.

There are some cases where the physical inventory of bulk materials is not simple. For some processes, suspending operations and consolidating materials for a physical inventory is not practical. Some facilities have obtained approval from DOE to use special inventory approaches as an alternative to a shutdown, clean-out physical inventory. They may be called "dynamic inventory" or "perpetual inventory" and could be conducted for all required physical inventories, if approved by the local DOE office.

Most likely, such alternative physical inventories will be conducted between annual shutdown, clean-out inventories. During these inventories, sample items from the book inventory are located and measured, and the amount of material in the process is estimated and compared to the amount expected to be in the process from throughput calculations. The processing never stops, except for a "hold" on material movements while the sampling occurs.

The frequency of physical inventories is graded according to the quantity and attractiveness of the nuclear materials on hand in the MBA. The conduct of a physical inventory is governed by documented plans and procedures defining responsibilities for performing the inventory and specifying criteria for conducting, verifying, and reconciling inventories of nuclear material. The following steps should be taken when conducting a physical inventory:

- The presence of items is verified.
- Inventories are based on measured values.
- Holdup inventory is measured or estimated on the basis of throughput, process data, modeling, engineering estimates, or other technically defensible factors.
- Materials identified as not amenable to measurement are based on values made at other sites or technically defensible values.
- Materials undergoing processing and recovery operations and that are not accessible for measurements by sampling are accounted for by use of process data, vessel level and density measurements, and calculated concentration values.
- Statistical sampling, if used for the inventory, is consistent with the graded safeguards concept. Parameters for the statistical sampling plans and inventory stratifications should be consistent with the parameters contained in DOE manuals. Confirmatory measurements are made on SNM items that are tamper-indicating.
- Verification measurements are made on SNM items that are not tamper-indicating.
- Dual confirmation measurements are made for items not tamper-indicating and not amenable to verification measurement.

Additionally, for Category IA items, the location and presence of these items must be confirmed on a routine basis. Inventory checks for Category IA items not in storage are conducted weekly for physical count verification and monthly for serial number identification. Inventory checks for Category IA items in storage require a physical count whenever the storage area is accessed; serial number verification is performed on a monthly basis.

Special inventories are required to confirm the status and location of nuclear materials, and to detect the loss or diversion of nuclear material when:

- Critical assemblies are disassembled.
- Custodial responsibilities are changed.
- Items are identified as missing.
- Inventory differences exceed established limits.
- Occurrences are considered abnormal.
- A special inventory is requested by authorized facility personnel or the field element. The magnitude of the ID determines both the loss detection capability of the accountability system and the degree of assurance that material is in authorized locations. The loss detection capability depends upon the uncertainty associated with determining the ID. Propagation of the variance is the recommended method for estimating the uncertainty of the ID. Other statistically valid techniques are allowed, but must be justified on the basis of factors, such as limited data, low transfer rates, categories, and major process variations. The field

element must approve the methodology selected by the facility.

When inspecting the nuclear material inventory program, the inspector must conduct both a compliance review and a performance review. Information gathered during the planning phase and obtained during the inspection activities provide the basis by which an inspector determines whether the program meets DOE requirements and performs at a level sufficient to ensure that the inventory objectives are met. Figure 5-1 provides a guideline for conducting these reviews.

Common Deficiencies/Potential Concerns

Certain common deficiencies have been observed in past inspections. The inspector should be familiar with these and consider them potential concerns when beginning any inspection. The information gathered during the planning phase of the inspection should provide the inspector with an indication as to whether any of the concerns described below warrant specific investigation.

Unmeasured Inventory

Some facilities have nuclear material that has not been measured. Therefore, they do not have accountability values for inventories and transactions. This deficiency can result from lack of qualified measurement methods, lack of management attention, inadequate planning, receipt of materials for which measurements are not available or which must be processed before an accountability value is established, inventory cutoff procedures that do not provide for the completion of processing for nuclear material, or waste streams that are not identified as removals from inventory. A more subtle reason for unmeasured material can occur during facility restart when unit operations of a process are started in a sequence that permits production without scrap recovery unit operations. As problems develop, scrap unit operations are delayed, scrap as unmeasured material continues to accumulate and remains at the time of the physical inventory.

The lack of accountability values for nuclear material on inventory results in inventory differences exceeding control limits, loss of control of nuclear material, and limited assurance that nuclear material is not diverted or stolen. Typically, inspectors can detect unmeasured inventory during the review of accounting records, shipper/receiver agreements, propagation of variance calculations for inventory differences, review of the measurement control program, and by interviewing nuclear material custodians and handlers.

Materials Not Amenable to Measurement Not Identified in MC&A Plan

Facilities may not have identified, misidentified, or inappropriately identified nuclear materials as "not amenable to measurement." Factors that contribute to DOE facilities having material listed as not amenable to measurement are:

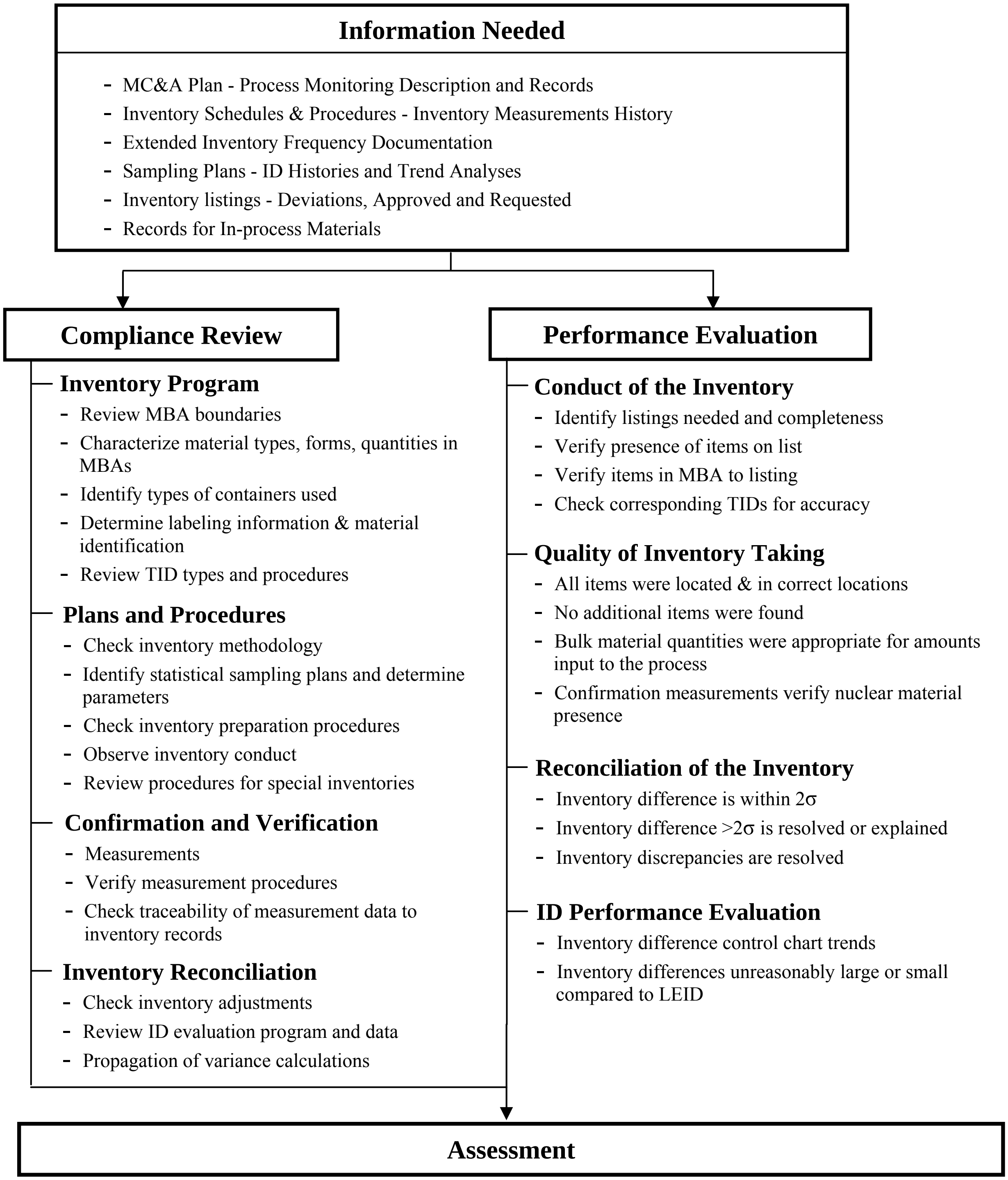

Figure 5-1. Inspecting the Nuclear Material Inventory Program

- The failure to allocate resources for developing and procuring measurement equipment and standards
- The creation of "one-of-a-kind" items, which may be very large or may remain in inventory after having been created for a specific experiment or test
- The generation of large amounts of unique scrap and waste
- The changing mission for DOE facilities, which eliminates the ability to complete processing of nuclear materials
- Efforts to repackage and consolidate the nuclear material inventory.

Inappropriate use of the category, not amenable to measurements, results in limited assurance that nuclear material is accounted for and has not been diverted or stolen. Excessive misuse is identified during the review of the MC&A Plan, deviations from DOE orders, and measurement systems.

Inventory Schedules Deficient Due to Programmatic Redirection

At some DOE facilities, schedules for physical inventories have been inordinately delayed or postponed for several reasons including: production/stabilization schedules were considered more important than conducting a physical inventory, award fee milestones were given a greater priority than an inventory, or a safety-related shutdown prohibited required inventory actions from occurring. Failure to conduct an inventory within an approved schedule delays the calculation of the ID and inhibits the ability of a facility to assure that material has not been lost, stolen or diverted. This situation can be detected by reviewing the inventory reconciliation records, examining inventory schedules, and reviewing requests for deviations.

Inappropriate Warning and Alarm Limits

A concern identified during some inspections is that facilities do not base control limits for IDs on variance propagation, or they do not use current data in the propagation of variances. Facilities often use the variation of historical ID data to determine and set inventory difference control limits. This is a concern because the practice could generate inflated control limits that are not indicative of the detection capabilities of the MC&A system. Inappropriate limits can be caused by a lack of management attention, inadequately trained staff, efforts to minimize cost, or the inability to meet control limits based on variance propagation. Using control limits that are not based on propagation of measurement uncertainty results in control limits for the ID that do not assure the detection of theft or diversion of nuclear material. Limits that are too large hamper the MC&A system in detecting losses. Limits that are too small generate false alarms. The use of inappropriate control limits can be detected by an analysis of control limit calculations, review of ID trend analyses, review of ID control charts, review of the measurement control program, and interviews with facility management or with facility statisticians.

Deficient Verification Measurement Program

A common problem at DOE facilities is that the facility does not verify the nuclear material content of containers or items for inventory items that are not tamper-indicating. Verification practices may not include the evaluation of measurement results against acceptance and rejection criteria based on valid technical and statistical principles. This problem is commonly caused by a lack of management attention, inadequately trained staff, inadequate inventory procedures, failure of material surveillance programs, or failure of TID program. The problem limits assurance that nuclear material is not diverted or stolen and makes the ID calculation questionable. Inspectors may detect the deficiency by observation of the inventory, review of inventory procedures, or review of the statistical evaluation program. Inspectors should determine whether these deficiencies were identified by the facility's internal review and assessment program or during a DOE field element survey.

Holdup Not Included in Inventory

Some facilities do not account for the variation in equipment holdup. Most processing systems in the DOE complex contain residual equipment holdup. For some processes, the holdup is a significant portion of the throughput. For physical inventories, it is important that facilities account for the nuclear material that remains in the equipment. For operating facilities, residual holdup should be included in both the beginning and ending inventory components of the ID equation. The quantity is not necessarily identical at these two points in time; the variation in the quantity contributes to the ID. Decreases in the quantity of residual holdup between beginning inventory and ending inventory may mask the diversion or theft of nuclear material, while increases may initiate an unwarranted investigation. Failure to account for the variation in process holdup can be detected by reviewing the reconciliation of physical inventory, evaluating the procedures for the holdup calculation, evaluating ID experience, investigating IDs that exceed control limits, reviewing inventory records, evaluating clean-up procedures, or interviewing operations personnel responsible for inventory preparation.

Alternate Physical Inventory Frequency Not Approved or Not Appropriate

An alternate inventory frequency is permitted with an approved deviation, if certain enhanced safeguards features are met. Deficiencies could exist if the facility does not have the appropriate documented approvals or if the criteria supporting the deviation are not met. This could include safeguards protection features that have a common mode failure or a duty cycle for the detection system that differs from the approved duty cycle times. Failure to meet the criteria could result in a degradation of safeguards since the physical inventory was not being conducted at the appropriate frequency. Indications of this deficiency typically surface during a review of deviation request documents or field inspection of the enhanced safeguards features.

Data Collection Activities

Information Needed

A. Inspectors should obtain information about the inventory program by interviewing facility staff, reviewing documentation, and observing the implementation of procedures in the conduct of inventory activities. This aspect of the inspection process provides inspectors with the opportunity to evaluate practices and validate the assurance provided by the facility's physical inventory.

B. During inspection planning activities, inspectors should interview points of contact and review available documentation. The focus of the planning meeting is to identify MBA inventory frequencies, inventory plans, and procedures. These documents and information provide the basis for testing the inventory element during the inspection. Planning assures that the information needed to evaluate the physical inventory capability is available and can be validated during data collection activities. If there is flexibility in the timing of the inspection, it is advantageous to overlap a portion of the inspection with the time during which the facility is performing the physical inventory and reconciling the resulting ID.

Personnel to interview (or arrange to interview during the data gathering phase) include:

- MC&A Manager: provides overall guidance for the facility inventory program. This person will probably be the first contact for the inspector and will provide the inspector with the inventory program overview and points-of-contact for specific discussions about the inventory process and characteristics of the MBAs.

- Nuclear Materials Representative: provides information on the structure of the accounting system, the data base of items, and possibly the inventory process. This person may be the inventory team leader and may also be the MC&A manager.

- MBA custodians (also known as MBA representatives): may be assigned to the MC&A organization or be part of the operating organization. They will have specific knowledge about the inventory procedures for their MBA(s) and will generally be responsible for preparing the MBA for the inventory and reconciliation of the ID. They should know all of the nuclear materials that are typically present in their MBA(s) and generally where they are located.

- Statistician: provides information about the inventory populations, sampling methodology, LEID calculations, and assumptions in the calculations.

- Accounting clerks: generally are not aware of specific locations of nuclear material, but provide information on the types of material transferred into and out of the MBAs and adjustments to the book inventory. Together, accounting clerks and MBA custodians reconcile the physical inventories to the book inventory.

- Operations Manager: might be in charge of MBA custodians and controls the inventory operations through nuclear material handlers. This person is responsible for assuring that the facility equipment and processes are ready for the physical inventory. The view of physical inventories by the operations manager may be different than that of the MC&A group, so interviewing this person and material handlers will provide useful information about the inventory process.

Since inspection team members responsible for other topic areas also interview many of these individuals, close coordination with other team members will minimize the impact of the inspection on facility operations.

Documentation to review includes:

- MC&A Plan: describes the MBAs, inventory program, verification and confirmation inventory measurements, inventory reconciliation and LEID methodology.

- NMMSS records: report all IDs and LEIDs; ensure that the facility is properly reporting data in a timely manner.

- Inventory difference history: validates the effectiveness of the inventory program.

- Statistical sampling plans: define the parameters for conducting a physical inventory and describe how samples are selected.

- Inventory lists: provide the basis for determining the physical inventory.

- Measurement control procedures: ensure that existing measurement data for items is valid.

- Reconciliation of physical inventories: validates timely closure of the physical inventory, calculation of the ID and LEID, and resolution of any anomalies.

- Inventory difference trend analysis: identifies potential protracted diversions or potential long-term facility operational issues (e.g., unmeasured waste stream).

- Cutoff procedures for physical inventories: ensure that no material movement occurs during the inventory or that if any material does move (e.g., samples to the analytical inventory), it will be part of the physical inventory.

- Records for in-process materials listed on inventory: validate holdup quantities or changes to holdup quantities used for accountability during an inventory.

- Inventory schedule: ensures that facility has a comprehensive program for conducting the inventory and has conducted and reconciled them.

- Supporting documentation for alternative inventory frequencies: describes rationale for the extended frequency and enhanced detection mechanisms in place.

- List of materials not amenable to measurement: identifies items that are not amenable to verification measurements but are subject to two independent confirmatory measurements.

- Approval by the field element manager for applicable items identified in Table 2, Section 2 for key compliance issues associated with the inventory.

C. Inspectors should coordinate inspection activities with personnel responsible for measurement and measurement control programs and accounting.

Compliance Review

D. Inspectors should focus on four basic topics to complete a compliance review of the nuclear material inventory program: (1) MBA and nuclear material characteristics; (2) plans and procedures; (3) confirmation and verification measurements; and (4) inventory reconciliation. Inspectors should determine whether the facility meets the DOE requirements for an inventory program.

MBA and Nuclear Material Characteristics

E. The characteristics of the nuclear material at the facility have a great influence in the categorization of areas and facilities at a site. Hence, inspectors must be assured that all of the materials are accurately represented in the accounting records.

- The inspector of the inventory program must interface with the inspector of the MC&A Administration topic to provide the necessary information about the inventories so that an evaluation of categorization and graded safeguards can be made.

- Inspectors should understand the various material types, forms, quantities, and containers that are typical for each MBA. This includes any holdup expected or anticipated, and the locations where it could occur.

- Inspectors must understand the boundaries for each MBA so that an evaluation can be made of the material protection appropriateness. The boundaries will provide an indication of areas where commingling of materials from different MBAs could occur.

F. The facility MC&A Plan should specify all materials that are deemed “not amenable to measurement.” As a result:

- Inspectors should verify that materials on inventory without approved measurement codes are on this list. The list of materials should be reasonable with such explanations as high radiation levels, large critical assemblies, storage configurations that do not permit easy access, and weapon assemblies that cannot be separated or measured.

- Inspectors should review the inventory program for these materials to ensure that they are included in the inventory process. Their presence must be checked and, in lieu of verification measurements, two confirmatory measurements must be made on different material attributes.

- Inspectors should evaluate material surveillance practices if the inventory values are based on measured values from other sites, and/or evaluate the validity of technical estimates, including estimates of uncertainty.

- Inspectors should determine whether the controls in place are appropriate for these materials and are effective in assuring that the inventory values have not changed without book inventory adjustments.

- If these items or similar materials have been through a recovery process, inspectors should review past recovery data for materials that were listed on previous inventories. It should be apparent that the values assigned to these materials are appropriate from the history of recovered data. The facility MC&A group should have this information available for the inspector's review.

- Inspectors should evaluate the potential impact of these materials on the ID and the limits of error associated with the ID.

- Inspectors should evaluate the facility's processing areas and interview operations personnel to determine locations for process holdup. Particular attention should be paid to this area if the estimated quantity of SNM associated with holdup is of the same order of magnitude as the ID.

- When locations are determined, inspectors should confirm that the holdup is included in the inventory. The basis for the quantities of holdup should be evaluated. If the holdup is measured, the quantification of its uncertainty and its contribution to the uncertainty of the ID should be validated. If the holdup is based on throughput, process data, modeling, engineering estimates, or other technical basis, the justification and supporting documentation for the values should be evaluated.

