
Acceptance Criteria for the Low Enriched Uranium Reform Amendments

**U.S. Nuclear Regulatory
Commission**

Office of Nuclear Material Safety and Safeguards

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ABSTRACT

Revisions have been made to the material control and accounting requirements for NRC licensees authorized to possess and use more than one effective kilogram of special nuclear material of low strategic significance to have MC&A systems able to (1) confirm the presence of special nuclear material, (2) resolve indications of missing material, and (3) aid in the investigation and recovery of missing material. This document presents criteria that can be used to aid in judging the acceptability of licensee plans that would be submitted to the NRC for implementing these capabilities. General performance objectives, system capabilities, and recordkeeping are addressed.

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PREFACE

NUREG 1065 is being issued to establish criteria that the NRC staff intends to use in evaluating whether an applicant/licensee meets the requirements of 10 CFR Part 74, "Nuclear Material Control and Accounting for Special Nuclear Material of Low Strategic Significance." NUREG 1065 is not a substitute for the regulations, and compliance is not a requirement. However, the use of criteria different from those set forth herein will be accepted only if the substitute criteria provide a basis for determining that the above-cited regulatory requirements have been met.

The MC&A rule for special nuclear material of low strategic significance is relatively brief and performance oriented. The acceptance criteria are intended to help the licensees to understand what performance is required to meet the requirements of the rule as well as help the NRC staff in reviewing license applications.

Changes in the acceptance criteria may be appropriate as additional insights and information are obtained. Constructive thoughts that will lead to improvements in the acceptance criteria should be addressed to the Chief, Fuel Facility Safeguards Licensing Branch, Division of Safeguards, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555.

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INTRODUCTION

The proposed reform of the Material Control and Accounting (MC&A) regulations for licensees authorized to possess and use low enriched uranium necessitates the development of objective criteria for evaluating the acceptability of MC&A plans that licensees are required to submit. The revised Fundamental Nuclear Material Control (FNMC) Plans would demonstrate how the requirements of the LEU Reform Amendments would be satisfied. (As appropriate, examples of how certain commitments are to be implemented would be included in an Annex which would not be incorporated as a condition of the license.) After acceptance by the NRC of a Plan as a condition of the license, the NRC will judge the adequacy of MC&A performance of a licensee by inspecting for compliance with commitments made in the Plan.

The recommendations presented in this report are subject to revisions and modifications as additional insights and information are developed.

Each section in this report except the first is divided according to the following format:

- Rule
- Intent
- Affirmations: the licensee must make the stated affirmations for the Plan to be acceptable
- Information to be included: the Plan and Annex should contain the stated information to demonstrate adequacy of the licensee's MC&A system
- Acceptance criteria: the ground rules used by NRC license reviewers to determine if the Plan is acceptable; and
- Questions and answers: these help to resolve uncertainties about the acceptability of specific approaches by explaining the intent of the regulation and including some examples of acceptable ways to comply with the regulation.

1.0 CONTENT OF THE FNMC PLAN AND ANNEX

The licensee's submittal to the NRC will consist of two documents: 1) a Fundamental Nuclear Material Control (FNMC) Plan, referred to herein as the Plan, that will contain the licensee's affirmations and will demonstrate how the licensee will comply with the requirements of the LEU Reform Amendments. The Plan will be inspectable for compliance by the NRC. 2) an Annex that will contain examples of how various portions of the plan will be implemented and will give other general information about the facility. The Annex will not be incorporated as a condition of the license and will not be used as a basis for inspection.

The Plan shall include a section that provides a general discussion of how the licensee's MC&A program satisfies the general performance objectives of 10 CFR 74.31(a). The description shall include information on the plant, the process, and the key features of the MC&A system including plant layout, types of internal controls, and how the performance of the system will be monitored. This section should be written sufficiently general that the licensee has the flexibility to make procedural or operational changes that do not decrease the level of safeguards performance without informing the NRC.

The licensee will have the flexibility to change procedures referenced or equipment specified in the Annex without notifying the NRC as long as the MC&A system performance documented in the Plan is not degraded. The material given in the Annex should be cross-referenced to the Plan, and it should be clearly evident how it relates to the affirmations stated in the Plan or to the requirements in the LEU Reform Amendments.