- The uncertainty for these quantification techniques should also be evaluated. Inspectors should determine that all potential holdup materials and their locations are addressed in the inventory program and that measurements are made where feasible. There may be cases where holdup cannot be measured, but the inventory program should specify how the holdup values are established and the approach should be reasonable with supporting data.

Plans and Procedures

G. Inspectors should review the procedures for conducting physical inventory. Since all material must be processed to a measurable form, the review should address responsibilities, notification, cutoff procedures, training, documentation, and reconciliation.

H. For material undergoing processing at the time of inventory, inspectors should review the techniques used to minimize the quantity of material in poorly measured forms and the controls in place to prevent unauthorized material movements during the inventory. Cutoff procedures are a special concern. At the time of most physical inventories, the facility specifies a cutoff time after which there are no movements of material until the inventory activities have been completed. However, there are instances where facilities do not close all the MBAs simultaneously. For example, there is some advantage to operating the scrap recovery operation for a period of time after all the other MBAs have terminated operations so that more of the inventory can be converted to a form that can be more accurately measured. There are also instances where it is very costly to shut down a processing operation. In such instances, any movements of material at the time of inventory are strictly controlled by the MC&A organization. For these special cases, inspectors should review the controls to ensure that all material movements are included. This can be accomplished by reviewing dates and times of transactions after the cutoff and checking the documentation of transfer notification at the MC&A organization.

I. Additionally, materials selected for inventory in the process area should have controls in place to ensure that they are not processed further until the inventory activities for these materials are complete. This may mean that items are placed "on hold" until appropriate measurements are made. If the material can not be tallied at the time of inventory, then the material should be monitored until it reaches a measurable form and then compared to its book values. Inspectors should determine the impact on the ID by evaluating the measurement results for the material when it has been processed to a measurable form. Inspectors should be aware of and account for any side streams (e.g., solid or liquid waste) resulting from the processing activities. The contribution of these materials to the uncertainty of the ID should be evaluated.

J. Inspectors should review facility documentation to determine whether the facility performs special inventories when critical assemblies are disassembled, custodial responsibilities are changed, missing items are detected, IDs exceed control limits, occurrences are abnormal, or when requested by authorized facility personnel or the cognizant DOE operation office. The results of IAEA inventories or special inventories should be evaluated, and if corrective actions are indicated, their implementation should be confirmed.

K. An inventory sampling plan is a record of how statistics are applied to inventory verification at the site. Inspectors should be aware of the statistical, practical, and programmatic considerations that went into developing the plan. Statistical sampling plans for verifying the presence of items should be reviewed to confirm their validity. Inspectors should determine whether the plans, when implemented, confirm that assumptions are valid, that the implementation is in accordance with the plan, and that the correct statistical inference is made.

L. The inventory population(s) must be described, along with the procedures for selecting samples. As mentioned earlier, items containing materials not amenable to measurement should be isolated and handled separately. Inspectors should identify (for each inventory population) the minimum number of defects to be detected, the probability of detecting the minimum number of defects, and the definition of a defect. These should be found or referenced in the MC&A Plan.

M. For all materials, the confidence level for finding a minimum detectable defect must be 95 percent. The minimum detectable defects for Category I materials is 3 percent; for Category II it is 5 percent; and for Category III and IV it is 10 percent. The site should include the responses to inventory anomalies and any follow-up activities. Inspectors should verify that inventory population is stratified according to item category and that separate samples are selected for the physical inventory, verification measurements, and confirmation measurements.

N. Inspectors must be able to draw conclusions from the inventory sampling data about the state of the entire population. If the sample indicates less than the specified number of defects, then the population is deemed acceptable. However, inspectors should consider what the facility has defined as defects. Typically, there are six attributes examined for each inventory item: (1) item identification; (2) item location; (3) item integrity; (4) quantity of nuclear material; (5) TID number; and, (6) label information (e.g., net weight, SNM quantity on label). The defects considered most important are: locating the correct item and verifying the quantity or attribute of the material. While the other defects must be investigated, the principal defects for inventory verification are an item that cannot be located and a quantity recorded in the book inventory that cannot be verified by performing measurements.

The response taken by the facility to address these defects is important in the inspector's assessment of the inventory sampling program. However, other attribute defects may be significant because defects indicate potential weaknesses in the MC&A program. These defects should be analyzed together with the results of vulnerability assessments, internal reviews and assessments, performance tests, and other assessments and follow-up activities as an indicator of system performance.

O. Inspectors should confirm the category determination of each MBA and review documentation to confirm that inventory frequencies are met. For Category II, III, and IV MBAs, inspectors should review the shipments and receipts to ensure that the category of the MBA has not increased during the inventory period. Other areas to be addressed include:

- Inventory checks for Category IA items: Inspectors should review documentation of daily, weekly, and monthly checks.

- Simultaneous inventories: For facilities with multiple MBAs with varied inventory frequencies, inspectors should review inventory documentation to confirm that, at least once annually, the facility performs a complete simultaneous inventory.

- Alternative control mechanisms: If they are the basis for decreased inventory frequency, the inspector should performance test the alternative control mechanisms to confirm their detection capability.

If the frequency of inventory deviates from that required by DOE orders, the basis of the deviation and required approval should be evaluated and confirmed.

Confirmation and Verification Measurements

P. Inspectors should confirm that the facility has established and implemented a system for performing inventory verification measurements on SNM items that are not tamper-indicating and confirmatory measurements on SNM items that are tamper-indicating. If the facility employs statistical sampling plans for measuring inventory, inspectors should review the inventory stratifications to assure that the total inventory is addressed. Assumptions made in determining sample size and sampling parameters should be discussed with the appropriate statistician to validate the application of the sampling plan.

Q. Inspectors should confirm that the DOE field element has approved the sampling plans. There should be separate sampling plans for the physical inventory taking, verification measurements, and confirmation measurements.

Inventory Reconciliation

R. Inspectors should review the accountability records for inventory adjustments. The facility's program for evaluating the adjustments should be checked for mathematical accuracy. Procedures should be reviewed for completeness to ensure that they address tests of trends, biases, and correlations.

S. Inspectors should evaluate the calculations for determining radioactive decay and fission/transmutation. If holdup adjustments are employed, their basis should be confirmed by a review of documentation. The audit trail of all adjustments should be reviewed to:

- Confirm completeness

- Assure that only authorized individuals are originators

- Confirm the basis of the adjustment, including a thorough technical review, when appropriate.

Documentation should be reviewed to confirm that reports addressing reviews of adjustments are transmitted to the DOE field element.

T. Inspectors should evaluate the facility's ID program. This activity should be coordinated with inspectors for the accounting subtopic. Procedures for establishing control limits are of special concern. The basis of control limits should be reviewed to determine whether it is current. If control limits are not based on variance propagation, the basis for the methodology should be evaluated to determine whether it is justified and approved by the DOE field element. The assumptions used to set warning and alarm limits should be reviewed to determine whether they are appropriate. The reporting of IDs exceeding limits should be confirmed by documentation. Procedures for responding to missing items and investigating IDs exceeding control limits should be reviewed. Resolution of these alarms and corrective actions resulting from investigations should be confirmed. Corrective actions should be performance tested.

U. Inspectors should review the assessment of IDs by evaluating the accuracy of methodology employed to test for trends and biases. The evaluation should address total and actual IDs on both an individual and a cumulative basis for all non-storage MBAs.

Performance Review

V. A facility in compliance with DOE orders and manuals for inventory has all of the basics to ensure that the inventory of nuclear materials is correct as indicated by the book inventory and that anomalies could be detected. However, the facility must also have adequate procedures and they must be followed. Having procedures does not, by itself, ensure a quality program. Inspectors must be able to determine whether procedures provide an effective means to ensure that the objectives of the physical inventory are being met. Also, inspectors must evaluate the degree to which the procedures are being followed under routine conditions and emergency situations; thus, they must conduct performance tests.

Correctness of Inventory Records

Performance tests for the correctness of inventory records (quantity, location, description, etc.) are described in Section 3, Accounting. These primarily include front and back checks of items on the inventory listing.

W. Quality of Inventory Taking. Performance tests for inventory evaluate the ability of the facility to assure that nuclear material is accounted for and is in authorized locations. As an example, witnessing the conduct of an inventory is a common performance test. If a regular inventory is not scheduled during the time of the inspection, a special inventory may be requested to allow inspectors the opportunity to witness the actions of personnel and to evaluate the inventory conduct. Special inventory performance tests could include an emergency inventory, requesting the facility to generate a statistical sample of items similar to routine inventories and then conducting the inventory, or generating a complete physical inventory listing for a specific facility location and evaluating the facility's inventory performance.

X. Inventory Reconciliation. Inspectors should evaluate the physical inventory reconciliation program. An anomaly could be introduced into the conduct of the physical inventory and the facility's response evaluated. An item could be intentionally overlooked by facility trusted agents. The test could determine whether the reconciliation process correctly identified it as missing. The failure of a confirmation or verification measurement could also be simulated to evaluate the facility response. All adjustments based on the physical inventory should be evaluated by reviewing the audit trail.

Y. ID Performance Evaluation. If the IDs for several accounting periods are available, they may be plotted on a control chart. Some facilities use these charts routinely. The chart would have the successive values of the ID plotted with the 2σ and 3σ limits for the ID. If standard deviation of the actual ID values is very small relative to the limits, then there is an indication that the limits are being overestimated and as a result the ID is not being used as a valid loss indicator. Similarly, if the standard deviation of the ID is large but the limits are not exceeded as frequently as would be anticipated, then the facility might be making unjustified adjustments in the ID or in the calculation of the limit of error for the ID. A similar control chart can also be constructed for the cumulative ID. The cumulative ID control chart can also be used to identify biases in the receipt, product, or waste stream estimates.

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Section 6

CONTAINMENT AND SURVEILLANCE

Contents

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General Information

The purpose of the containment and surveillance program is to ensure that nuclear material is not removed from an authorized location without approval or timely detection. The program is intended to provide graded protection for all nuclear material consistent with the graded safeguards concept. Containment measures typically consist of several layers of protection that may include MAAs, PAs, MBAs, storage repositories, and processing areas. At each of these areas, the following measures are generally implemented:

- Controls to prevent unauthorized personnel from gaining access to nuclear materials, security areas, data, and equipment or devices vital to the MC&A program

- Procedures or equipment to provide surveillance of all categories of nuclear materials whether in use, storage, or transit

- Documented controls for nuclear material operations relative to MBAs, MAAs, PAs, storage repositories, and processing areas

- TIDs to detect unauthorized container openings

- Procedures to examine container integrity

- Portal monitoring to detect unauthorized removal of SNM through routine exits

- Monitoring to detect unauthorized removal of SNM through waste streams

- Daily administrative checks (DACs) in Category I MBAs to ensure that there are no obvious abnormalities or missing items and no apparent evidence of tampering.

Some of these containment measures pertain to physical security systems as well as MC&A. The inspection responsibility may be delegated to either topic team, or both. As a general rule, the physical security systems topic team examines hardware such as SNM and metal detectors, and interacts with the MC&A topic team as necessary. The activities of these two teams are coordinated to avoid missing important elements or duplicating effort. Coordination is routinely accomplished by the topic leads.

Experience has shown that an effective way to organize containment and surveillance program inspection activities is to review documentation and subsequently evaluate the containment and surveillance measures listed above. For the program to be adequate, the containment and surveillance measures must be documented in plans, policies and procedures, and must be effectively implemented.

Each facility is required to have measures for controlling access to vital areas. Nuclear materials accountability is accomplished through establishing defined MBAs. Access controls may vary from complex systems for Category I MBAs to administratively controlled systems for Category IV MBAs. All Category I facilities are required to have MAAs and PAs to facilitate the protection of SNM.

Each facility is required to have a material surveillance program. Surveillance programs include automated or direct visual observation. The most prevalent material surveillance mechanism throughout the DOE complex is the two-person rule. Surveillance requirements are more comprehensive for Category I and II quantities of SNM than for Category III and IV quantities.

Material containment is facilitated through delineation of MAAs, PAs, and MBAs. It is incumbent on the MC&A function to establish the relationship between MBAs and MAAs, and to assure that an MBA does not cross an MAA boundary. For each area, the MC&A program is required to define the authorized activities, the location of materials, material types and amount authorized, and the containment and surveillance mechanisms and controls in effect. Storage repositories are also a vital component of containment systems. In addition to routine containment measures, storage repositories must have both a records system documenting ingress and egress, and defined procedures for conducting inventories and DACs. Processing areas often have similar requirements; however, the requirements are typically more specific and tailored to the particular nuclear material processing operation. To maintain effective containment for process materials, the amount of nuclear materials contained or used in processing should be limited to what is necessary for operational requirements. Processing areas are required to limit the amount of material in use to that which is necessary for operational requirements. Otherwise, it should be stored in repositories or kept in enclosures designed to assure that access will be limited to authorized individuals.

An important aspect of containment and surveillance is detection and assessment. Detection and assessment mechanisms include:

- **TID program.** This program complements the inventory verification and confirmation program. The TID program is administered by the MC&A organization, but implementation is usually the responsibility of the MBA custodian.

- **Portal monitoring.** Conducted at all routine MAA and PA exits, portal monitoring includes routine searches of all personnel, vehicles, and packages. Portal monitoring devices must be capable of detecting metal, SNM, and shielded SNM.

- **Waste stream monitoring.** All liquid, solid, and gaseous waste streams, including environmental releases, are required to be monitored. A response plan for evaluating and resolving discharges exceeding approved limits must be included in the waste monitoring program.

- **DACs.** The DAC program is both a containment and surveillance measure that is required at all Category I MBAs or where the potential for rollup to a Category I quantity of SNM exists. These checks typically consist of item counts, TID verification, records review, and a thorough examination of the containment measures for each Category I area.

The combination of containment and surveillance program elements must assure that nuclear materials are adequately protected, consistent with the graded safeguards concept. Program effectiveness may be assessed by analyzing the successive layers of protection that an insider would have to defeat or circumvent in order to remove or divert materials.

Figure 6-1 shows the inspection activities for the components of the containment and surveillance subtopic.

Information about the facility's containment and surveillance program is generally obtained by reviewing policies and procedures; interviewing managers, staff, and operating personnel responsible for MC&A activities; observing containment and surveillance practices; and conducting performance tests. This inspection process provides inspectors with a sense of how well the containment and surveillance program is structured, documented, and implemented.

Common Deficiencies/Potential Concerns

In addition to the potential concerns listed in this subsection, inspectors should consider the deficiencies listed in the OA-10 Physical Security Systems and Protective Force Inspectors Guides.

MBAs Crossing an MAA Boundary

An MBA boundary shall not cross an MAA boundary. Deficiencies arise when MBA boundaries are established that cross an MAA boundary. This deficiency has the potential to have a Category I quantity of SNM placed outside an MAA or a Category II quantity of SNM outside a PA. It can occur when a facility does not have sufficient staff to have several MBA custodians or defines an MBA inappropriately to minimize MBA transfers. Inspectors might identify the problem by reviewing a list of authorized locations and relating the locations to MBAs, or while inspecting SNM locations during tours of areas.

Inadequate Daily Administrative Checks

The DAC program is facility-specific, for which the scope and extent of checks are approved by the DOE field element based on recognized vulnerabilities. Deficiencies in DAC programs have been identified at a number of facilities and, generally, are associated with inadequate documentation, poor implementation, and incomplete procedures. In addition, DACs at facilities are sometimes inconsistent when a lesser category MBA becomes Category I for special conditions, for multiple MBAs where rollup to a Category I is credible, and when personnel routinely responsible for implementation are absent. These deficiencies usually stem from poor procedures, inadequate training, and management inattention. An inadequate DAC program degrades the detection capability of this containment and surveillance mechanism and degrades the protection afforded the SNM.

Weak or Inconsistent Material Surveillance

The implementation of material surveillance measures is often weak and/or inconsistent. For example, DACs are often performed using checklists. While these checklists may be adequate, they do not assure that the personnel performing the DACs complete them conscientiously or are even fully aware of what they are supposed to accomplish or how it is to be done. Similarly, sites often implement some form of two-person rule to satisfy material surveillance requirements, but personnel are unsure of their surveillance duties, how to recognize unauthorized or abnormal conditions, and what their response requirements are. These conditions fail to meet DOE policy requirements, which specify, "Only appropriately authorized and knowledgeable personnel (i.e., individuals capable of detecting incorrect or unauthorized actions) must be assigned responsibility for surveillance of SNM." and "Visual surveillance procedures must ensure that activities are observable and that observers will recognize, correctly assess, and report activities that are unauthorized or inconsistent with established safeguards requirements." In cases where the physical layout of a process area or storage vault complicates the effective use of a two-person rule, it may be necessary to supplement personnel efforts with additional, possibly automated, mechanisms. Weak or improper implementation of surveillance mechanisms diminishes the benefit of this protection element and degrades the overall safeguards and security program effectiveness. Material surveillance deficiencies are usually caused by a lack of training, redundancy when a few individuals perform the same routine tasks for extended periods, deficient procedures, or a lack of follow-up, oversight, and performance testing.

Information Needed

- SSSP
- MC&A Procedures
- MC&A Plan
- Site Performance Tests

Compliance Review

Access Controls
- Materials access
- Data access
- Equipment access
- Computer systems (class & unclass)

Material Surveillance
- Mechanisms
- Programs
  - Cat I & II
  - Cat III
  - Cat IV

Material Containment
- MAA/PA
  - authorized activities & locations
  - detection mechanism(s)
  - material types, forms, amounts
  - containment controls (normal & emergency)
  - periodic audit
- MBA
  - formally documented
  - geographic boundaries & functions
  - material types, forms, & quantities permitted
  - custodial responsibilities
  - personnel authorized to ship or receive
  - material flows
  - ensure transfer procedures followed
  - ensure transfer quantities measured
- Storage Repositories
- Processing Areas
  - activities & locations described
  - detection elements
  - material movement procedures
  - normal & emergency control procedures
  - response actions for abnormal situations
  - periodic audit of process controls

Detection & Assessment
- TIDs
  - acquisition, procurement, destruction
  - type(s) used
  - assurance of uniqueness
  - storage
  - issuance
  - personnel authorized to apply, remove & dispose
  - containers on which to be applied
  - application procedures
  - frequency & method of verification
  - response procedures for violation
  - assurance not reused
  - frequency & method of internal audit
  - violation reporting procedures
  - approval of items considered intrinsically TIDs
- Portal Monitoring
- Waste Monitoring
  - liquid, solid & gaseous streams leaving MAA
  - response plan
- DACs
- Other Detection/Assessment Elements

Performance Evaluation

MC&A Boundary Evaluation
- Observe &/or test MC&A boundaries
  - Verify: boundaries and portals
- Observe entry controls including searches
  - Verify: transfer points & controls
- Observe MBA procedure implementation
- Observe entry/opening of SNM storage areas

Adequacy of Access Controls
- Observe &/or test access controls for:
  - Materials
  - Data & data stations
  - Equipment (including computer systems)
  - PA, MAAs, MBAs, storage & process areas
  - Key Control

Material Surveillance Evaluation
- Identify & observe surveillance measures
- Test surveillance effectiveness
- Observe: Shipments, transfers & receipts
  - (Coordinate w/ inventory & accounting subtopics)

Material Containment Evaluation
- Practical application in agreement with program documentation
- Accurate boundary description (see boundary evaluation above)
- Verify SNM in process is limited
- Test effectiveness of containment features & ability to detect containment breaches
- Observe & verify: containment including TID use & integrity

Detection & Assessment
- TIDs
  - Conduct front/back checks
  - Observe & verify: application, removal, destruction, storage, & issue controls
  - Test response to TID violation
- Portal Monitoring
  - Observe searches: personnel, package, & vehicle
  - Test sensitivity
  - Test response to a simulated SNM detection
- Waste Monitoring
  - Observe waste transfers
  - Verify records of tests, calibration, & maintenance
  - Test detection capability
  - Test response to a simulated detection of abnormal condition
- DACs
  - Observe DACs
  - Test DAC effectiveness
- Temporary MAA Setup Observed

Assessment

Figure 6-1. Inspecting Nuclear Material Containment & Surveillance

The Impact of PAP/PSAP on Material Surveillance

There has been an increasing trend toward using the Personnel Assurance Program (PAP) or the PSAP as a replacement for some of standard safeguards and security program elements. Some sites have moved away from the traditional approaches to material surveillance (e.g., the two-person rule), and have begun to cite their PAP/PSAP as justification for weak surveillance measures and delayed detection of theft or diversion efforts. DOE policy requires sites to establish a material surveillance program capable of detecting unauthorized activities or anomalous conditions and reporting material status. The requirements allow for either automated surveillance or visual surveillance/direct observation (e.g., two-person rule). In the case of Category I or II material outside an alarmed storage area, DOE policy states, "either the two persons must be physically located such that they have an unobstructed view of the item(s) and can positively detect unauthorized or incorrect procedures, or there must be a system of hardware, procedures, and administrative controls sufficient to ensure no unauthorized accumulation of a Category I quantity without timely detection." Category I or II SNM in use or process is required to be protected by material surveillance procedures, alarm protection, or (with the approval of responsible heads of field elements) alternative means that can be demonstrated to provide equivalent protection. The lack of a fully effective material surveillance program, with or without PAP/PSAP, degrades the site ability to provide timely detection of theft or diversion efforts. This condition normally results from a management emphasis on production goals, misunderstanding of the requirements of PSAP or a material surveillance program, or an effort to minimize expenditures. The deficiencies can be detected by observation, facility performance testing, or during interviews with personnel.

Inadequate Performance Testing of Material Surveillance Measures

The material surveillance program is required to address both normal and emergency conditions, and must provide for periodic testing. Facilities must plan and document the testing of material surveillance systems and procedures. While most sites have established their material surveillance program on the basis of analysis and possibly even detailed and documented VAs, many have not planned, conducted, or documented performance tests to validate the effectiveness of their surveillance program. Without a viable material surveillance testing program, the effectiveness of the material surveillance program cannot be assured. The lack of performance testing is due to a lack of awareness, potential costs, or failure to fully implement the DOE order requirements for the material surveillance program.

Data Collection Activities

Information Needed

A. In preparation for the actual inspection effort, inspectors will need to review certain site-specific documents. These documents should provide the details of how the material containment and surveillance program is implemented at the facility. The specific documents to be reviewed include:

- Site Safeguards and Security Plan
- MC&A Plan (sections relating to containment and surveillance)
- MC&A procedures (e.g., containment and surveillance, access control, nuclear material transfer, and MBA operating procedures)
- Site containment and surveillance performance test plans and test results

- Internal review and assessment results

- Field element survey reports.

In reviewing this documentation, inspectors should develop an appreciation and understanding of the containment and surveillance mechanisms and practices in use at the site. The documentation review should also help inspectors determine how and how well the containment and surveillance program interfaces with other MC&A program elements. During the inspection it will be important to note any discrepancies between the documented program and the program as physically implemented and observed.

B. Inspectors should use initial briefings and interviews at the site to resolve questions that result from document reviews and identify any additional documentation (for example, procedures, memoranda, and lists) that is required to conduct the inspection. Additional details that may be covered at this initial meeting include:

- Identifying individuals who will be assigned as points of contact for containment and surveillance inspection activities

- Discussing material transfers, including activities for shipments and receipts, waste discards, and any planned activities

- Up-to-date assessing of the facility's containment and surveillance posture

- Providing logistics for conducting containment and surveillance performance tests

- Identifying special considerations or facility conditions that could impact data collection or the inspection plan

- Considering any additional information not contained in the documents that were reviewed.

Compliance Review

C. To evaluate the compliance of the site containment and surveillance program, inspectors should determine whether the program documentation is complete, current, and approved by the appropriate oversight personnel. Some aspects of material containment and surveillance are implemented by organizations other than the MC&A group. Procedures related to material containment and surveillance may be developed by security or operations organizations as well as the MC&A organization. Regardless of which organization develops or implements procedures, inspectors should review these documents to determine whether applicable containment and surveillance measures are addressed appropriately.

D. Inspectors should review the facility's plans and procedures to determine that they meet applicable requirements and are consistent with the security and MC&A plans. The inspector's determination should include whether:

- The personnel who perform MC&A functions are knowledgeable of, and have access to, the applicable procedures.

- Procedures have been distributed to all personnel who must implement them.

- The personnel correctly understand and implement the procedures.

Access Controls

E. Inspectors should determine whether the facility has established a graded program for controlling access to nuclear materials, accountability data, and items or equipment vital to the MC&A program. Inspectors should determine whether the program, as documented, is capable of ensuring that only authorized personnel have access to nuclear materials, data, and equipment. The program should be examined to determine whether it addresses procedures and mechanisms to detect and respond to unauthorized access.

F. Inspectors should review processing areas and operations to determine what quantities of nuclear material are reasonable to sustain operating schedules. Inspectors should assure that excess materials are not stored in processing areas but in appropriate storage repositories equipped with mechanisms to limit access to authorized individuals.

G. Inspectors should determine that Category I quantities of SNM are used or stored within an MAA enclosed within a PA with ingress and egress restricted to defined portals and pathways subject to material and personnel controls. Inspectors should review material categories and the MBA structure to assure that appropriate access controls are in place for Category I, II, III, and IV quantities of material. For Category III and IV areas outside of a PA, inspectors should review VAs to determine whether accumulation of a Category I quantity has been addressed and evaluated as "not credible."

H. Inspectors should focus on determining whether the access controls are sufficient to prevent unauthorized personnel from gaining access to MC&A data or data generating equipment, and to prevent personnel with authorized access from performing unauthorized activities. Inspectors should review procedures and equipment to determine whether the containment and surveillance measures are sufficient to ensure that only authorized persons have access to computer systems that contain the MC&A data. This aspect of the inspection requires coordination with the computer/cyber security inspectors.

I. Inspectors should review the access controls established for special data generating equipment, measurement equipment, and data recording devices. The controls should provide assurance that the integrity of data and equipment is maintained. This aspect of the inspection requires coordination with the inspector for measurement/ measurement control.

J. Inspectors should review the controls used to assure that the correct MC&A data is entered and that any changes are fully auditable. This aspect of the inspection requires coordination with the material accounting topic team leader.

Material Surveillance

K. Requirements for material surveillance are divided into surveillance mechanisms and surveillance programs, and are applicable to storage repositories as well as processing areas. Inspectors should determine what surveillance mechanisms are employed by the facility. Automated mechanisms should be inspected to assure that they provide coverage for the identified areas, detect anomalies, and report alarm conditions.

The material surveillance program may include one or more of the following surveillance mechanisms:

- Intrusion alarms in unoccupied areas
- Personnel observation (e.g., two-person rule) in active areas
- Automated surveillance (e.g., digital imaging)
- Health and safety alarms
- Shelf monitors
- Item motion detectors
- Process monitoring controls and instrumentation.

Visual surveillance and observation is usually accomplished by some form of the two-person rule. This surveillance mechanism is the most common method of providing material surveillance for material in processing areas, and for accessing or conducting activities in storage repositories. Procedures for the two-person rule specify what is required (for example, constant visual contact, two persons in same room, two persons in same vault, etc.).

L. Inspectors should assure that surveillance procedures provide for investigation, notification, and reporting of anomalies. Card reader systems, SPO procedures, and double-lock systems are common methods for enforcing a two-person rule.

Inspectors may select areas to review access logs and records, and to determine whether this aspect of the two-person rule is being implemented as required.

M. Inspectors should interview operations managers, material handlers, and MBA custodians to determine whether they understand both the material surveillance measures for their areas and how to implement them. Process logs, inventory records, and other types of operational information are mechanisms that might identify anomalies. Inspectors should determine whether this type of documentation is available and whether procedures exist that initiate investigations when anomalies are identified.

N. The MC&A program documentation should describe the material surveillance methodologies and operational control points on which the program is based. Inspectors should determine whether the procedures for Category I and II quantities of SNM require the following:

- Only knowledgeable and authorized personnel with appropriate clearances are assigned surveillance responsibilities.
- Controls are in place to ensure that one individual cannot gain access to SNM.
- Surveillance mechanisms are in effect when storage repositories are not locked and alarmed.
- All persons in a secure storage area are under constant surveillance.
- Surveillance mechanisms are available to ensure that there is no unauthorized accumulation of a Category I quantity of SNM outside an alarmed storage area.
- SNM in use or process is under surveillance, under alarm protection, or protected by alternative means approved by the DOE field element.

O. Inspectors should review the surveillance procedure for Category III quantities of material to ensure that it specifies that when the material is not contained in locked storage, it must be attended, be in authorized locations, and not be accessed by unauthorized individuals. For Category IV quantities of material, inspectors should review the site-specific procedure approved by the field element for adequacy.

Material Containment

P. To assure that SNM is adequately protected, facilities are required to implement controls that ensure Category I quantities are used, processed, or stored only within an MAA. The MAA must be enclosed in a PA. All Category I facilities should have at least one MAA.

Inspectors should identify all MAAs and their boundaries and determine whether the MAAs are within PAs, as required. This can usually be accomplished through a review of documentation (including floor plans), interviews, and a tour of the areas. Inspectors should verify that there are sufficient controls for ensuring that Category I quantities of SNM are used, stored, or processed only within an MAA.

Q. The MAA is an important material containment feature having clearly defined barriers and designated portals. Therefore, inspectors should:

- Determine that barriers are sufficient to provide assurance that SNM cannot be removed from the MAA without detection.
- Review MAA protective systems to ensure that all personnel, vehicles (if any), and hand-carried items are searched to prevent SNM removal, and that all emergency exits are alarmed.

- Examine procedures to assure that access to MAAs is limited to designated portals, and that the authorization and identity of all personnel entering the MAA is verified. Similar to Category I SNM, Category II quantities of SNM are required to be used, processed, or stored in a PA.

R. The MBA is the fundamental component around which a site nuclear material accountability program is structured. Therefore, inspectors should:

- Identify the location, boundaries, and category designation of each MBA. Category I MBAs must be totally contained within an MAA. The MAA boundary should coincide with a MBA boundary at locations where material is being transferred in to or out of an MAA. Category II MBAs must be contained within a PA.

- Determine whether the facility's MBA structure is capable of localizing inventory differences. This effort should be coordinated with the materials accounting subtopic. MBAs should be reviewed to determine that a qualified MBA custodian is designated for each MBA.

- Assure that procedures specify administrative controls, material flows, material transfer procedures, and measurement requirements for material crossing MBA boundaries. The MBA structure must limit the MBAs to integral operations and a single geographical area. Inspectors may choose to review selected MBAs to determine whether these requirements are met.

- Review the equipment and procedures used to control access to material in MBAs. Inspectors should identify all routine and emergency portals and pathways associated with the MBA to determine that they are consistent with the requirements prescribed for the MBA.

S. Containment measures are also required for storage repositories. Containment for storage repositories in a secure mode is achieved through barriers and intrusion systems. When in the access mode, most facilities implement a two-person rule in Category I or II storage areas and, at a minimum, administrative controls in Category III or IV storage areas.

Inspectors should review the controls at storage areas for compliance with approved plans and procedures. This should include determining that controls allow only authorized individuals access to storage repositories. Inspectors should assure that there are procedures to authenticate material movements into or out of the repository, document ingress and egress, conduct inventories and DACs, and report and investigate abnormal conditions.

T. Inspectors should identify the location, quantity, and category limits of materials used or stored in processing areas. This can be accomplished by interviewing MC&A personnel and MBA custodians as well as touring the processing areas.

U. Inspectors should review the controls that are intended to ensure that category limits are strictly observed. Inventory records, transfer logs, or other documents should be used to verify that these limits are not exceeded.

V. Inspectors should verify that Category I processing areas are within an MAA; Category II processing areas are within a PA; Category III processing areas are within an appropriate security area; and, Category IV processing areas are consistent with approved safeguards and security plans. Inspectors should pay particular attention to temporary use areas (e.g., temporary MAAs and other areas where SNM may be transferred temporarily for special operations or testing) to determine whether they meet the applicable requirements and that the activity has an approved security plan that contains applicable MC&A elements.

W. Inspectors should review the equipment and procedures used to control access to processing areas. The review should include access authorization lists, entry controls, personnel identification and verification systems, and access logs. Typical methods for controlling entry to processing areas include locks, keys, card readers, badge systems, and administrative controls. For these mechanisms, the procedures and equipment should be effective for their intended purposes and should be consistent with provisions stated in formal documentation.

Detection and Assessment

X. Elements of detection and assessment include the TID, portal monitoring, waste monitoring, and DAC programs. Because of the close relationship between material containment and security systems and the overlap in applicable orders, the MC&A and physical security systems inspectors should coordinate inspection activities for portal monitoring.

Y. When assessing TIDs, the inspector's responsibilities include:

- Determining whether the TID program meets the applicable requirements, is appropriately documented, and is effectively implemented

- Reviewing the facility's TID program, which should be clearly defined and documented (Note: portions of the TID program may be documented in policy and procedures separate from the MC&A plan.)

- Determining whether the program contains all of the elements specified in the order

- Reviewing the procedures that are used in program implementation, namely: TID acquisition, distribution, application, removal, storage, inventory, and anomaly reporting. The review should focus on whether the procedures are clear, complete, and consistent with the TID policy.

Z. When assessing portal monitoring, the inspector's responsibilities include:

- Reviewing documents that define the portal search procedures.

- Verifying that guard post orders are consistent with documented plans and procedures. The plans and procedures should detail the actions to be taken in the event that SNM or metal is actually detected, as well as how to handle authorized transfers, metal implants, tools and equipment, etc.

- Identifying all routine exits of MAAs or PAs, and verifying that provisions are in place for conducting searches of all exiting personnel, packages, or vehicles. The method and frequency source checks and calibration should be specified as well as reporting procedures and the procedures to be followed should any of the monitoring equipment become inoperative or dysfunctional.

AA. When assessing waste monitoring, the inspector's responsibilities include:

- Reviewing the documents that establish the facility waste monitoring program. The documents should require all liquid, solid, and gaseous waste streams leaving an MAA to be monitored for SNM. The waste monitoring program documents should identify all waste streams and define the monitoring method(s) for each. These documents should specify:

    - Measurement and measurement control requirements for the monitoring systems

    - Measurement systems calibration requirements

    - Measurement standards

    - Calibration records and maintenance requirements

- Controls over the waste monitoring equipment

- SNM detection capability and requirements.

• Reviewing the response plan to ensure that it has been developed and to determine whether it meets applicable requirements. Specifically, inspectors should determine whether the plan is capable of evaluating and resolving situations involving any discharge exceeding the facility-specific limits approved by the field element.

• Verifying that the plan addresses occurrence reporting.

• Looking at the history of waste discharges to identify if recent changes significantly impact the capability of detecting unauthorized removals of SNM. The collection of these data should be coordinated with the material accounting subtopic inspector.

BB. When assessing DACs, the inspector's responsibilities include:

• Reviewing the methodologies, procedures, and requirements the facility has established for conducting DACs of Category I MBAs.

• Assuring that the scope and extent of the DACs are approved by the field element.

• Determining whether the DAC program is capable of detecting obvious anomalies and tampering.

• Assuring that nuclear material is not in unauthorized locations.

Performance Review

CC. Performance is the ultimate determination of containment and surveillance program effectiveness. While the DOE Order is intended to establish minimal requirements of an effective program, compliance does not assure effectiveness, and non-compliance does not establish the program as ineffective. This section focuses on how well the containment and surveillance program works.

One indicator of program effectiveness is the site's own performance testing program. Without an effective performance testing program, the site cannot assure the effectiveness of the containment and surveillance program. Performance tests must be designed and conducted to fully evaluate the effectiveness of material surveillance activities for Category I and II quantities of SNM.

Inspectors should determine whether the site has established such a performance testing program and whether at least 95 percent of the tests conducted demonstrate the detection of unauthorized actions related to the control of Category I and II quantities of SNM.

DD. Inspectors should conduct independent performance tests of the program elements. Performance tests are valuable mechanisms that will assist the inspector in evaluating the effectiveness of the site containment and surveillance program, its systems, and components. The performance tests chosen should exercise the site's personnel, equipment, and/or procedures used to affect containment and surveillance measures. The tests should employ any of various scenarios for defeating the established containment and surveillance system(s). The tests might include attempts to remove SNM from the area, or to move the material to an unauthorized location.

MC&A Boundary Evaluation

EE. Typically the protective force and physical security systems topics cover the effectiveness of PA, MAA, and vault boundaries. However, the MAA and SNM vaults are areas where the MC&A inspector may be able to identify particular areas of concern. Further, the MC&A inspector is the only one who can identify concerns with MBA and process area boundaries.

Inspectors should observe all of these boundaries and determine whether the necessary controls are in place and operating effectively. DACs typically include the requirement to check the integrity of walls and other boundary elements. Testing of this element might include simulating a breach of the MAA wall to determine whether personnel will identify and report the problem.

Adequacy of Access Controls

FF. Facilities are required to have a graded program to assure that only authorized persons have the ability to enter, change, or access materials control and accountability data and information. Inspectors may choose to test these measures by requesting one or more unauthorized individuals to access the accountability computer system or attempt to exceed authorized privileges (e.g., attempts to alter or enter data by individuals not given that authority).

GG. Surveillance measures are required to assure that unauthorized or unaccompanied authorized personnel cannot enter the storage area undetected when the door is unlocked or open. Inspectors should run specific tests for this requirement, which may include attempted entries into SNM storage areas that violate access controls or the two-person rule requirement.

HH. Inspectors should determine the validity/adequacy of access controls including access lists, key control for nuclear material access, approval mechanism, escort procedures, clearance program interface, PAP/PSAP enrollment, the two-person rule application, knowledge verification, and other qualification requirements.

II. Access logs are routinely maintained for personnel not normally assigned to the MAA. Measures commonly used to control access to MAAs are badge checks, card readers, authorization lists, and search equipment. Inspectors should determine whether the measures used are adequate and if they are effectively implemented. Requesting an unauthorized individual to gain access is one possible test of these measures.

Material Surveillance Evaluation

JJ. Inspectors should:

- Establish which mechanisms the site has identified to be in effect for each of its authorized SNM storage or handling areas.
- Determine whether each mechanism/system is actually in effect and observe its operation.
- Review and evaluate the effectiveness of each mechanism in practice (including the two-person rule, where implemented). If possible, devise one or more simple tests to determine whether the mechanisms are effective. One such test involves the attempt of one of the two-person rule team to get the other to leave the area. Another test could have one individual attempt to cause a break in the observation capability of the other.