2.0 ACCEPTANCE CRITERIA FOR CONFIRMING THE PRESENCE OF SNM,
RESOLVING INDICATIONS OF MISSING MATERIAL AND AIDING THE
INVESTIGATION AND RECOVERY OF MISSING MATERIAL

2.1 RULE

- 74.31(a) General Performance Objectives. Each licensee who is authorized to possess and use more than one effective kilogram of special nuclear material of low strategic significance, excluding sealed sources, at any site or contiguous sites subject to control by the licensee, other than a production or utilization facility licensed pursuant to Part 50 of this chapter, or operations involved in waste disposal, shall implement and maintain a Commission approved material control and accounting system that will achieve the following objectives:
- (1) Confirm the presence of special nuclear material; and
 - (2) Resolve indications of missing material; and
 - (3) Aid in the investigation and recovery of missing material.

2.2 INTENT

Each licensee subject to this proposed rule is expected to implement and maintain an MC&A system that will be capable of achieving the above general performance objectives. It is intended that the licensee will be able to verify the presence of the SNM for which the licensee is responsible at least annually. Verification involves physical confirmation of the presence of the material. An accurate record system is essential. It is also intended that the licensee will investigate and determine the causes of indications of possible losses of significant amounts of SNM. An indication may be an excessive inventory difference, an allegation of theft, evidence of a breach in the physical security barrier, or unauthorized entry into buildings or areas in buildings containing accessible SNM accompanied by other factors such as tampering with equipment or missing items, or the inability to locate material called for in routine operations. The licensee's investigations of possible losses are expected to either locate the missing material or reach a conclusion based on objective evidence as to the most probable cause for the indicated loss. If theft or diversion is the assigned cause of a loss, the licensee will be expected to provide any available information to help identify the loss by material type and quantity and the time period over which the loss could have occurred in order to aid in the recovery of the SNM.

2.3 AFFIRMATIONS

The licensee must make the following affirmations with respect to confirming the presence of SNM, resolving indications of missing material, and aiding the investigation and recovery of missing material:

- An MC&A system will be developed and maintained that is capable of annually confirming the presence of SNM that is authorized for possession and use under the license.
- An expeditious investigation will be promptly initiated for all indications of significant losses of SNM and allegations of theft of SNM.
- Information will be provided to aid in the investigation of indications of missing material and recovery of SNM in the event of a loss, theft, or unauthorized diversion.
- A cause or probable cause that is based on objective evidence will be assigned for all indications of possible loss that are investigated.
- The results of investigations of alleged thefts or of indications of loss in which the amount of SNM exceeds a quantity of U-235 established by the NRC on a site specific basis and for which no innocent cause is found for the indication of loss will be reported to the NRC.

2.4 INFORMATION TO BE INCLUDED

To be complete, the Plan should contain the following information:

- A description of the MC&A system defining its key components and their purposes.
- A description of the licensee's plan for investigating indications of missing material. In addition, enough information regarding the licensee's approach for resolving indicated losses and the expected times to complete the investigations should be presented in the Annex to permit an evaluation of the plan and determination if the affirmations can be achieved.
- The bases for deciding to initiate a loss investigation.
- The bases for resolving an indication of missing SNM or terminating an investigation of a possible loss.

2.5 ACCEPTANCE CRITERIA

A judgment that the licensee's Plan is acceptable will be based on the following criteria:

- Based on the description of the MC&A plan, the licensee can be reasonably expected to achieve the general performance objectives of the rule.

- The licensee's investigation of indications of a loss of SNM can be completed expeditiously but no longer than 60 calendar days after the indicated loss is discovered even if a physical inventory is required.
- The licensee's plan shows the capability to initiate investigations expeditiously, and within 8 hours in the event of incidents involving an alleged theft or an indication of missing SNM accompanied by evidence that a theft may have occurred.
- The bases for initiating a loss investigation include an allegation of theft, an indication that a theft has occurred, an inventory difference equal to or exceeding an action threshold based on detecting with 90% probability the quantity established by the NRC on a site specific basis, failure to locate an item when desired, and any knowledge or other positive indication of a loss of SNM. However, an investigation may be discontinued when it has been determined that the quantity involved is less than the action threshold and there is no tangible evidence that a theft may have occurred or that a recurring loss situation is continuing.
- In the event of an indication of missing SNM, the MC&A system will provide an estimate of the amount of SNM involved. In addition, when possible, the licensee should identify the physical form of the material and the time interval within which the loss, if any, would have occurred.
- Additional criteria for loss indications involving excessive inventory differences are given in Section 5, and for item losses are given in Section 6.

2.6 QUESTIONS AND ANSWERS

1. Q: What constitutes evidence that a theft of SNM has occurred?
 A: Indications that a building or storage enclosure has been broken into may not be sufficient reason to conclude a theft may have taken place. However, if the indication is accompanied by other evidence such as missing SNM, damaged SNM containers, tampering with equipment usable for transferring SNM, etc., the event should probably be treated as a possible theft or attempted theft.
2. Q: What kinds of information might licensees be expected to provide to aid in the investigation and recovery of missing SNM?
 A: It is not intended that licensees be required to implement any special procedures to enable "localization" of a diversion of SNM. However, information will usually be readily available to the licensee from production records, accountability data or routinely prepared reports that can facilitate the investigation of missing material.

Examples of the kinds of information that may aid investigations and timely recovery of the SNM are:

- data that led the licensee to determine that a loss or theft had occurred
- any abnormal events that may have contributed to or caused the loss
- the interval during which the loss could have occurred
- the amount of material and material form involved in the loss
- the names of the people who could have been responsible for the loss.

3. Q: Why must the licensee's plan show the capability to initiate an investigation within eight hours in the event of incidents involving an alleged theft or an indication of missing SNM accompanied by evident that a theft may have occurred?

A: A commitment on the part of the licensee to initiate investigations of these kinds of loss indicators without delay is important so that physical evidence needed for resolution is not lost and events are fresh in the memory of possible witnesses. If law enforcement agencies or other authorities are brought in to investigate or recover the material, time may be an essential factor in collecting factual information and, in the event that a theft actually occurred, prompt apprehension of the thief and recovery of the material is important. Also, public concern may be an issue in some events, and consideration needs to be given to show that efforts are being taken promptly to protect public health and welfare.

4. Q: What is meant by annually when confirming and verifying the presence of SNM?

A: Verification involves physical confirmation of the presence of SNM every 12 months. It is considered reasonable to expect that the annual inventory will be conducted within one month of the annual anniversary date.

3.0 ACCEPTANCE CRITERIA FOR MANAGEMENT STRUCTURE

3.1 RULE

74.31(c) System Capabilities. To meet the general performance objectives of paragraph 74.31(a), the material control and accounting system must include the capabilities described in paragraphs (c)(1) through (8) of this section. The licensee shall:

- (1) Establish, document, and maintain a management structure which assures clear overall responsibility for material control and accounting functions, independence from production responsibilities, separation of key responsibilities, and adequate review and use of critical material control and accounting procedures.

3.2 INTENT

The intent of this paragraph is to require licensees to implement a management structure that permits effective functioning of the MC&A system, and assures that the MC&A program performance will not be adversely affected by the management structure. Documentation, review and approval of the procedures, and the assignment of the key functions to specific positions eliminates ambiguities about what is to be done by whom. The management structure is meant to separate key MC&A functions from each other in order to provide overchecks that increase MC&A system reliability and counter defeat of the system through deceit and falsification. It is also meant to free MC&A management from conflicts of interest with other major functions such as production.

3.3 AFFIRMATIONS

The licensee must make the following affirmations with respect to management structure:

- Responsibility for the overall MC&A system management will be assigned to a position that is separate from production responsibilities or any other responsibilities that may give rise to conflicts of interest.
- The responsibility for each MC&A function is assigned to a specific position in the organization, and the organization is structured in a way that the key functions are separated or overcheck one another. The position descriptions will be made available in writing to the personnel affected.
- The facility organization and the MC&A policies and procedures are documented.
- All critical procedures will be reviewed and approved prior to their implementation.

- Management policies will be established to ensure that all critical MC&A procedures are adhered to including measurement procedures used for accountability purposes.

3.4 INFORMATION TO BE INCLUDED

To be complete, the Plan should contain the following information:

- A description of the management structure giving the functional responsibilities of each organizational unit showing that the MC&A organization is independent of potentially conflicting responsibilities, and that the organization allows separation or overchecks of key MC&A functions. A chart showing the relationships between the functions should be included. The Annex should contain an organization chart and job descriptions for each key MC&A position.
- A description of the organizational relationships of persons who perform key MC&A functions including performing measurements and measurement control activities, preparing source documents, performing shipping and receiving activities, and conducting inventories.
- A description of the policies, instructions, procedures, duties, responsibilities, and delegations of authority in sufficient detail to demonstrate the separation or overchecks built into the MC&A system.
- A summary of the review and approval plan for critical MC&A procedures.
- Criteria for identifying critical procedures.