KK. Process monitoring systems can monitor/track material quantities and location; SNM transfers; quantities transferred; and processing, handling, sampling or mixing activities. Where process monitoring systems are in use, the site should have established performance requirements and tested the systems supporting those requirements. Inspectors should review these tests for effectiveness and results, and consider conducting one or more independent tests of the systems.

Material Containment Evaluation

LL. Material containment features, especially in processing areas, should be evaluated. The inspector's responsibilities include:

- Inspecting the effectiveness of procedures for transfer controls, and emergency evacuation and response procedures.
- Ensuring that existing measures are consistent with provisions identified in formal documentation.

- Inspecting the material access, surveillance, and containment features at selected processing areas in the event the inspector does not have time to review all processing areas at a large, complex facility. The areas should be selected on the basis their importance, location, material category, attractiveness, and containment measures in place.

Detection and Assessment Mechanisms

MM. The TID record system is required to accurately reflect the identity of TIDs in at least 99 percent of the cases, and the TID program must assure that TIDs are properly applied in at least 95 percent of the cases.

The records must meet the accuracy requirement for identifying serial numbers and locations of the TIDs, and the TIDs must be properly applied using the required application techniques and safeguards procedures, and intact. A high failure rate indicates the program is ineffective.

Inspectors should observe both the implementation of TID procedures and the test personnel who normally implement the procedures. This might involve written tests or observations of normal procedures such as a TID application, removal, or inventory. Inspectors can choose to review the program for training TID custodians and applicators; however, such a review should be coordinated with inspectors involved in the administration program review.

NN. A facility TID program usually prescribes the use of records and forms for TID issuance, application, inventory, removal, and destruction. Inspectors should:

- Select a sample of TID numbers and records and compare the various record systems for consistency.

- Verify applied TIDs with records (for example, check to determine whether TID identification numbers on containers or locations are identical to the identification numbers in record systems). This check is commonly conducted using “a front and back check” and involves a two-step approach: (1) selecting a sample of installed TID data from the records system and comparing it with the actual item data, and (2) collecting TID and item data, and comparing them with the records system.

- During tours of process or storage areas, examine TIDs on containers to determine whether they have been properly applied and are on the types of containers defined in the facility's TID policy.

- Interview selected TID custodians and review their records to ascertain what controls are in place to assure that access to TIDs, logs, and usage forms is limited to authorized personnel.

NOTE: It is important to establish/define what constitutes a TID program error before conducting the test/evaluation. Since the TID program is an important component of the inventory program, any performance tests to determine whether the TID program meets its goal of being applied correctly 95 percent of the time and the identity of the TIDs 99 percent of the time must be coordinated with the inspector of the inventory topic.

OO. The inspection emphasis for portal monitoring is on equipment performance and procedure effectiveness. An effective interface and coordination with the physical security systems and protective force topic teams is essential for this inspection activity. Inspector responsibilities include:

- Observing routine portal operations to verify compliance with procedures. Particular attention should be paid to factors that could degrade performance such as poorly designed traffic flow, or rushed or inattentive SPOs.

- Observing the operation of SNM detectors (portal or hand-held) used for searching personnel, vehicles, and packages for SNM at exits of MAAs, PAs, storage repositories, or other areas. Exit searches are intended to detect removal of SNM.

- Determining whether search practices are consistent and adequate.

- Assuring that the site testing program for their portal monitors (SNM and metal) includes all applicable tests described in American Society for Testing and Materials guides unless otherwise directed by the Office of Security. If these standards are not met, compensatory actions are required and should be performance tested.

- Reviewing the installation of SNM detectors to determine whether the detectors can be bypassed. SNM detectors are sensitive to background radiation; therefore, inspectors should review the provisions for ensuring that background radiation does not degrade performance. Calibration data should be reviewed, and the calibration of selected detectors should be performance tested. SNM detector alarms may be audio, visual, or both and may be monitored locally or remotely. The procedures for responding to all types of alarms should be reviewed and tested to ensure that they are effective. If inspectors choose to test the exit searches, the tests should be coordinated with the physical security systems topic team. Such tests may involve the use of sources to simulate SNM.

PP. Metal detectors are typically used in conjunction with SNM detectors to detect metallic shielding of SNM when exiting from an MAA or PA, and for metal contraband when entering an MAA or PA.

If inspectors conduct performance tests of the sensitivity and calibration of metal detectors, the tests should be coordinated with physical security systems and protective force teams. Metal detection should be sensitive (at the specified level) anywhere in the detection zone. Some facilities desensitize the detectors at shoe level to accommodate steel-toed shoes. In addition, metal detectors are sensitive to the speed and configuration of the metal passing through the detector. These conditions present a potential vulnerability and should be tested by inspectors. The response to alarms may also be reviewed and tested.

Inspectors should review the installation of metal detectors, paying particular attention to large masses of metal near the detectors that may affect sensitivity or cause excessive nuisance alarms. Inspectors should also focus on identifying means by which metal detectors may be bypassed (for example, putting items around or above the detection volume) if the metal detector is not visually monitored by SPOs.

Waste Monitoring

QQ. The instrumentation (along with other detection elements) used to monitor waste and equipment removed from an MAA must be able to detect the removal of a Category I quantity of SNM. Inspectors must coordinate with the inspector evaluating measurement systems.

RR. Specific test scenarios may be devised for selected waste streams to evaluate detection effectiveness. In testing the waste monitoring program, inspectors must assure that all applicable safety precautions are considered in developing and while actually conducting a performance test.

SS. Facilities are required to monitor all liquid, solid, and gaseous waste streams leaving an MAA for SNM. The inspector's responsibilities include:

- Selecting one or more MAAs and determining whether all waste streams are monitored and whether measurement and measurement control requirements are being met.

- Verifying that appropriate standards were used during the calibration of measurement systems and that the calibrations records were maintained.

- Verifying that the facility maintains and controls waste monitoring equipment and that such equipment is capable of detecting the specified amounts of SNM. In some instances (i.e., exhaust stack monitors), only a sample of the flow stream is taken. In such instances, it is necessary to relate the quantity of material detected with the quantity removed. As a result, the inspection of the waste monitoring systems might involve document and record reviews as well as performance tests.

Daily Administrative Checks

TT. The scope and extent of DACs are determined and approved by the field element. Inspection of the DAC program might involve a review of containment measures and procedural compliance in processing areas and storage repositories, or an item inventory verification. Inspectors should:

- Observe DAC practices in selected MBAs to verify compliance with procedures.
- Determine whether the procedures are sufficient to provide assurance that there are no obvious abnormalities or missing items and there is no apparent evidence of tampering.
- Determine that, in processing areas, the DAC verifies the presence of SNM and MBA records reflect the quantity present.
- Test the DAC program by simulating one or more types of abnormal situations that the DAC is designed to detect.

UU. Since processing areas usually contain limited amounts of Category I quantities of SNM, item inventory is the most common DAC procedure performed. A variation of the item inventory procedure may be used for storage repositories, especially if the repository has been accessed. Where the item inventory procedure is used, inspectors should determine whether:

- The DAC method is effective.
- It meets the requirements for detection and assessment.
- The results of the inventory are fully documented.

If the DAC program uses an item inventory procedure, the facility's ability to generate inventory listings should be tested. Inspecting DACs associated with containment measures normally focuses on the integrity of TIDs, locks, or other restraint devices, and alarm log entries. Inspectors should: (1) review these measures for effectiveness, and (2) examine a sample of DAC records to ascertain that they are complete and prepared daily or upon entry to the storage area. Particular attention should be paid to provisions for conducting the DACs when the regular custodian is absent.

VV. Inspectors should interview or test custodians and alternates to determine whether they are knowledgeable of the DAC procedures, process, and requirements. Inspectors should also review the response plan for evaluating and resolving anomalies. Finally, inspectors should determine whether there are any MBAs that do not normally have a Category I quantity, but might have one on a temporary basis. The provisions for conducting DACs should be reviewed in these areas during the period in which it contains a Category I quantity.

Temporary Material Access Area (TMAA) Setup

WW. If a facility has provisions for TMAAs, the frequency with which such an MAA is established must be determined. Inspectors might consult the inspector examining the accounting records or interview the MBA custodian. Inspectors might also ask the facility to set up a TMAA for OA to evaluate. This type of performance test can be integrated with the protective force and physical security systems topic teams and is very effective. Alternatively, the facility may have a TMAA scheduled during the inspection period or could modify its existing schedule to have a TMAA set up during the inspection period for inspectors to observe.

Section 7

INTERFACES

Contents

This section discusses the input of the MC&A topic into the overall integration process, how integration within the MC&A team is accomplished, and how MC&A integrates with other topic teams on an inspection.

Integration

Integration is the process in which inspection team members work together to achieve a better understanding of the overall protection programs utilized at DOE facilities. In this context, it includes all the associated attributes: coordinating, cooperating, interfacing, and assimilating information. The fundamental goal of integration is to ensure that DOE facilities are provided the necessary degree of protection, and that vulnerabilities are clearly identified and analyzed. It also results in a more effective and organized inspection effort, a refinement of inspection techniques, and a more comprehensive inspection report. Lastly, the integration effort significantly contributes to OA's ability to provide an accurate, in-depth evaluation of protection programs throughout the DOE complex.

OA topic teams are fully integrated. The primary objective of a comprehensive inspection is to provide a meaningful, management-level evaluation of the overall status of safeguards and security at the inspected facility. To ensure that this objective is accomplished, the MC&A topic team and all other topic teams must work closely together throughout every phase of the inspection process, carefully integrating their efforts.

Integration is realized by exchanging information and discussing how information collected by one topic team influences protection program elements observed by other topic teams. Additionally, integration provides a means of prioritizing the efforts of the various topic teams, of assigning particular issues for investigation to particular teams, and of mobilizing special inspection team elements to examine issues that transcend topic boundaries.

During data collection, the various topic teams collect a massive quantity of data pertaining to their particular subject matter areas. A careful delineation of each team's inspection activities is required to avoid wasteful duplication of effort. However, even with a clear definition of activities, the boundaries among topic teams are not always neatly differentiated; and each topic team is bound to discover data of interest and significance to other teams. Such data must be shared in a timely manner, with determinations made as to which topic team will pursue identified issues to a point of resolution.

Much of the required integration occurs on an informal basis. During planning and data collection, topic leads and individual topic team members share information with their counterparts from other topic teams. A formal team meeting is scheduled on a daily basis to provide a forum for exchanging information among the topic teams.

It is essential that the integration process be instilled with the fundamental realization that DOE protection philosophy is based on the concept of protection in depth—i.e., layers of protection applied in a manner that ensures that the failure of a single layer does not expose the protected asset. To be effective, layered protection requires the careful integration of protection layers and of the protection elements within each layer. Thus, integration ensures that the OA's security interests at a particular facility are afforded the necessary degree of protection in depth. The formal part of this process is to identify and characterize the priority security interests at a facility, test and evaluate the protection system elements that are critical to the protection of these interests, and analyze the impact of deficiencies in these critical system elements. This determines the overall status of safeguards and security at the inspected facility.

Interface with Other MC&A Subtopic Areas

The five MC&A subtopic areas (administration, accounting, measurement and measurement control, inventory, and containment and surveillance) comprise the overall MC&A topic. The size of the MC&A team depends upon the size of the facility and the strategic importance of the MC&A program at the site. Thus, one or two inspectors could inspect at a facility of less strategic importance, while a team of five or six inspectors might be required at larger facilities with multiple Category I MBAs, several MAAs, and strategic holdings of SNM.

Although coordination is ongoing throughout the inspection, planning activities define the major coordination effort required for the inspection. Facility tours are scheduled for the initial phase of data collection activities; planning activities determine which inspectors will participate in which tours. Facility access control requirements are necessary for security as well as environment, safety, and health.

The following is a description of the specific coordination efforts relating to the MC&A subtopics.

Administration

The inspector responsible for the administration subtopic must receive feedback from all inspectors on the MC&A team. The effective implementation of the facility MC&A Plan and procedure directives can be determined only by a thorough review by all inspectors with feedback to the administration subtopic inspector. Any training deficiencies must be analyzed to determine whether the cause is endemic to all facility programs, to a specific facility program, or is a single deviation. Emergency response activities and occurrence reporting that typically occur in other subtopic areas reflect the overall administrative effectiveness of a facility program. Field inspection activities identify MBA categorization problems that must be reflected in the administration subtopic. Inspection activities also provide a basis from which to evaluate facility VAs and the effectiveness of MC&A self-assessment program.

Similarly, documentation weaknesses identified in the administration subtopic can be validated by inspectors of other subtopic areas. In this case, the inspector for administration will make field assignments to inspectors in other subtopics to validate the perceived weakness(es).

Accounting

The inspector responsible for inspecting accounting systems routinely interfaces with the inspectors of the inventory and measurements subtopics. The accounting records must contain all the inventory data including the calculations of the ID and its error limits. Measurements are required for physical inventory, shipments and receipts, and material transfers. Material transfer paths are discussed with containment personnel. Documentation deficiencies and training programs are discussed with the inspector of the administration subtopic.

Measurements

The inspector responsible for inspecting measurements routinely interfaces with accounting system personnel to ensure that data is correctly transferred to the accounting system. The error limits associated with measurements are incorporated into the LEID calculation that is part of the inventory subtopic. The results of the training and documentation reviews are discussed with the inspector of the administration subtopic.

Inventory

This area interfaces with all other MC&A subtopics. The accounting system must identify quantities and locations, material must be properly contained and stored at measured values, and documentation requiring the above activities must be current and implemented by the facility.

Containment

Documentation and training activities are discussed with the administration subtopic inspector. Waste monitoring equipment and SNM detectors are reviewed with the measurements subtopic inspector, and any questions concerning container location and quantity are reviewed with the accounting subtopic inspector.

Interface with Other Inspection Topics

Figure 7-1 summarizes areas where the MC&A team may interface with other topic teams.

Classified Matter Protection and Control

MC&A interfaces with the classified matter protection and control (CMPC) topic team because of the requirements for protecting information (SNM inventories may be classified), for special programs, and for accountability of classified parts (some may contain SNM/other nuclear material, and, at some facilities, MC&A may be responsible for maintaining the classified part database). In addition, most MC&A computer systems are authorized to process classified information and, as a result, the CMPC requirements for classification management, marking and storage of records, reports, and classified media are applicable. Interface with operations security (OPSEC) and technical surveillance countermeasures (TSCM) may also be necessary.

Personnel Security

The DOE human reliability programs have been implemented at some facilities, and facility personnel who routinely handle SNM are placed in this program. MC&A personnel are frequently in the PSAP program. MC&A can identify the individuals who should be in this program, and the personnel security topic team can validate their participation.

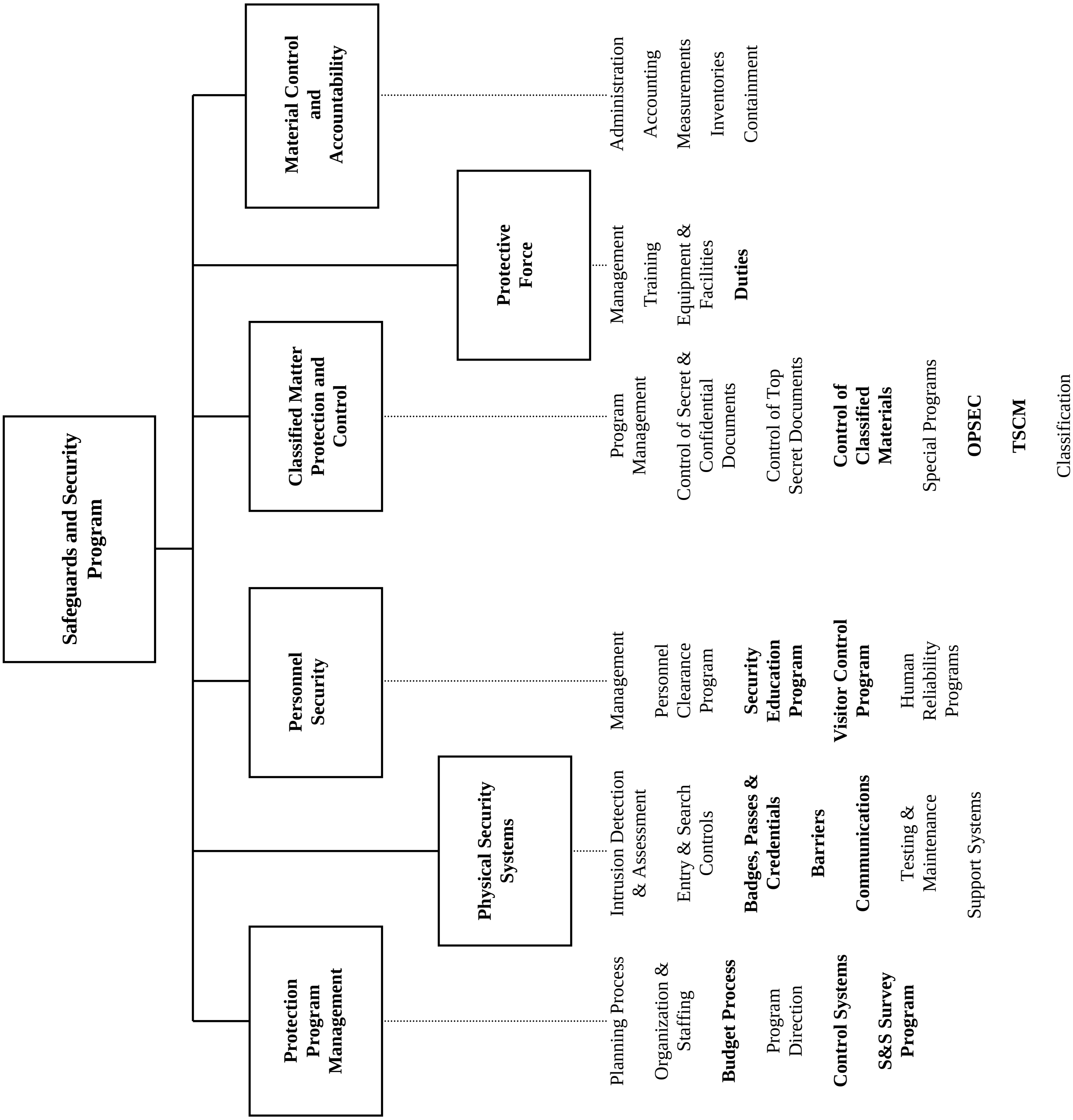

Figure 7-1. Areas of Interface Between MC&A and Other Inspection Topics (Bold)

Computer Security

At most facilities, several computer systems are used to process MC&A data, including process control computer systems, MBA accounting systems, measurement systems with computer controls, and centralized MC&A computer systems for maintaining facility accounting records. During planning activities, the MC&A and computer security topic teams coordinate inspection activities to determine which systems may be jointly inspected. Typically, computer security will inspect the operating system for compliance with applicable DOE orders. MC&A and computer security inspectors may jointly evaluate user-written software in terms of access controls, software configuration controls, and data integrity. Any findings that could result from these inspection activities are placed in the appropriate section of the inspection report and cross referenced as necessary.