3.5 ACCEPTANCE CRITERIA

A judgment that the licensee's Plan for establishing, documenting, and maintaining the management structure is acceptable will be based on the following criteria:

- The management structure and MC&A policies and procedures will identify authorship, approval authorizations, and the effective date.
- The responsibilities and authorities for each position assigned a function having a significant impact on SNM control and accounting (including all positions authorized to control SNM movement, source data generation, measurement control, and data analysis) are clearly defined in a written position description that defines the responsibilities for that position.

- The background experience required for each position assigned an SNM control and accounting function will correspond to the duties required of that position.
- The descriptions of the management structure and assignment of duties and authorities show that those responsible for each MC&A function will have sufficient authority to perform the function in the intended manner.
- The MC&A organization will be separate from the production organization and will also be separate from organizations that generate source data if practical; otherwise, independence of the functions will be attained by suitable controls. Examples of suitable controls are complete separation of the central accounting functions from the SNM handling functions; overchecks of shipping, receiving, and waste disposal documents by MC&A before SNM is moved; and overchecks by authorized personnel of measurement data and other source data, calculations, and data analyses.
- The MC&A management responsibility will be delegated to an individual at an organizational level sufficient to assure independence of action and objectiveness of decisions.
- No two key MC&A functions will be assigned to the same person unless adequate checks and balances are provided. As a consequence of this criterion:
 - Individuals who generate source data, such as performing measurements, preparing analytical reports, and performing measurement control or shipping and receiving activities, will not perform any accounting or record control functions unless overchecks of the work are provided to prevent falsification of both source data and accounting records
 - No individual may have the sole authority to overcheck, evaluate performance or audit information for which that individual is responsible.
- Critical MC&A procedures and all changes to them which directly affect the licensee's ability to detect the loss of SNM or resolve indications of missing SNM as per §74.31(a) will undergo technical review by cognizant members of the staff and will be approved by line management directly affected and by a level of management above the level responsible for executing the critical procedures (but not beyond onsite plant management).

3.6 QUESTIONS AND ANSWERS

1. Q: What are the primary responsibilities of the MC&A organization manager?

- A: The MC&A manager has overall responsibility for;
- Adequacy, completeness and effectiveness of the MC&A program,
 - Recording and reporting of SNM status,
 - Management and effective use of approved MC&A systems, procedures and results including recommending corrective actions and confirming that they have been carried out,
 - Control and approval of all physical inventories of SNM including evaluation and reconciliation of inventory values, IDs, estimated standard error of the IDs, and approvals of reports adjusting inventory records,
 - Performance of technical evaluations and analyses of measurement capabilities including equipment and methods,
 - Reviewing new or changed operations to determine if they involve previously unreviewed safeguards considerations and determining that safeguards plans meet regulatory requirements, and
 - Coordinating MC&A activities with other organizations performing safeguards activities.

2. Q: What is meant by "clear overall responsibility"?

A: Responsibilities should be assigned in a way that no ambiguity exists regarding who is responsible for a task or function. This may be done by making assignments by name or position title where each position is currently assigned or delegated to an individual. Responsibilities should not be assigned to an organizational unit but rather to specific positions within that unit.

3. Q: What are the "key responsibilities" which must be separated?

A: The tasks for material measurement and material accountancy must be separated at some point so that one person does not perform both data generation and evaluation tasks and thereby control all shipper/receiver difference and/or inventory difference information all the way from raw data taking through evaluation. In addition, separation of responsibilities must be preserved in the independent assessments as described under the discussion of §74.31(c)(8).

4. Q: When may a conflict of interest occur?

A: A conflict of interest may occur when a performance objective of one of the functions assigned to an individual could be contrary to a performance objective of another of that individual's functions.
Examples are:

- When a production operator or supervisor has responsibility for both maintaining effective material accounting and meeting production schedules; or
- When an individual can control decisions having the possibility of personal gain, such as when authorized to evaluate the performance of the work or organization for which that person is responsible; or
- When an individual has authority over two functions that should normally serve as overchecks, such as generating source data as well as maintaining material accounting records.