Physical Security Systems

The interface with the physical security systems (PSS) topic team is particularly important—especially the close interface of the containment and surveillance program with physical security hardware and procedures. In particular, SNM and metal portal monitors are equipment systems that are routinely inspected. PSS and MC&A should agree, prior to the inspection, how this equipment will be inspected. These are evaluated in PSS in the subtopic areas of intrusion detection and assessment, entry and search controls, and testing and maintenance.

The PSS, MC&A, and protective force topic teams routinely interface in evaluating the integrated protection of SNM. During planning activities, the PSS, protective force, and the MC&A topic teams may schedule an integrated inspection of an MAA or vault. Since MC&A inspectors routinely access facility vaults, it is common for MC&A inspectors to examine certain PSS and protective force protective features.

The following general guidelines are used to assist the PSS and MC&A inspectors in coordinating their activities:

- Elements that are primarily MC&A functions:
  - TIDs
  - Waste monitors
  - DACs
  - Transfer authorizations
  - MBA custodial responsibilities
  - MBAs and their relationship to MAAs

- Elements that are primarily PSS related:
  - Vault construction
  - Intrusion sensors and alarm system sensitivity and design
  - Badge systems
  - Locks

- Elements that are applicable to both topics:
  - Material surveillance procedures
  - Combination and key controls
  - Access authorization lists
  - Portal monitors (metal and SNM detectors)
  - Material transfer operations and surveillance
  - Storage area entry procedures
  - MAA access controls
  - PA access controls
  - MAA and PA containment barriers
  - Card readers and key pads
  - Closed circuit television (CCTV) surveillance or identification systems.

As a general rule, for the elements that overlap, the PSS team should focus on the hardware aspects, whereas the MC&A team should focus on material handling and procedural aspects. For example, the PSS team should focus on card readers, CCTV, barriers, and portal monitors, whereas the MC&A team should focus on vault entry procedures, material surveillance procedures, access authorization lists, and material transfer operations. The MC&A team identifies the locations where attractive material is processed or stored. Members of PSS teams, generally, are not familiar with characteristics of nuclear materials and containerization. In some instances, it may be prudent to identify these characteristics for the PSS inspectors so that they may better assess the PSS for the area. The MBA structure, if properly established, provides assurance that all the material that should be present in the facility can be accounted for. There are occasions where SNM must be measured or processed using a piece of equipment that is not in an MBA. For such activities, temporary MBAs are established. Assurance must be provided that the SNM, when transferred into such MBAs, is not more vulnerable to theft. Diversion scenarios using waste discard streams must be similarly addressed using integrated safeguards approaches. At large, complex facilities with multiple MAAs, the MC&A and PSS teams should strongly consider focusing on the same MAAs, buildings, and processes. This would ensure that the efforts complement each other and that a comprehensive inspection is achieved.

Protective Force

During the inspection planning phase, MC&A inspectors identify the extent of protective force (PF) activities that interface with the MC&A topic. The PF sub-topic inspection area of duties is the most common area of overlap. At most locations, PF personnel are involved in access controls and physical checks of TIDs on facilities or containers, and respond to various types of alarms. Additionally, some sites use PF personnel as the "second person" for material surveillance programs. Specific topics of interest to MC&A inspectors include:

- Training programs to qualify PF personnel to knowledgeably perform material surveillance and related duties
- Procedures for conducting routine and emergency duties; for example, alarm response, SNM monitor testing and operations, and the transfer of SNM
- Standards established for the operation of equipment and disposition of anomalies.

Based on the degree of interface and its importance in the overall protection of SNM, MC&A inspectors may consider conducting integrated exercises with the PF topic team. Typical examples of integrated exercises include:

- Mock shipments of SNM
- Testing of SNM and metal detector operations
- Emergency response exercises
- Review of routine duties (observations)
- Material control exercises requiring PF response
- Setup of a temporary material access area.

Also, with inspectors of the PF topic it may be important to familiarize them with characteristics of nuclear materials and containerization so that they may better assess the PF responsibilities for the area.

Protection Program Management

There are four areas of PPM where MC&A and PPM must integrate: (1) planning process; (2) organization and staffing; (3) program direction; and (4) safeguards and security survey program. As part of the planning activities, the results of the VAs performed by facility personnel, the SSSP, and any deviations reported to the operations office are reviewed. The PPM and MC&A topic teams interface and evaluate the MC&A content and facility impact of these documents. During the data gathering phase, MC&A may undertake specific inspection activities that will provide specific input to the PPM topic. Facility corrective action plans are also in important part of PPM. MC&A corrective actions must be adequately tracked by the facility corrective action program, including root cause analyses and trending. In the organization and staffing and program direction subtopic areas, MC&A provides feedback to PPM on second and third tier management of the MC&A program and how it interacts with senior level management. PPM provides feedback to the MC&A team on first and second tier management interaction.

During data gathering, MC&A may identify management concerns to the PPM team. This can serve as a data point for PPM that could lead to a systemic management issue. MC&A inspectors may also identify key funding issues that require senior management attention. Building upgrades, process improvements, and acquisition of measurement equipment are frequent inputs that MC&A provides to PPM. PPM uses these inputs in their evaluation of the overall facility PPM topic. Conversely, the PPM team may have identified an issue and may try to determine whether it is an isolated instance or a generic facility deficiency. In this case, the PPM team will ask the MC&A team to examine a specific area to see whether the deficiency exists.

The MC&A inspection team also supports the PPM team in the MC&A survey subtopic. MC&A provides field validation of operations office findings, and feedback from facility interviews relative to the effectiveness of operations office MC&A surveys. During the interpretation of results, MC&A survey inspectors from the field element frequently meet with the MC&A inspector and conduct root cause analyses. They must determine whether findings from the OA inspection are indicative of an inadequate DOE operations office survey program.

Other Programs—Emergency Management

MC&A may be required to assist in other programs, primarily in support of emergency management exercises that involve the use or protection of SNM. MC&A personnel define potential targets and provide support as evaluators or controllers during performance tests.

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Section 8

ANALYZING DATA AND INTERPRETING RESULTS

Contents

Introduction

This section provides guidelines to help inspectors analyze data, assign findings, interpret the results of the inspection, and recommend assignment of ratings. The guidelines include a description of the analysis process and factors to consider while conducting an analysis. Information is also included on the significance of potential deficiencies, as well as suggestions for additional activities when deficiencies are identified. Inspectors can refer to this section for assistance in analyzing data and interpreting results, and for determining whether additional activities are needed to gather the information necessary to accurately evaluate the system and assign ratings. The OA-10 Appraisal Process Guide, Section 5, Closure, describes the overall OA process for closure and should be consulted when analyzing inspection results.

When analyzing the data collected on a particular aspect of the site safeguards and security system, it is important to consider both the individual segments of the safeguards and security system and the system as a whole. In other words, failure of a single segment of a security system does not necessarily mean the entire security system failed. This is one reason why integration among topic teams is important. It provides for a look at the "big picture" within the framework of the site mission when determining whether the overall security system is effective.

The analysis process involves the critical consideration of all inspection results, particularly identified strengths and weaknesses (deficiencies). Analysis will lead to a logical, supportable conclusion regarding how well the MC&A program meets the required standards and satisfies the intent of DOE policy. If more than one subtopic has been inspected, a workable approach is to first analyze each subtopic individually. Then, the results of the individual analyses can be integrated to determine: (1) the effects of subtopics on each other, if subtopics are to be rated separately; or (2) the overall status of the topic, if a single MC&A topic rating is to be given. In general, only one rating will be assigned for the MC&A topic, but in special circumstances, sub-topic ratings may be given. If subtopic ratings are given, accounting, measurements, and inventory are combined into a single rating to maintain consistency with the DOE Order for MC&A surveys.

If there are no deficiencies, the analysis is a relatively simple matter. If there are negative findings, weaknesses, deficiencies, or standards that are not fully met, the analysis must consider the importance and impact of those conditions. Deficiencies that reduce protection and put nuclear material at risk are significant findings and are rating drivers. It is best that the deficiencies be analyzed both individually and in concert with other deficiencies, and balanced against any strengths and mitigating factors to determine their overall impact on the MC&A program's ability to meet the required standards. Factors that should be considered during analysis include:

- Is the deficiency isolated or systemic?
- Did the field element, or contractor management previously identify the deficiency and, if so, what action was taken?
- What is the importance or significance of the standard affected by the deficiency?
- Were there mitigating factors, such as the effectiveness of other protection elements, which could compensate for the deficiency?
- Was the deficiency a planned action?
- What is the deficiency's actual or potential effect on mission performance or accomplishment?
- What is the magnitude and significance of the actual or potential vulnerability of DOE security interests resulting from the deficiency?
- Has the deficiency been presented to the field element and approval granted to continue to operate with the deficiency present in the MC&A system?

The analysis must result in conclusions concerning the degree to which the MC&A program meets the required standards and the resulting effect on the ability of the MC&A organization to accomplish its mission.

Each topic team is responsible for determining which inspection results are designated as findings. Findings identify aspects of the program that do not meet the intent of DOE policy. Although any program element or system not in compliance with DOE policy or not meeting DOE performance standards may be identified as a finding, topic teams are expected to exercise judgment. Minor and non-systemic items are omitted.

Findings are presented in a manner that identifies both the specific problem and the reference (DOE Order requirement). If findings address specific aspects of a standard, the topic team should determine whether the potential findings should be "rolled up" and reported as a single finding. This "rollup" may be appropriate if the single finding statement can clearly and completely convey the problems. Findings should always be worded to express the specific nature of the deficiency, clearly indicate whether the deficiency is localized or indicative of a trend, and clearly identify the organization responsible for the deficiency.

Integrated Protection of SNM

Data gathered and developed by one topic team often affects other topics being inspected. To take this interdependency into account, topic teams continue their integration activities until all pertinent information has been shared. This integration normally consists of a discussion of inspection results among topic teams regarding how information developed by one team influences the adequacy of the performance observed in another topic area.

During data analysis, each topic team should consider information obtained through integration, along with its own data. When necessary, the inspector who made the observation may prepare draft input that will be integrated and used by another topic team.

Integration of the results of the various inspection activities, subtopics, and elements is essential to an effective inspection effort. Minimally, this integration process should address:

- The impact of individual components on overall system performance
- An analysis of defense-in-depth
- The impact of findings in other inspection topics.

The integrated impacts of the findings are determined by:

- Reviewing vulnerability analyses to determine whether any one threat scenario has been defined that is impacted by more than one finding.
- Identifying a scenario that was not previously identified and that could result in undetected SNM diversion or theft.
- Identifying whether items of non-compliance could result in a single-point failure.

Inspectors must be aware of the relationships and interfaces among the various elements of the MC&A system and other inspection topics. Material accounting programs are reviewed to identify specific SNM that could be diverted and potential diversion scenarios that could be used to conceal the diversion. Reviews of material accounting detection and assurance measures also address the time that the diversion could remain undetected. Material controls are reviewed to identify access and movement/accumulation scenarios. Reviews of the physical security and protective force programs address the methods of penetrating MAA and PA boundaries. The integration of these reviews focuses on determining whether defense-in-depth is being provided by the safeguards systems and assessing whether or not SNM is at risk.

Ratings

The three ratings are Effective Performance (green), Needs Improvement (yellow) and Significant Weakness (red); OA-10 assigns these ratings based on a thorough analysis of inspection results and their implications. The OA-10 inspectors are responsible for assigning ratings; however, internal OA-10 protocols require the inspectors to defend the validity of the ratings with the inspection manager. In turn, the manager presents the validations to the Director of Independent Oversight and Performance Assurance. This layered "check and balance" concept of operation assures the highest degree of confidence that the ratings are fair and objective.

Guidelines for assigning ratings are:

- Effective Performance – Assigned when the system (topic or subtopic) provides reasonable assurance that the identified protection needs are met; or other compensatory factors exist that provide equivalent protection; or the impact of any identified deficiency is minimal and does not significantly degrade the protection provided.
- Needs Improvement – Assigned when the system only partially meets identified protection needs; or provides questionable assurance that the identified protection needs are met; or identified deficiencies are only partially compensated for by other systems or compensatory factors, and the resulting deficiencies degrade the effectiveness of the system.
- Significant Weakness – Assigned when the system being inspected does not provide adequate assurance that the identified protection needs are met, and there are no compensating factors to reduce the impact of identified deficiencies on system.

The findings should also be reviewed when the analysis section has been completed to assure that the analyses address each finding and appropriately evaluate the significance of each finding.

Findings

Inspection findings are the primary means of identifying elements of the MC&A system that do not meet the intent of the DOE orders. Findings should be presented in a manner that identifies the specific problem to be resolved and references the DOE order requirement. Where several findings address similar aspects of a DOE order requirement, the inspection team should determine whether they appropriately roll up into a single finding. Findings should be worded as closely as practical to the wording in a specific DOE order. However, the finding should clearly identify the nature of the deficiencies and specify whether the deficiency is limited to a particular location and/or system at the site. Facts related to findings should have already been validated as part of data collection. The OA-10 Appraisal Process Guide provides information on assigning policy findings and for the formatting of all findings.

Interpreting Results

Review of the MC&A systems according to DOE orders requires close coordination among inspection team members. The review of all the findings in each of the five MC&A subtopics (administration, accounting, measurement and measurement control, inventory, and containment) is the first step in evaluating what rating should be assigned to the topic. Similar criteria appear several times, and it is possible for more than one member of an inspection team to evaluate facility performance in the same area. This necessitates close team coordination to preclude inconsistencies. Based on performance test results, note that criteria evaluated as satisfactory from a compliance review might prove to be unsatisfactory when performance is evaluated.

An important aspect among all topic areas is the periodic validation with the contractor and the field element of any information that might be presented in the inspection report or that might be the basis of a finding. In a typical process, the inspector will:

- Begin the periodic (daily) validations with a summary of the inspection activities performed since the last validation
- Specifically identify any performance test conducted
- Present each observation of the activities, and allow the field element and contractor to respond
- Respond to any concern expressed by the field element and contractor during the validation.

The validation will identify possible items overlooked by the inspector, mitigating conditions, additional documentation and will identify awareness of MC&A status by the field element and contractor.

The inspection activities for the topic areas have been divided into performance tests and compliance reviews. Because the performance tests can evaluate how several elements of the MC&A system function together, these tests tend to be a more robust test of acceptable performance than the compliance inspections. The discussion below summarizes the key compliance elements of the five subtopic areas considered during the analysis and rating assignment activities. To ensure that all major inspected elements of the MC&A topic have been addressed, this section should be reviewed prior to assigning a rating.

Program Management/Administration

Administration deals with the management of the MC&A program, including documentation, training, internal reviews and assessments, performance testing, termination of safeguards, and reporting. Program planning, policy implementation, and cost-effective MC&A program implementation are also considered. Evaluated elements include organization and management, the MC&A plan, emergency plans, incident investigation and reporting, and administrative controls.

Effective performance in administration is indicated by proactive management, adequate funding and staffing, and sufficient management attention to support a program that complies with DOE orders. Conversely, weak administration may have an inadequate organization structure and insufficient authority to implement programs, which should prove evident throughout the program. Typically, repeated findings from previous inspections or surveys, failure to close findings in a timely manner, and other signs of inactivity are indicators of less than effective performance.

If a deficiency exists and administration and the field office have been proactive in attempting resolution, but have been hampered by fiscal, technical, or production obstacles from headquarters, it may be appropriate to direct a finding at headquarters staff. The OA-10 Safeguards and Security Appraisal Process Guide provides the detail for documenting and preparing issue papers and findings for Headquarters organizations.

An effective administrative program is characterized by current and adequate procedures, including the MC&A plan, with DOE and other approvals as required. Outdated procedures and documents, including those that have been in draft for extended periods of time, are characteristics of a less than effective program.

Each of the following questions should be considered when analyzing MC&A Administration data:

- Were all the documents requested during the inspection planning available, current, comprehensive and appropriately approved? If not, what is the MC&A impact on the facility operations?

- Is the MC&A organization independent of production responsibility? If not, what is the impact?

- Are field element approvals current?

- Does the MC&A organization provide for custody of SNM?

- Is the MC&A performance testing program comprehensive? Are tests thorough, conducted in accordance with an approved schedule, and evaluated? Are follow-up actions completed in a timely manner?

- Does the site have an approved MC&A plan and approved emergency plans, perform internal reviews and system assessments, and have an adequate training program? If not, identify the impact of each shortfall on the performance of the MC&A system.

The steps to analyze the collected information are as follows:

- Review documentation of related inspection activities. Were any findings identified that are related to the administration subtopic (e.g., training)?

- Review the documentation and structure of the MC&A organization. Does MC&A administration comply with the appropriate requirements?

- Review the performance of the inspected MC&A system against existing standards. Determine the impact of any noncompliance.

Validate information that may be used in the inspection report.

Documentation. Incomplete documentation affects not only the capability of an OA inspection to assess an MC&A system, but also affects field element surveys and internal assessments. The adequacy of documentation must be assessed in conjunction with the reviews of training, internal assessments, and field element surveys. If the site does not have an approved MC&A Plan that addresses the current methods for implementing MC&A at the site, then a less than Effective Performance rating is indicated. Additionally, the inspection analysis of the comprehensiveness of the MC&A Plan must address the status of documented procedures, training, and assessments.

Training. In general, an evaluation of the training program is based on whether the program successfully bridges the gap between required knowledge and skills and those actually demonstrated by the individuals involved. The determination must include a review of successfully completed training in defined competency areas (both formal and OJT), as well as custodian performance as determined from performance testing activities. In addition, reviews of any problem areas related to staff performance revealed during other inspection activities should be investigated. If problems are identified in transfer documentation, TID applications, and measurement activities, an analysis may determine whether the problem was an individual performance issue or a training issue.

The training program is considered inadequate if it fails to provide the necessary knowledge and skills required for successful completion of the individual's job function. Determination of adequacy requires a review of both compliance issues and performance testing to thoroughly assess the system.

Emergency Plans. Current emergency plans, approved by all appropriate levels of management, are evidence of effective performance. Performance tests of emergency plans in which personnel follow and use existing procedures are also indicative of effective performance. Outdated or inadequate plans or emergency responses in which personnel react from memory that is inconsistent with the procedure indicate less than effective performance.

Incident Investigation and Reporting. When incidents, such as an ID exceeding warning or alarm limits, occur at a facility, effective performance includes prompt response per procedure, including documentation and followup. Incidents that occur and have little or no documentation or inadequate closure (including followup and lessons learned) are symptomatic of less than effective performance.

Reviews and Assessments. It is essential that periodic reviews and system assessments be fully documented and comprehensive, and demonstrate adequate closure by report issuance and followup to achieve an Effective Performance rating. Staffing deficiencies that do not allow completion of an internal audit program or repeated findings and frequent extensions of commitment dates are indications of less than effective performance.

Accounting

Materials accounting addresses the various methods used to account for nuclear material and involves the completeness, accuracy, timeliness of the accountability record system, and the system's capability to respond to emergency conditions. Elements requiring evaluation include the facility accounting system, material transfers, and material control indicators. When inspection activities related to the accounting program have been completed, inspectors must analyze and integrate the results with the results from the measurements and inventory inspection activities. The integration of these three elements is used to arrive at a rating for accounting if subtopics are to be rated separately.

If problems are identified in the completeness of internal transfer forms, the analysis should consider whether the problems observed were due to the training program for custodians, the procedures, or the design of forms, or whether other root causes existed.

The facility accounting system typically provides for a database for tracking nuclear material, including material transfers and verification, detection, and evaluation IDs. It is important that procedures exist that are current, describe system operation, and provide assurance against tampering and unauthorized modification. These are essential elements for an accounting system with effective performance.

Internal and external nuclear material transfers have to be documented, and it is important that a program be implemented to provide assurance that attempts to divert or steal nuclear material during transfer will be detected or deterred.

Material control indicators include documented programs of evaluating and investigating S/RDs, IDs, and other inventory adjustments. It is important that the program include timely resolution and reporting requirements. Observed deficiencies are important in this area since they could indicate that the facility does not know how much material is on the inventory.

A facility accounting system that does not reflect item identity, quantity of nuclear material, and location is evidence for a less than Effective Performance rating. Systemic problems in the accounting system (numerous incomplete/ incorrect transfers) are also indicative of a less than Effective Performance rating.

Measurement and Measurement Control Systems

Measurement deals with the methods and systems used to determine quantities of nuclear material. Measurement and measurement control systems must provide assurance that nuclear material values are as stated and that out of control situations are promptly identified. It is essential that procedures describe the measurements made and that personnel performing nuclear material measurements be adequately trained. These elements are considered essential to an effective measurement program.

When inspection activities related to measurement and measurement control systems have been completed, the inspector must evaluate and integrate those results into the accounting subtopic. Measurement and measurement control systems must provide assurance that assigned SNM values are as stated on the facility inventory records. A deficiency noted in a single measurement system must be evaluated as either an isolated problem or as indicative of an overall system problem.

An isolated problem with a measurement system is evaluated in terms of the system contribution to the inventory values. Failures of measurement systems that affect significant quantities of material or artificially modify the LEID are indicative of less than an Effective Performance rating. An isolated problem with a single measurement system that does not affect a significant amount of material or significantly modify the LEID would be treated as a finding in the inspection report, but would not necessarily impact the rating. Generic measurement system problems must be coordinated with the accounting subtopic and with the MC&A inspection program administration element.

It is essential that statistical programs are based on sound statistical theory, and are fully documented—especially underlying assumptions used to determine warning and alarm limits.

Measurement systems which do not provide assurance that nuclear material quantities are as stated are evidence for a less than Effective Performance rating. Failure to have a measurement control program that does not detect when a measurement system malfunctions is also indicative of a less than Effective Performance rating. The degree to which the failure of the measurement and measurement control systems impact the nuclear material quantity could determine the difference between a Needs Improvement and a Significant Weakness rating.

Inventory

Taking a physical inventory and reconciling the inventory records must be carefully planned, documented, completed and reconciled as stated in DOE orders and the facility MC&A plan in order to assure an Effective Performance rating. It is important that confirmation and verification programs be in place and adequately documented with defined acceptance and rejection criteria.

When the inspection activities related to the inventory program have been completed, the inspector must evaluate and integrate those results into the accounting subtopic. The inventory program must provide assurance that the records are an accurate representation of material on hand and that the assigned SNM values are based on measured values. A deficiency noted in a component of the inventory program or a defect identified during a performance test must be evaluated as either an isolated problem or indicative of the overall system.

Isolated problems associated with measured values should be evaluated to determine the impact on reports of material holdings and inventory differences. Significant quantities of material for which the measurement method cannot be determined from the records system audit are indicative of a Needs Improvement rating. Evaluation of impact should consider the program for confirmatory and verification measurements.

By-difference accounting, excessive amounts of material not amenable to measurement, and values estimated by engineering judgement may also indicate a less than Effective Performance rating. Performance tests of the confirmatory and verification measurements provide evidence of whether by-difference values impact the quality of the physical inventory statement.

The training program, inventory plan, and inventory procedures are evaluated in conjunction with the program administration analysis to determine whether the findings are unique to inventories or are indicative of the MC&A system. A key element of the physical inventory program is to include features that ensure that the inventory methods are consistent from one period to the next. Such features may include training, documented procedures, process and storage area layout, and materials management practices.

A facility physical inventory program that does not provide assurance that nuclear material is as stated in the facility records is evidence of less than effective performance. The lack of assurance could be caused by a number of factors including incorrect frequency for taking a physical inventory, inappropriate sampling plan for inventory items, deficient procedures that could permit nuclear material to remain unaccounted for during a physical inventory, or untimely reconciliations. The severity of the problem will determine whether the rating is Needs Improvement or Significant Weakness.

Nuclear Material Containment and Surveillance

Containment deals with the various methods used to ensure that material is appropriately maintained in authorized locations, and material movement is properly tracked and monitored. Containment involves (1) the adequacy, reliability, and logistics of detection and surveillance devices utilized by the facility; and (2) the placement and maintenance of personnel and vehicle monitors, process monitoring devices, alarm systems, and other mechanisms used to alert the facility to unauthorized activities.

Containment elements requiring evaluation include: materials access, data access, material surveillance, material containment, barriers and other access deterrents, and detection and assessment.

Material access must be controlled so that only authorized personnel have access to the material. This area overlaps with physical security systems. Data access controls must provide access for authorized personnel and prevent unauthorized use. This area overlaps with computer security.

It is important that the material surveillance program provide timely assurance that materials are in their authorized location, including the detection of unauthorized material flows and transfers in its program. Material containment includes programs for MAAs (overlaps with physical protection), MBAs, material in storage, and material in use. The detection and assessment program is typically designed to detect removal of SNM from its authorized locations and to provide appropriate response when an unauthorized event is detected.

The adequacy of the containment program depends on the adequacy of the individual system elements and how effectively those elements are integrated. An effective containment program will normally provide assurance that an insider cannot remove Category I or II quantities of SNM from the process or storage repository without authorization or timely detection.

A containment program that meets all DOE requirements and site-specific objectives will be rated Effective Performance. Deficiencies in one or more elements should be analyzed both individually and cumulatively to determine the overall impact on the material control program. The following factors should be considered when analyzing the impact of an identified deficiency:

- Category and attractiveness level of the material affected
- Whether the field element or contractor has previously identified the deficiency and initiated corrective actions (Note: Even if both have occurred and a plan is in place, depending on the effectiveness and timeliness of the actions, the deficiency may still be the subject of a finding.)
- Whether the deficiency is only an isolated instance or is indicative of systemic or widespread deficiencies
- Length of time the deficiency has existed
- Effectiveness of other controls that protect the SNM (defense-in-depth)
- Probability of success and the degree of risk of detection or personnel injury involved in an attempt to exploit the deficiency
- Whether the deficiency would allow an insider to defeat multiple layers of the system.

When multiple deficiencies are identified, the inspectors should analyze the cumulative effect of the deficiencies on protection of SNM. The inspectors should consider whether:

- A single insider's position would enable exploitation of more than one deficiency. The effectiveness of a single insider must be evaluated in conjunction with the PSAP program and results should be fully integrated with personnel security.
- The same material process (or repository, or transfer point) is impacted by multiple deficiencies and, if so, the degree of protection provided by the remaining controls.
- The deficiencies "line up" to an open path (vulnerability) by which an insider could remove SNM with little or no probability of timely detection.
- A deficiency in one element (for example, TID records) allows the potential to conceal the exploitation of a deficiency in another element (for example, material surveillance). The team members inspecting the containment program should coordinate findings on the documentation of containment controls with the inspector addressing the administration program.

Consideration of Integrated Safeguards and Security Management Concepts

The ISSM concept provides a useful diagnostic framework for analyzing the causes of identified deficiencies. For example, inspectors may find that a required action is not being completed. Upon further investigation, the inspectors may determine that the reason is that there has not been a clear designation of responsibility for completing the required action. This situation may indicate a weakness related to line management responsibilities. In such cases, the inspectors would cite the deficient condition (i.e., the failure to complete the required action) as the finding and reference the requirement. In the discussion and opportunities for improvement, however, the inspectors may choose to discuss the general problem with assignment of responsibilities as a contributing factor.

As part of the analysis process, OA inspectors should review the results (both positive aspects and weaknesses/findings) of the review of the MC&A topic in the context of the ISSM concept. Using this diagnostic process, inspectors may determine that a number of weaknesses at a site or particular facility may have a common contributing factor that relates to one or more of the seven guiding principles. For example, a series of problems in MBA custodian training could occur if line management had not placed sufficient priority on protective force training and has not provided adequate resources to implement an effective training program. In such cases, the analysis/conclusions section of the MC&A report appendix could discuss the weaknesses in management systems as a contributing factor or root cause of identified deficiencies.

APPENDIX A

PERFORMANCE TESTS

Contents

APPENDIX A
PERFORMANCE TESTS

INTRODUCTION

This appendix provides a simplified list of potential performance tests that can be conducted during an OA inspection. These scenarios are very general in nature and are to be used as guidelines for the inspector. Each scenario has an objective, brief scenario description, and general evaluation criterion. Additional details are developed during the inspection when specific facility requirements and procedures have been determined. The scenarios in this appendix do not agree one-for-one with the performance evaluation subsection of Sections 2 through 6. The tests described here are more generic to the subtopic. An additional type of performance test, called a Tabletop Exercise, is described in Appendix C.

PROGRAM ADMINISTRATION

AD:1 MC&A Training Effectiveness

Objective

To determine whether the MC&A training program provides assurance that personnel performing MC&A functions are trained and/or qualified.

Scenario

Prepare a 20-question written test (possibly using existing facility tests) of facility-specific questions on duties and responsibilities from facility documentation and give it to a random sample of MBA custodians or material handlers. The test should be pre-approved by the facility trusted agent.

Evaluation Criteria

Ninety percent of those tested scoring 70 percent or higher implies SATISFACTORY performance. Some questions can be designated as "correct answers required for passing performance." Testing organizations may vary the acceptance criteria based on their knowledge of what the people should know.

AD:2 Emergency Response

Objective

Determine the effectiveness of material control practices and procedures employed during an alarm/evacuation.

Scenario

The MBA custodian opens an emergency exit door (controlled by a "shadow" SPO) and throws out a can containing a nuclear material source. Alternatively, an evacuation of a building is staged.

Evaluation Criteria

- Is the appropriate response plan activated?
- Is proper control of material maintained according to facility plans?
- Is the SPO response to a breach of an emergency exit appropriate and according to procedure?
- Does the SPO rover locate the material or is the emergency situation resolved?
- Can loss of material be localized?

AD:3 Emergency Response

Objective

Determine the ability of personnel to respond to and properly resolve a missing SNM item.

Scenario

State that an item of SNM is missing using various theft or hoax scenarios, or create a dummy item with a realistic history in the accounting records just prior to an inventory.

Evaluation Criteria

- Are response procedures followed?
- Can an unauthorized removal be localized?
- Does the accounting system identify the missing item?
- Does the system distinguish between a hoax and an actual missing item?

AD:4 Vulnerability Assessment (VA) Validation Checks

Objective

Determine whether the detection probabilities used by the facility are supported in the VA.

Scenario

Review the VA and select several detection probabilities. Ask the facility to produce the documentation that supports the detection probability.

Evaluation Criteria

- Does documentation exist to support the VA detection probability?
- Does performance testing data support the detection probability assigned?
- Does the facility have an ongoing performance testing program to support the detection probability?

AD:5 Internal Review and Assessment Program Observations

Objective

Determine whether the facility can perform an internal review by observing an actual assessment.

Scenario

Select an internal review topic and an area to be reviewed. Request the facility to conduct an internal review. Observe the review, or introduce an anomaly by having a finding (using the individual to be reviewed as a trusted agent) to determine if the internal review is effective in detecting that finding.

Evaluation Criteria

- Is the reviewer knowledgeable in the area being reviewed?
- Is the topic being reviewed documented in the internal review and assessment program plan?
- Are communications between the reviewer and reviewee clear and concise?
- If there were any findings, did the reviewer effectively communicate them to the reviewee?

- If an anomaly was introduced by the inspector, was it detected?
- Were appropriate actions taken?

AD:6 Facility-Conducted Performance Test Observations

Objective

Determine whether the facility can conduct performance tests in accordance with established procedures.

Scenario

Select a performance test from an existing bank of facility performance tests. Request the facility to conduct the test.

Evaluation Criteria

- Was the test conducted in accordance with the established procedure?
- Were the pass/fail criteria clearly defined?
- If required, were corrective actions taken?
- Was the test properly controlled?
- Were the conclusions of the facility accurate and properly recorded?

AD:7 Closure of Corrective Active Validation

Objective

Determine whether closed findings from the internal review and assessment program have been appropriately closed.

Scenario

From a list of closed findings from the internal review and assessment program, select several closed findings. Validate the closed findings through field inspections.

Evaluation Criteria

- Were the findings stated as closed by the facility still closed?
- Were the findings appropriate for the identified deficiency?
- Were the closure actions still in place?
- Did the corrective action address the root cause of the deficiency?

ACCOUNTING

AC:1 SNM Receipt Closure

Objective

Determine whether transactions (receipts) with unmeasured values or significant SRDs are entered into the process.

Scenario

Utilize a NMMSS-generated TJ-14, "Transaction Activity Summary By Facility" to test facility records.

Evaluation Criteria

- Are receipts measured and transactions closed prior to introducing material to process?
- Are exceptions granted for those materials that do not have a measurement or for transactions not completed?

AC:2 Accountability Data Traceability

Objective

Determine whether an audit trail exists from source data to accounting records that reflects compliance with internal and DOE requirements.

Scenario

Evaluate accounting documentation related to a statistical sample of transactions detailed in a NMMSS-generated TJ-26, "Random Sample" report.

Evaluation Criteria

- Is the required documentation present and technically correct to provide assurance that the accounting system accurately reflects inventory quantities?
- Is an audit trail available for all transactions?
- Are item histories complete such that a missing or faulty record can be reconstructed or corrected, and an inventory list of all material in any MBA or storage facility can be constructed?
- Are there checks and balances that detect errors or discrepancies?

AC:3 Document Sampling

Objective

Determine whether the accounting system is in compliance with all reporting requirements.

Scenario

Randomly select a sample of accounting documents to verify accuracy and completeness and then use this sample to physically locate material. (May be used with the tests for accountability data traceability and item location.)

Evaluation Criteria

- Were all records complete, accurate, and submitted in a timely manner?
- If discrepancies exist, are they a systemic problem or isolated cases?
- Does the information in the records agree with the physical inventory?

AC:4 Accounting System Failure

Objective

Determine whether the materials accounting system can function following system failures at different levels and whether the system can be recovered.

Scenario

Simulate failure of different levels of the accounting system, including on-line data entry points on process lines or sensors, primary accountability computers, and primary storage media.

Evaluation Criteria

- Were operations successfully restarted?
- Was there resolution of all items, operations, and measurements affected while the system was down?
- Was the system successfully restarted from backup data or systems?

AC:5 Computer Access Authorization

Objective

Determine whether facility computer access controls to the nuclear material accounting system can be violated.

Scenario

An authorized user intentionally enters incorrect passwords to the nuclear material accounting computer system.

Evaluation Criteria

- Were facility procedures for access control documented?
- Was the unauthorized entry detected?
- Was the facility response appropriate and in accordance with established procedures?

AC:6 Material Transfer Checks for MBA Categorization

Objective

Validate the facility controls to assure that a Category II or III MBA cannot receive material that would increase the category level.

Scenario

Attempt a material transfer (using only documentation not actual material) to a Category II or III MBA to increase the category of the MBA.

Evaluation Criteria

- Do procedures exist to prohibit the increase in category level for MBAs?
- Was the attempted transfer detected?
- Was the facility response to the attempted transfer appropriate?

AC:7 Item Identification Front and Back Checks

Objective

Determine whether the facility records accurately reflect the identity, value, and location of inventory items.

Scenario

Select a sample of items from either the inventory listing or during the field inspections. Record the item ID, location, Pu weight, and TID. Verify the items in the field or the sample taken from the field to the accountability system records.

Evaluation Criteria

- Were items in the field successfully reconciled to the nuclear material accounting system records?

AC:8 Field Data Accounting Records Check

Objective

Determine whether the data records maintained by the MBA custodian agree with the records maintained by the nuclear material accounting system.

Scenario

Take a sample of MBA custodian records and verify the data with the central nuclear material accounting records.

Evaluation Criteria

- Were MBA custodian records reconciled to the accounting system records?

AC:9 SNM Item Listing Generation

Objective

Determine whether the facility can generate a physical inventory listing for MBAs possessing Category I SNM within 3 hours, or within 24 hours for other MBAs.

Scenario

Request the facility to generate an inventory listing and note the time required to generate the listing. (This scenario can be combined with an actual physical inventory. The inspector can introduce an anomaly into the inventory list and evaluate the facility response.)

Evaluation Criteria

- Was the inventory list generated within the appropriate timeframe?
- Was the list accurate?
- How did the facility consider items in transit or data that had not been entered into the computer system?
- If an anomaly was introduced, did the facility detect it and initiate appropriate action?

AC:10 Internal Transfer Forms Falsified

Objective

Determine whether the facility can detect a falsified internal transfer.

Scenario

A facility transfer form is prepared by an unauthorized individual and processed through the accountability system.

Evaluation Criteria

- Did the facility procedure for processing transfers detect the falsified transfer?
- Was the facility response appropriate and timely?

AC:11 Audit Trail Traceability

Objective

Determine whether the nuclear material accounting system can trace changes by type of change and the individual making the change.

Scenario

Select a series of nuclear material accounting records and review their audit trail. The review can include a computer printout or may be a manual verification. Alternatively, the inspector may request a nuclear material accounting clerk to make a series of changes to transfer records and then review the traceability of the changes.

Evaluation Criteria

- Did the audit trail provide the necessary information in a timely manner regarding the types of changes made to the accounting database?

AC:12 Personnel Data Entry Observation for Source Document and Accounting Data

Objective

To evaluate the training and procedures of facility accounting personnel by observing the entry of data into the nuclear material accounting system.

Scenario

Select individuals from the nuclear material accounting group and select a series of nuclear material accounting transactions. Request the individuals to enter the transactions into the accounting system while an inspector observes. Example transactions include MBA internal transfers, project changes, shipment data, receipt data, or correction to these documents.

Evaluation Criteria

- Were nuclear material accounting procedures followed?
- Were the nuclear material accounting personnel knowledgeable of the transaction?
- Were the procedures sufficiently clear to allow the nuclear material accounting person to enter the transactions?

MEASUREMENT AND MEASUREMENT CONTROL

M:1 Scales and Balances

Objective

Determine whether the scales and balances program provides data of the quality required for MC&A records.

Scenario

Select a sample of accountability weighing instruments from the MC&A organization records and verify the frequency and currency of the calibration and the performance of daily linearity checks. Check the performance of the instrument against standards normally used or against independent weight standards that are in the normal weighing range of the instrument.

Evaluation Criteria

- Was instrument calibration current?
- Are appropriate standards being used?
- Are daily checks being made?
- Were personnel familiar with the operating and MC&A procedures?
- Did the instruments perform to the stated specifications?

M:2 Tank Calibration Verification

Objective

Determine the performance standard error and the limits of bias of one or more key MC&A volume measurement systems.