5. Q: What are some examples of overchecks that serve to protect the MC&A system against falsifications or errors?

A: Examples of appropriate overchecks are:

- Review of the measurement data and calculations by another person;
- Maintaining a duplicate copy of all source data and transfer forms under controls separate from the accounting function;
- Double entry bookkeeping;
- Separating computer software development and modification from the data input capability;
- Separating the power to authorize a discard of SNM from the authority for hands-on access;
- Performing independent audits.

6. Q: What are "critical MC&A procedures," and what specific functions do they include?

A: Critical MC&A procedures are those procedures which, if not performed correctly, could prevent the licensee from satisfying the two objectives of (1) confirming the presence of special nuclear material and (2) resolving indications of missing material and aiding in the investigation and recovery of missing material. Hence, critical procedures encompass the establishment of basic MC&A system policies, determination of the physical inventory, determination of inventory differences and shipper/receiver differences including their resolution, detection of a loss, and determination of the total MC&A measurement error.

4.0 ACCEPTANCE CRITERIA FOR MC&A MEASUREMENTS

4.1 RULE

- 74.31(c)(2) Establish and maintain a measurement system which assures that all quantities in the material accounting records are based on measured values.
- 74.31(c)(3) Follow a measurement control program which assures that measurement bias is estimated and significant biases are eliminated from inventory difference values of record.
- 74.31(c)(4) In each inventory period, control total material control and accounting measurement uncertainty so that twice its standard deviation is less than the greater of 9 kilograms of U-235 or 0.25% of the active inventory, and assure that any measurement performed under contract is controlled so that the licensee can satisfy this requirement.

4.2 INTENT

The intent of the rule is that all record quantities are to be based on measurements. The measurement systems used to determine these quantities are to be controlled by a formal measurement control program that results in a measurement standard error of the inventory difference (SEID) that is within the limits stated in the rule. The program will also provide bias estimates to be used in correcting the ID and shipper/receiver measurements for significant measurement biases. Periodic monitoring is needed to assure that biases and random error variances are controlled within limits necessary to satisfy the requirements of the rule.

4.3 AFFIRMATIONS

The licensee must make the following affirmations with respect to accountability measurements and measurement quality:

- A measurement system will be established and maintained for all SNM receipts, removals and inventory items, and all quantities of SNM in the material accounting records will be based on measured values.
- A measurement control program will be followed by which all measurement biases are estimated and any significant biases will be eliminated from ID values and shipper/receiver differences.
- Measurement systems that are the key contributors to the SEID will be identified. The list will be reviewed annually and updated as necessary. These will be considered as key measurement systems and their

standard deviations will be monitored and controlled by the measurement control program.

- The estimate of the measurement contributions to the SEID will be traceable to the appropriate measurement error data and to the calibration standards used.
- The measurement errors will be controlled so that twice the estimated SEID for a typical 12-month material balance will be less than the greater of 9 kilograms of U-235 or 0.25% of the active inventory in each inventory period.
- The measurement systems will have sufficiently small standard deviations due to random effects, calibrations, and bias adjustments to achieve the requirements of §74.31(c)(4) and (5). A measurement control program will be used by the licensee and contractors to assure that the quality of the measurements will be maintained on a level consistent with the regulatory requirements.

4.4 INFORMATION TO BE INCLUDED

To be complete, the Plan should contain the following information:

- Identification of the measurements that are expected to be key contributors to the SEID. The measurement methods, their expected standard deviations and their applications should be described in the Annex.
- A description of the approach to be used for monitoring and controlling measurement error standard deviations of the key measurement systems and for estimating biases of all measurement systems including the bases for:
 - Setting frequencies of replicate measurements for monitoring standard deviation and standards measurements for estimating biases and performing recalibrations;
 - Assigning standard materials to be used for calibrations and bias determinations;
 - Setting control limits for determining when a measurement system is out of control (i.e., warning limits and action limits for biases and standard deviations) and what actions should be taken.
 - Deciding which measurement data will be corrected for an estimated bias; and
 - Determining when records will be adjusted for measurement biases;

- The controls over measurements performed by contractors and how they are included in the licensee's system.
- An example in the Annex showing the estimation of the measurement standard error for a typical inventory difference based on material flows and inventory components and the variances due to random effects and bias estimates expected for the plant. The example should include the equations for calculating measurement standard deviations and bias estimates, a description of the error model, and the error propagation method used in the calculation of SEID. The example should also show which measurement systems are key contributors to the total SEID.
- If the licensee does not intend to calculate the measurement contribution of the estimated SEID for each inventory period, the approach should be described for assuring that the estimate used (based on previously accumulated data) is valid and meets the requirements of 74.31(c)(4).