Scenario

Select key volume measurement systems and for each require, or obtain from previous measurements made during recent weeks, duplicate measurements of at least 10 volumes of process materials normally measured. Perform a statistical evaluation of the data to obtain the estimated standard error and limits of bias for each system.

Evaluation Criteria

- Were the tank calibrations current?
- Do the results of the analysis differ significantly from historical measurement control data?
- Is the observed standard error reasonable for the system?
- Were personnel familiar with the volume measurement procedure?

- Do any of the tanks have a significant bias and, if so, at what probability level? Has a bias been previously observed? Are corrections for bias being applied?

M:3 Analytical Measurements

Objective

Determine whether the measurement control data used to control the analytical method are reasonably stated.

Scenario

Using a process control standard with a standard value traceable to a national measurement base, submit two samples to operations in the morning and two in the afternoon. Request two analyses for each sample.

Evaluation Criteria

- Did the results agree within accepted control limits?

- Did the precision and accuracy of the results agree with the stated precision and accuracy of the method?

M:4 Off-Specification Measurements

Objective

Test the performance of accountability measurements and reporting procedures when measurement systems are outside system specifications.

Scenario

Select items from the inventory that are outside the performance capability or calibrated range of a measurement device. Request that the items be measured. Review the reporting and investigation of out-of-limits conditions for all accountability measurement instruments for a specific period.

Evaluation Criteria

- Were the items measured on the instrument that was beyond the operating range?

- Was the measurement flagged as being suspect due to the operating range limitation?

- Have all out-of-limits conditions been documented and investigated with appropriate corrective actions?

M:5 Confirmatory/Verification Measurements

Objective

Determine whether the confirmatory or verification measurement program provides data of the quality required for the MC&A records.

Scenario

Select key measurement systems and measure standards or analyze items using an independent method or with an independent laboratory serving as a referee to compare standard errors and limits of bias with values reported by the facility measurement control program.

Evaluation Criteria

- Did the measurements perform to the specifications established for the system?
- Are the levels of precision and accuracy adequate to meet the material loss detection goals?
- Were acceptance/rejection criteria available for the system?
- Were personnel familiar with the operation of the system?

M:6 Confirmatory Measurement

Objective

Determine whether a confirmatory measurement system is effective and whether appropriate actions are taken if a confirmatory measurement indicates that all nuclear material is not present in an item.

Scenario

Partially shield the detector of an assay device so that it appears that some of the nuclear material is not in the item or adjust an item in such a way that the confirmatory measurement should detect the change.

Evaluation Criteria

- Does the confirmatory measurement fall outside the acceptable range?
- Is the item remeasured?
- Is supervision notified and are response procedures followed?

M:7 Operation Of Measurement Equipment/Blind Sample for Measurement

Objective

Determine whether operators and procedures are adequate to assure operation of nuclear material measurement equipment.

Scenario

Select a measurement system and operator. Request the operator to operate the equipment and record measurement data, or select a sample of nuclear material to be measured, and follow the material through the measurement process.

Evaluation Criteria

- Are procedures clear?
- Are operators trained?
- Did the equipment function as required?
- If data indicated an out of control condition, were appropriate corrective actions taken?
- Were data properly recorded?

M:8 Measurement of a Standard/Calibration

Objective

Determine whether the facility can successfully measure a known standard or conduct an instrument calibration.

Scenario

Select a piece of measurement equipment and request the facility to measure a standard or calibrate the instrument. (The inspector should consider the feasibility of modifying the measurement system to obtain an unacceptable result.)

Evaluation Criteria

- Was the procedure complete, current, and followed by the operator?
- Were the measurement results evaluated correctly?
- If control limits were exceeded, were corrective actions taken?

M:9 Training Tests: Knowledge Tests

Objective

Determine whether operators are knowledgeable of measurement equipment operation.

Scenario

Prepare a knowledge examination and administer it to a group of qualified operators. (The test should be preapproved by the facility trusted agent.)

Evaluation Criteria

- Did all personnel score greater than predetermined acceptable results?
- If unsatisfactory results were obtained, what justification was provided by the facility?

M:10 Training Tests: Training Records

Objective

Determine whether the facility training records for measurement personnel are current.

Scenario

Select the names of several operators that the facility states are qualified to perform accountability measurements. Review the training records to assure that they are qualified.

Evaluation Criteria

- Were training qualification criteria documented?
- Were records available for all qualified personnel?
- Was each individual qualified based on the facility criteria?

M:11 Records Checks: Measurement Results/Traceability of Standards

Objective

Assure that results of measurement data are properly recorded and that standards are traceable to the National Institute of Standards and Technology (NIST).

Scenario

Select a group of items from the inventory listing or select a group of measurement results from the laboratory. From the list, verify that the results are appropriately transcribed. The items from the inventory list should have measurements traceable to laboratory results. The measurement results should be traceable to the inventory. For each measurement system, identify the appropriate standard and request documentation of its certified value.

Evaluation Criteria

- Were data legibly recorded in the laboratory?
- For multiple analyses of the same sample, were values calculated appropriately?
- Were outliers dispositioned according to procedure?
- Were standard data traceable to NIST?
- Were reference standard sheets available?

M:12 System Not Approved for Measurement

Objective

Determine whether the facility has procedures in place to assure that measurement systems not approved for accountability purposes are not used for accountability measurements.

Scenario

Request an accountability measurement on a measurement system that is currently not approved for accountability measurements. This can be accomplished by attempting to use a system currently out of calibration, by placing a system out of accountability early in the inspection and subsequently requesting a measurement, or by requesting an accountability measurement on an instrument outside the range/use (for example, weighing an item on a scale outside the checkweight range or requesting that an item be measured on an NDA instrument not used for that material type).

Evaluation Criteria

- Were procedures for tagging the equipment out of service for accountability purposes followed?
- Did the facility measure and report the measurement for the item?
- Was the equipment identified as "not to be used for accountability"?
- Were appropriate actions taken?

M:13 Submission of Samples: Independent Verification of Measurement Results and Duplicate Samples for Analysis

Objective

Determine the capability of the facility measurement equipment to achieve consistent measurement results.

Scenario

A sample is taken and analyzed by a different offsite laboratory or by a different laboratory within the facility, or duplicate samples are taken by the inspector and sent to the laboratory for duplicate analyses.

Evaluation Criteria

- Were sampling and analytical procedures followed?
- Were results obtained within predetermined acceptable tolerances?
- Were any corrective actions required? If so, were they taken?

INVENTORY

I:1 Inventory Effectiveness

Objective

Determine whether inventory procedures are implemented to provide a determination of the material on inventory.

Scenario

Witness the conduct of a physical inventory of an MBA to determine that procedures are correctly followed and the inventory is effectively performed.

Evaluation Criteria

- Was all nuclear material located during the physical inventory?
- Did all nuclear material have an associated measured value?
- Did the inventory procedure include measures to assure the quality of the inventory-taking activities?
- Was the ID within established control limits?

I:2 No-Notice Emergency Inventory

Objective

Determine whether the emergency inventory program assures that all material is inventoried and inventoried only once. (The test does not address inventory verification measurements, audits of records for transcription mistakes, or other activities to reconcile the results of the physical inventory to the book records.)

Scenario

Select an MBA or part of an MBA for which to complete the inventory in the timeframe allowed. Initiate the inventory by either simulating a request from the operations office or initiate as a response to another test, such as the daily administrative check. Coordinate with appropriate containment tests for evaluation of emergency response.

Evaluation Criteria

- Were all items stated to be in the area actually present and were no other items present?
- Were the correct procedures followed when anomalies were found?
- Were confirmation measurements within limits?
- Was the inventory completed within the time frame expected for the area?

I:3 SNM Location

Objective

Determine whether inventory items are in their stated locations and inventory records accurately reflect the physical inventory.

Scenario

Choose a random sample of SNM items from the accounting records and make a physical check of their location and inventory characteristics or randomly select items from the physical inventory and verify their accountability information in the accounting records.

Evaluation Criteria

- Did the information in the accounting records about each item selected agree with the information listed on the item?

- Was the location of the item correct?

I:4 Item Location

Objective

Determine whether an item location anomaly can be properly resolved.

Scenario

Move an item to a different location without a change in the records just prior to an inventory. (May be included as a test of DACs.)

Evaluation Criteria

- Did the system identify the item?
- Were reconciliation procedures followed?

I:5 SNM Verification

Objective

Determine whether items in the inventory have the correct SNM values and whether the inventory is correctly stated.

Scenario

Randomly select items from the inventory for remeasurement using an accepted verification measurement method.

Evaluation Criteria

- Were all selected items found?
- Were proper calibration checks performed on the measurement system prior to operation?
- Were the measurement results for the items within the documented acceptance/rejection criteria?
- Were proper steps followed to resolve any anomalies?
- If discrepancies were found, were they appropriately reconciled and the inventory tested further?

I:6 Variables Test of Unsealed Items - Verification Measurement

Objective

Determine that partial removal of SNM from items in the inventory has not occurred such that a goal quantity of SNM is diverted. The removals may be classified as:

- Partial removal from a small number of items

- Partial removal from a small number of items where the removed SNM is replaced by non-SNM material or SNM of a lower attractiveness level

- Partial removal from all items

- Partial removal from all items where the removed SNM is replaced by non-SNM material or SNM of a lower attractiveness level.

Scenario

Obtain an inventory listing for an MBA and select a goal quantity to be detected and a non-detection probability. Stratify the inventory and select a random sample. Check items for proper locations and data and measure the items using an accepted measurement system.

Evaluation Criteria

- Were all selected items found?
- Were proper calibration checks performed on the measurement system prior to operation?
- Were the measurement results for the items within the documented acceptance/rejection criteria?
- Were proper steps followed to resolve any anomalies?
- If discrepancies were found, were they appropriately reconciled and the inventory tested further?

I:7 Attributes Test of Sealed Items - Confirmatory Measurement

Objective

Determine that inventory quantities are correctly stated by item and in total; i.e., the inventory is free of gross defects that total a stated goal quantity of SNM. A gross defect is defined as a difference between the stated and measured contents of an item that could not be normally attributed to measurement error.

Scenario

Obtain an inventory listing for an MBA and select a goal quantity to be detected and a non-detection probability. Stratify the inventory and select a random sample. Check items for proper locations and data and measure the items using an accepted measurement system.

Evaluation Criteria

- Were all selected items found?
- Was the TID integrity verified for each item?
- Were proper calibration checks performed on the measurement system prior to operation?
- Were the measurement results for the items within the documented acceptance/rejection criteria?
- Were proper steps followed to resolve any anomalies?
- If discrepancies were found, were they appropriately reconciled and the inventory tested further?

I:8 Physical Inventory Anomaly Recognition

Objective

Determine whether the facility can resolve an anomaly that occurs during a physical inventory.

Scenario

Introduce an anomaly during a physical inventory. (The anomaly can be an extra item, a missing item, or a broken TID.)

Evaluation Criteria

- Was the physical inventory anomaly detected within the predetermined timeframe?
- Were appropriate notifications made and corrective actions taken?
- Were procedures adequate to respond to the situation?

I:9 Reconciliation Verification

Objective

Determine whether the facility can reconcile a physical inventory.

Scenario

Conduct a records check of physical inventories that have been previously completed. Alternatively, have the facility conduct a physical inventory and observe the inventory reconciliation through calculation of the ID. (An anomaly can be introduced during the reconciliation as a means of verifying the ability of the facility to properly reconcile. An item can be intentionally missed, an extra item can be inventoried, a value can be modified, or statistical sampling plans can be altered.)

Evaluation Criteria

- Was the reconciliation completed in a timely manner?
- Were anomalies detected during the reconciliation?
- Were reconciliation procedures clear?
- Were appropriate corrective actions taken?
- Was the ID properly calculated?
- Was the ID properly reported and recorded in the nuclear material accounting records and to NMMSS?

I:10 Propagation of Variance Verification

Objective

Determine whether the limit of error of inventory difference (LEID) is properly calculated.

Scenario

Review the records for the LEID calculation. Trace variance data to original source data. Verify that covariances are properly accounted for.

Evaluation Criteria

- Was the LEID reported as stated?
- Were the major contributors to the LEID identified?
- Were the variances based on current data?
- Were covariances between measurements and between inventory terms properly accounted for?

I:11 Statistical Sample Generation

Objective

Determine whether the facility can generate a sample for the physical inventory in accordance with its procedures.

Scenario

Given the facility statistical sampling parameters, request the facility to generate a sample inventory list. Alternatively, introduce an anomaly into the system (e.g., modify the statistical sampling parameters) and determine if the facility can detect it.

Evaluation Criteria

- Was the list generated in a timely manner?
- Were procedures adequate to produce the statistical sample?
- If an anomaly were introduced, was it detected in a timely manner?
- Were appropriate corrective actions taken?

CONTAINMENT

C:1 Barrier Integrity

Objective

Determine whether SPOs or individual conducting a DAC will locate a hole in the MAA boundary. The inspector should validate that part of the DAC is to identify breaches of barrier integrity.

Scenario

Simulate a hole in the wall of the MAA boundary.

Evaluation Criteria

- Did SPOs (or other plant personnel) identify the simulated hole?
- Were actions taken by the SPOs or personnel appropriate?

C:2 Internal Controls

Objective

Determine whether transfer authorization forms (serialized, controlled forms) can be obtained by unauthorized personnel.

Scenario

An insider, who is not authorized to receive transfer authorization forms, tries to obtain some forms.

Evaluation Criteria

- Does the person in control of the transfer forms authorize delivery to the insider?
- Does the insider obtain the transfer forms?

C:3 Internal Controls

Objective

Determine whether the combination lock for the entrance to an SNM storage or process area (or the second combination of a two-lock door) can be compromised.

Scenario

An unauthorized insider (operator, health physics, SPO, etc.) requests the combination from an authorized person for a valid reason or the insider surreptitiously gains access to the combination.

Evaluation Criteria

- Did the authorized person reveal the combination?
- Could the insider gain unauthorized access to the area?

C:4 Material Surveillance

Objective

Determine whether the two-person rule can be compromised.

Scenario

One person of the two-person rule requests that the other person leave to get additional supplies. (This scenario can be tested in vaults, processing areas, waste assay and packaging areas, TID applications, etc.)

Evaluation Criteria

- Did the person leave the area?
- Was a second authorized person called to provide two-person coverage?

C:5 Material Transfers

Objective

Test the proper authorization signatures on transfer forms.

Scenario

An insider who has access to forms authorizing the transfer of SNM is not authorized to sign the forms. The insider fills out the form, signs for himself, and attempts to remove a packaged nuclear material source through the MAA boundary; or an insider authorized to sign transfer forms attempts to remove material from an MAA.

Evaluation Criteria

- Does the SPO at the MAA boundary check the authorizing paperwork?
- Does the SPO recognize that the signature is not authorized or that the person is not authorized to transfer material?
- Does the SPO permit the insider to leave the MAA with the material?

C:6 Material Transfers

Objective

Determine whether transfer documentation can be counterfeited.

Scenario

A transfer form is copied, signed by an authorized signature, and used to transfer nuclear material sources out of an MAA.

Evaluation Criteria

- Does the SPO allow the transfer of material?

- Does the SPO recognize the form as having been copied and, even though the signature is authorized, is the insider stopped from leaving the MAA?

C:7 Portal Detection Systems

Objective

Determine whether SNM can be removed in items (used respirators boxes, laundry, waste boxes, toolboxes, etc.) being removed from an MAA.

Scenario

Place simulated SNM (sources) inside one of the items scheduled for removal by an insider. The insider then tries (under the two-person rule) to remove the SNM through the MAA boundary.

Evaluation Criteria

- Did the SNM portal monitor alarm or did the SPO monitor the containers?
- Did the SPO allow the insider to leave the MAA?
- Did the SPO respond appropriately to the alarm?
- If a TID should have been present, did the SPO question the lack of a TID?
- Was the SNM found and notification made?

C:8 Portal Detection Systems

Objective

Determine the adequacy of a portal detection system to detect the removal of SNM.

Scenario

Observe the conduct of SNM and metal detector calibrations and tests. Conduct variations of the same tests in an attempt to defeat the detector. Use various amounts of non-ferrous metal in conjunction with SNM sources to test the combination of SNM and metal detection capability.

Evaluation Criteria

- Are the calibration sources detected by the portal detectors?
- Can shielded SNM in quantities greater than allowable limits be removed undetected?

C:9 Portal Detection Systems

Objective

Determine whether an SPO enforces post orders for other members of the security force.

Scenario

An SPO walks through the MAA boundary causing the portal metal detector to alarm, OR SPO places a nuclear material source in a pocket and walks through the MAA boundary.

Evaluation Criteria

- Does the SPO at the MAA boundary stop the SPO from leaving the area?
- Does the SPO at the MAA boundary require the SPO to re-enter the portal or search the SPO with a portable detector?
- Is the search effective?

C:10 Portal Detection Systems

Objective

Determine whether SNM can be piggybacked with sources to be removed from the MAA.

Scenario

An insider carries a nuclear material source in his or her pocket and a second nuclear material source in a scrap can with accompanying transfer authorization forms.

Evaluation Criteria

- Once the packaged nuclear material and authorizing paperwork are checked by the SPO, is the insider requested to walk back through the portal monitor?

- Once the portal alarms again, does the SPO search the insider with a portable detector?

C:11 Portal Detection Systems

Objective

Determine whether SNM can be removed from MAA boundary exits other than the normal personnel entry point.

Scenario

Place simulated SNM (sources) inside containers that leave the MAA. An insider tries to remove the material through an MAA exit other than the primary exit.

Evaluation Criteria

- Does the SPO search the containers with portable equipment?
- Is the source detected?
- Is the SPO response to alarms appropriate?

C:12 Tamper-Indicating Devices

Objective

Determine whether TIDs can be obtained by unauthorized personnel.

Scenario

An insider who is not authorized to receive TIDs tries to obtain them from the TID custodian or the TID administrator.

Evaluation Criteria

- Did the custodian or administrator check the person against the authorization list?
- Did the signatures match?
- Did the insider receive any TIDs?

C:13 Tamper-Indicating Devices

Objective

Determine whether TID numbers can be accurately traced to corresponding item/identification numbers/storage locations.

Scenario

Randomly select a sample of TIDs from the TID administrator for a TID custodian and trace the TID numbers with corresponding items to current status, or randomly select a sample of TIDs in use and trace their identification numbers to accounting records.

Evaluation Criteria

- Is the documentation accurate enough to provide assurance that the records reflect current status?

C:14 Tamper-Indicating Devices

Objective

Determine whether TIDs are being applied and removed consistent with procedures.

Scenario

Observe the application and removal of TIDs by randomly selected persons authorized to use TIDs.

Evaluation Criteria

- Did the person follow approved procedures?
- Were the correct seal type and serial numbers used?
- Can access to the container (or location) be achieved without detecting damage to the TID?

C:15 Tamper-Indicating Devices

Objective

Determine whether TID discrepancies are detected and proper resolution achieved. May be included as a test of daily administrative checks and physical inventories.

Scenario

Replace a TID with another without initiating changes in accounting records or make a change in the TID number in the accounting records.

Evaluation Criteria

- Was the different number detected?
- Were records checked to verify which TID should be on the item?
- Was the item remeasured to verify the SNM content?

C:16 Daily Administrative Checks

Objective

Determine whether procedures for daily administrative checks (DACs) are followed and whether the procedures are effective.

Scenario

Witness the conduct of the DAC procedures, including an abnormal situation that should be detected by normal procedures. Select a random sample of DAC records to validate DAC performance.

Evaluation Criteria

- Did the person conducting the check follow procedures?
- Was the abnormal condition detected?
- Did the records selected reflect required DAC completion?

C:17 TID Records Check

Objective

Determine whether the TID records system is accurate.

Scenario

Select a sample of the records for TIDs. The records may be from the TID custodian, the MBA custodian who applies TIDs, or the central records for TIDs. (This is a records check performance test.)

Evaluation Criteria

- Are the records current?

- Are authorized TID custodians, applicators, and witnesses the only personnel to apply/witness TIDs?

- If containers are checked relative to the TID log, do the containers have the appropriate TIDs, and conversely, do the records reflect the containers with the proper TIDs?

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APPENDIX B

STATISTICAL SAMPLING

Contents

APPENDIX B

STATISTICAL SAMPLING

INTRODUCTION

This appendix is used by MC&A inspectors as a reference to support statistical calculations that may be required during a facility inspection. It is organized as follows:

Overview: A brief introduction to the application of statistical sampling during a facility inspection

Sampling Strategies: Considerations in using statistical sampling during an inspection

Formula for Variables Sampling: A simple formula for sample size determination

Table B-1: Confidence Intervals for Small Sample Sizes (Clopper-Pearson)

Table B-2: Ninety Percent Two-Sided Confidence Intervals For the Proportion of Defects

OVERVIEW

The first decision that must be made is determining whether or not a statistical sample is appropriate in testing a particular MC&A element. A statistical sampling plan provides an objective mechanism for evaluating specific criteria, but is not always warranted. Inspections are audits specifically chartered to evaluate compliance of the facility. A single instance of non-compliance must be reported. Whether or not the single instance can be extrapolated to the entire facility must be based on additional investigation by inspectors.

Statistical sampling plans can be used to assist in determining facility compliance. Inspectors choose the appropriate statistical parameters, select the sample size, and determine the criteria for acceptance and rejection. Inspectors then select the sample, conduct or have the test conducted, evaluate the results, and draw conclusions based on the results. The most difficult aspect of this process is determining valid accept and reject criteria that are fair to both the facility and the inspection process and that can be completed during the inspection period.

Most sampling plans chosen in the inspection process are based on an acceptance number of zero—that is, no defects are acceptable. No defects are acceptable for two reasons:

(1) These plans provide a minimum sample size

(2) The criteria being studied are of a critical nature and, in some cases, one defect is intolerable. As stated in Bowen and Bennett, *Statistical Methods for Nuclear Materials Management*:

> "The use of a zero acceptance number has considerable merit in audit and inspection applications. In many cases, the emphasis may properly be placed on uncovering errors, if they exist, rather than on attempting to discriminate between the acceptable and rejectable quality levels. In financial auditing, sampling plans of this type are called 'discovery sampling plans,' which is suggestive of their emphasis on finding errors rather than testing a hypothesis."

It should be noted that when a statistical sample is chosen and a failure is found, it is not indicative of an unsatisfactory rating. Similarly, if no defects are found, it does not assure that a satisfactory rating will be obtained. The inspector must use judgment in evaluating the results of any test chosen. As can be seen from the Clopper-Pearson method for determining confidence levels from small samples (see Table B-1), the overall system probability of success is very broad when inferences are drawn from small samples. Thus, while a problem may be indicated, concluding that the overall system is defective based **solely** on the results of the sample may not be correct. Similarly, the absence of a problem may not mean that none exists, since when a small sample is chosen the overall power may be very low.

SAMPLING STRATEGIES

Inspectors use statistical sampling plans to select elements of the site's MC&A system for testing. Some inspection activities where statistical sampling plans may be used are:

- Knowledge interviews/tests of facility personnel
- TIDs

- Portal monitors (SNM and metal)
- Inventory verification
- Nuclear materials records audits.

Selection of a sampling plan and its attributes depends on the status of site compliance and the testing performed during internal assessments and DOE operations office surveys. If the site has compliance deficiencies (for example, lack of documentation), statistical sampling plans may be inappropriate because of the difficulties in identifying the population to test and developing mathematical models. If, by contrast, the element being tested by inspectors has already been tested during internal assessments or DOE operations office surveys, then inspectors would use limited sampling plans to verify that the internal assessments or DOE operations office testing were valid. The third situation that may occur is that the MC&A system is well characterized and fully operational but the site or operations office has not implemented testing using statistical sampling. In this case, inspectors may use statistical sampling to test randomly selected components with the intention of demonstrating the assurance provided by the site's program.

As previously discussed, focus areas are not always selected at random. This is consistent with DOE management's interest in the existence of deficiencies, rather than projections based on statistical sampling. If the identified deficiencies indicate potential vulnerabilities, then they would be interpreted in the context of the SSSP. However, each inspection should use some random selection to assure that all elements of the MC&A system have a non-zero probability of being inspected. Whether non-random sampling is used depends on inspection goals (e.g., identifying weaknesses or quantifying effectiveness).

FORMULA FOR VARIABLES SAMPLING

The generalized formula for calculating the sample size required from a population where zero is the acceptable acceptance number is:

$$N = N_0 * (1 - B^{Xg/M})$$

where:

N = Sample size

N_0 = Number in total population

B = Non-detection probability (probability of missing a defect)

X = Average item weight

g = Fractional defect detectable (e.g., g = 1 for attribute sample where item is classified as acceptable or unacceptable)

M = Goal quantity for detection

Example:

$N_0 = 1000$
B = 0.2
X = 400 grams
g = 1
M = 2,000 grams
$N = 1000 * (1\text{-}0.2^{(400*1/2000)}) \cong 1000 * (1\text{-}0.72) \cong 1000 * 0.28 \cong 280$ items

The two tables that follow are to be used as reference material during the inspection.

Table B-1. Confidence Intervals for Small Sample Sizes (Clopper-Pearson)

Sample Size	System Successes	≥90%	≥95%	≥99%
1	0	.000 < P < .950	.000 < P < .975	.000 < P < .995
2	0	.000 < P < .776	.000 < P < .842	.000 < P < .929
2	1	.025 < P < .975	.013 < P < .987	.002 < P < .998
3	0	.000 < P < .632	.000 < P < .708	.000 < P < .829
3	1	.017 < P < .865	.008 < P < .906	.002 < P < .959
4	0	.000 < P < .527	.000 < P < .602	.000 < P < .734
4	1	.013 < P < .751	.006 < P < .806	.001 < P < .889

Table B-2 shows 90 percent two-sided confidence intervals for the proportions of defects in a population for various sample sizes. This table was extracted from "Methodology for Sampling Classified Documents and Material Accountability Subsystems," June 1991.

Table B-2. Ninety Percent Two-Sided Confidence Intervals for the Proportion of Defects

Number of Defects	Sample Size			
	100	**125**	**150**	**175**
0	(.00000, .02951)	(.00000, .02368)	(.00000, .01977)	(.00000, .01697)
1	(.00051, .04656)	(.00041, .03739)	(.00034, .03123)	(.00029, .02682)
2	(.00357, .06162)	(.00285, .04951)	(.00237, .04138)	(.00203, .03554)
3	(.00823, .07571)	(.00657, .06086)	(.00547, .05088)	(.00469, .04371)
4	(.01378, .08920)	(.01100, .07173)	(.00916, .05998)	(.00784, .05154)
5	(.01991, .10225)	(.01589, .08226)	(.01322, .06881)	(.01132, .05913)
6	(.02645, .11499)	(.02111, .09254)	(.01756, .07742)	(.01503, .06654)
7	(.03331, .12746)	(.02657, .10261)	(.02210, .08586)	(.01892, .07382)
8	(.04043, .13972)	(.03224, .11251)	(.02681, .09417)	(.02295, .08097)
9	(.04776, .15180)	(.03807, .12228)	(.03165, .10236)	(.02709, .08803)
10	(.05526, .16372)	(.04404, .13192)	(.03661, .11046)	(.03133, .09500)
	200	**225**	**250**	**275**
0	(.00000, .01487)	(.00000, .01323)	(.00000, .01191)	(.00000, .01083)
1	(.00026, .02350)	(.00023, .02091)	(.00021, .01883)	(.00019, .01713)
2	(.00178, .03114)	(.00158, .02772)	(.00142, .02497)	(.00129, .02272)
3	(.00410, .03831)	(.00364, .03410)	(.00328, .03072)	(.00298, .02795)
4	(.00686, .04518)	(.00609, .04022)	(.00548, .03624)	(.00498, .03297)
5	(.00990, .05184)	(.00880, .04615)	(.00791, .04159)	(.00719, .03785)
6	(.01314, .05835)	(.01168, .05195)	(.01050, .04682)	(.00954, .04261)
7	(.01654, .06473)	(.01469, .05764)	(.01321, .05195)	(.01201, .04728)
8	(.02006, .07101)	(.01781, .06324)	(.01602, .05700)	(.01456, .05188)
9	(.02367, .07721)	(.02102, .06876)	(.01891, .06198)	(.01718, .05641)
10	(.02737, .08334)	(.02431, .07422)	(.02186, .06690)	(.01986, .06090)

Table B-2. (Continued)

Number of Defects	Sample Size			
	300	**325**	**350**	**375**
0	(.00000, .00994)	(.00000, .00918)	(.00000, .00852)	(.00000, .00796)
1	(.00017, .01571)	(.00016, .01451)	(.00015, .01348)	(.00014, .01259)
2	(.00119, .02084)	(.00109, .01924)	(.00102, .01788)	(.00095, .01669)
3	(.00273, .02564)	(.00252, .02368)	(.00234, .02200)	(.00218, .02055)
4	(.00457, .03025)	(.00421, .02794)	(.00391, .02596)	(.00365, .02424)
5	(.00659, .03472)	(.00608, .03207)	(.00565, .02980)	(.00527, .02783)
6	(.00874, .03909)	(.00807, .03611)	(.00749, .03355)	(.00699, .03133)
7	(.01100, .04338)	(.01015, .04007)	(.00942, .03724)	(.00879, .03477)
8	(.01334, .04760)	(.01231, .04398)	(.01142, .04086)	(.01066, .03816)
9	(.01574, .05177)	(.01452, .04783)	(.01348, .04444)	(.01258, .04151)
10	(.01819, .05588)	(.01679, .05163)	(.01558, .04798)	(.01454, .04481)
	400	**425**	**450**	**475**
0	(.00000, .00746)	(.00000, .00702)	(.00000, .00664)	(.00000, .00629)
1	(.00013, .01180)	(.00012, .01111)	(.00011, .01050)	(.00011, .00995)
2	(.00089, .01566)	(.00084, .01474)	(.00079, .01392)	(.00075, .01319)
3	(.00205, .01927)	(.00193, .01814)	(.00182, .01714)	(.00172, .01624)
4	(.00342, .02274)	(.00322, .02141)	(.00304, .02022)	(.00288, .01917)
5	(.00494, .02610)	(.00465, .02458)	(.00439, .02322)	(.00416, .02201)
6	(.00655, .02939)	(.00617, .02767)	(.00582, .02615)	(.00551, .02478)
7	(.00824, .03262)	(.00776, .03071)	(.00732, .02902)	(.00694, .02750)
8	(.00999, .03580)	(.00940, .03371)	(.00888, .03185)	(.00841, .03018)
9	(.01179, .03893)	(.01109, .03666)	(.01047, .03464)	(.00992, .03283)
10	(.01362, .04204)	(.01282, .03958)	(.01210, .03740)	(.01147, .03545)
	500			
0	(.00000, .00597)			
1	(.00010, .00945)			
2	(.00071, .01254)			
3	(.00164, .01543)			
4	(.00274, .01821)			
5	(.00395, .02091)			
6	(.00524, .02355)			
7	(.00659, .02613)			
8	(.00799, .02868)			
9	(.00942, .03120)			
10	(.01089, .03369)			

APPENDIX C

TABLETOP EXERCISES

Contents

APPENDIX C

TABLETOP EXERCISES

INTRODUCTION

This appendix provides a simplified list of potential tabletop exercises and two examples that can be conducted during an OA inspection. Each example has an objective, narrative, site staff needed, questions to be answered, master scenario event list, and draft cue cards. Additional details are developed during the inspection when specific facility requirements and procedures have been determined.

OVERVIEW

The first decision that must be made is determining whether or not tabletop exercises are appropriate to testing particular MC&A elements. The major advantages to tabletops often include:

- The ability to simulate activities that could take several days or weeks to perform (e.g., complete inventory or detailed measurement results)
- The ability to performance test activities that take place in high radiation areas or in areas with excessive contamination
- The ability to test several people or groups of people in shorter periods of time (e.g., MBA custodians or material handlers)
- An additional means by which to evaluate site MC&A performance
- An opportunity to train site personnel
- A means to identifying opportunities for improvement thus enabling MC&A site personnel to begin to conduct their own tabletops and improve existing MC&A systems.

The performance tests listed in Appendix A can be accompanied by a tabletop exercise, such as those included in the narrowed list of potential tabletops (Table C-1). From the list in Table C-1, two candidate tests were selected and were developed in more detail. These two example tabletops follow the format outlined in the OA Inspector's Guide for Emergency Management Tabletop Performance Tests. These tabletops are shown as Examples A and B. Example C is a blank form to be used for future tabletops.

Table C-1. List of Tabletop Candidates

Remeasure an item; test the performance of accountability measurements and reporting procedures when measurements are outside system specifications. (M:4)
Determine book shipper's values. (AC:1)
Examine internal transfers. (AC:10)
Determine the effectiveness of material control practices and procedures employed during an alarm/evacuation. (AD:3)
Determine the ability of personnel to respond to and properly resolve a missing SNM item. (AD:2)
Determine whether inventory items are in their stated locations and inventory records accurately reflect the physical inventory; (I3) talk through the scenario where there is an item that is not in its assigned location or when an item to be transferred is not in its assigned location.
Validate the facility controls to assure that a Category II or III MBA cannot receive material that would increase the category level.
Determine whether the confirmatory or verification measurement program provides data of the quality required for the MC&A records. (M:5)
After locating a breach in the MAA boundary, determine whether SPOs or individual conducting a DAC takes the appropriate actions; the inspector should validate that part of the DAC is to identify breaches of barrier integrity. (C:1)
Examine material surveillance-integration with PF and Systems.
Examine TID anomalies.
Classify an MC&A anomaly. (231.1-2)

Example A Tabletop Scenario: Item Remeasurement

Objective: Given that an item has been remeasured and found to be outside limits, does the facility initiate the proper actions to resolve the measurement differences?

Narrative: An item has been remeasured. The result is significantly different from the original value. The facility rechecks the numbers, researches the results, and ensures that the measurement conducted is valid. The facility determines that an inventory difference (ID) should be booked. The facility should also determine when the item was first measured, what process area it was first generated in, and what the ID was during the inventory period when the item was first generated.

Site staff needed: Measurement personnel, MC&A person/manager, MBA custodian, and possibly a statistician and a technical MC&A individual.

Questions:

1. Does the facility recognize that the remeasurement is significantly different from its original value? (How was this determined?)

2. Does the facility take the appropriate actions when the difference is identified (i.e., research the item, examine the measurement system to ensure it is in control, collect TID history, remeasure the item)

3. Was the impact of the ID (during the inventory period when the item was originally measured) examined to determine if that ID was significant. If it was significant, was DOE notified?

4. Were other similar items examined to determine if there is additional facility impact?

Master Scenario Event List

Scenario Input (Verbal or Text Message)	Expected Outcome
Cue 1: Select an item for measurement. (We must know what the original value is and its uncertainty; what the new value is and its uncertainty; what the combined uncertainty is; what the ID and LEID were when the item was generated; the TID History; what kind of item it is; and how the item will be measured.)	Determine how the item will be remeasured. Describe the measurement procedure, discuss calibration of method, control limits, measurement control, etc.
Cue 2: Measurement result is outside WL/AL limits.	Recheck numbers; recheck calibration and remeasure.
Cue 3: Re-measurement remains outside WL/AL limits. This is different from first measurement, but within combined uncertainty; check weight; expect different weight that is within combined uncertainty.	Notify MC&A. Perform an historical check of the item. Check the TID history. Is the TID the original?
Cue 4: MC&A has researched the item and finds no historical reason why the measured value has changed. (If an item from a production lot is selected, then other items of the lot should be reviewed prior to the end of the tabletop.)	Determine that an ID should be booked. Book the ID. Review the ID for the inventory period when the item was generated to see if it would have exceeded limits in the prior period. Check whether other similar items exist that should be evaluated. (Measurement results of additional items should confirm book value.)
Cue 5: Previous ID period is evaluated and found to exceed WL and AL.	Notify DOE.

DRAFT CUE CARDS

1. You have just been asked to remeasure item 123 at the request of OA. The item had an original value of *y*old. What actions do you take?

2. The new value is *y*new.

3. The uncertainty of *y*old is *y*olduncertain and of *y*new it is *y*newuncertain. What actions do you take now?

4. The historical research has been completed. The TID has not changed, no unusual events were discovered during your research.

5. You have evaluated the impact of the ID from the period when the item was first generated. This evaluation indicated that based on the difference observed, the ID for the inventory period now exceeds its warning/alarm limit. What actions do you take?

Example B Tabletop Scenario: Book Shipper's Values

Objective: Determine if the site takes the appropriate actions when a shipment is received from offsite, receipt measurements are made, and a significant shipper/receiver difference occurs.

Narrative: A DOE/NRC Form 741 and associated backup data are prepared. The 741 is presented to the site and a receipt procedure is requested. Raw receivers data is then presented to the site. The site states that receipt measurements are made and the receipt measurement data and uncertainties are presented. A significant difference is identified and resolved by the site.

Site staff needed: Accounting clerk, MC&A manager, receipt personnel, and measurement personnel.

Master Scenario Event List

Scenario Input (Verbal or Text Message)	Expected Outcome
Cue 1: Complete Form 741 with shipper's values and associated backup data.	Explain initial receipt activities at warehouse. Review shipper/receiver agreements, if any.
Cue 2: Check raw receiver's data and receipt documentation; piece-count, TIDs, values etc. all agree. Data should be equivalent to what the site uses. Identify the internal transfer mechanism the site uses.	Validate the data. No problems exist in observed/weight difference. Receive internal transaction for receipt into warehouse.
Cue 3: When will accountability measurements be performed?	How will 741 be closed? (A-E transactions)
Cue 4: Receivers measure values; two of the items agree in value and one item will be outside limits. Significant SRD exists.	Determine if difference is significant. Discuss reconciliation process.

DRAFT CUE CARDS

1. "Here is a 741 and associated shipper's backup data. What actions are taken for this receipt at your facility?"

2. Give site the receiver's initial raw data receipt check information (gross weight, TID check result, number of items, etc.).

3. Describe your plan to close this 741.

4. Give receiver's measured values with uncertainties. ("What actions will you take?")

Tabletop Scenario:

Objective:

Narrative:

Site staff needed :

Questions:

Master Scenario Event List

Scenario Input (Verbal or Text Message)	Expected Outcome
Cue 1:	
Cue 2:	
Cue 3:	
Cue 4:	
Cue 5:	

Draft Cue Cards

1.
2.
3.

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