4.5 ACCEPTANCE CRITERIA

A judgment that the licensee's Plan for accountability measurements and measurement quality is acceptable will be based on the following criteria:

- The licensee's description of the MC&A measurements and measurement control plans show that the measurement systems that are the key contributors to the standard error of ID will be routinely monitored by the measurement control program. The set of key measurement systems identified by the licensee is estimated to account for at least 90% of the total measurement SEID or has the potential to adversely impact the ID by greater than 10%.
- The measurement control program provides for periodic recalibrations and routine determinations of the random effects and biases of at least the key measurement systems for materials accounting. The program should be in accordance with the following principles:
 - The standard deviations of measurement systems are estimated from replicate data from measurements made in the same manner as made routinely on typical items and samples. If standard deviations are based on replicate measurements of reference standards, the licensee collects data that demonstrate that the standard deviation estimates do not differ significantly from those based on replicated routine item and sample measurements.
 - All reasonable and probable sources of measurement error, such as the effects of sampling, instruments, and environmental factors are accounted for in estimating the standard deviations, either directly as experimental variables in an analysis of

variance or by being included in the sample of measurement control data from which the standard deviations are determined. The licensee will show that it is reasonable to expect that the measurements used in estimating the ID will be in control so that the SEID will be within the limits stated in the rule at the inventory time.

- Bias tests and recalibrations are made by measurements of standard reference items or materials whose assigned values are traceable to national measurement systems. The reference items or materials should closely resemble the unknowns to which the method is applied, and the measurement procedures and conditions of measurement should closely resemble those of typical measurements made on unknowns. The recalibration frequencies are to be compatible with the expected stability of the measurement systems.
- A record of a bias will be maintained if a bias estimate exceeds 2 times the standard deviation of the bias estimate. The Plan contains the statistical basis and decision criteria for determining when an inventory record needs to be adjusted for measurement bias and which records need to be adjusted. The decision criteria also should take into account the significance of the bias on subsequent material balances and on future shipments, the magnitude of biases associated with individual items compared to data rounding or the number of significant figures carried in the records, and available alternatives to record corrections. Simply maintaining a bias adjustment account to be applied to IDs is generally sufficient except where subsequent material balances or shipments require that bias adjustments be made to individual lots or items.
- The proposed schedules and frequencies of measurements for measurement control are designed so that the estimates of standard deviations and measurement biases will be based on measurement control data collected under the same measurement circumstances and over a span of time that corresponds with the time span of the SNM accounting measurements to which the standard deviations and bias estimates will be applied. Redeterminations of the standard deviation and bias of each key measurement procedure will be made periodically. Pooling of data from previous determinations of the standard deviation is used only if statistical tests show the standard deviations do not differ significantly.
- The effort expended by the licensee in monitoring and controlling the bias of each measurement system and the standard deviation of each key measurement system is shown to be consistent with its impact on ID and SEID. The number of degrees of freedom for estimating the measurement standard deviation may be graded according to its contribution to the SEID.
- Warning limits for investigations of a change in bias or standard deviation will be set at the 0.05 level of significance. If control

data exceed this limit an investigation will be initiated to find the cause and corrective action will be taken.

- Action limits will be set at the 0.001 level of significance. If control data exceed this limit, the measurement system shall not be used for MC&A purposes until corrective action is completed.
- The approach to be used for estimating the SEID for a typical material balance period, as shown in the Annex, meets the following criteria:
 - All reasonable and probable sources of measurement error affecting ID have been included.
 - The assumed measurement standard deviations are shown to be reasonable. They may be shown to be reasonable by comparisons either with records of past performance data from the licensee's facility or published measurement performance in similar applications, as reported in such sources as Rogers (1983) or Reilly and Evans (1977). (Records showing these data must be available to the NRC.)
 - The calculation of the SEID is performed in accordance with a recognized error propagation method. Such methods have been published by Jaech (1973); Tingey, Lumb and Jones (1982); and the IAEA (1977).
- The licensee will confirm that accountability measurements supplied by a contractor will be controlled by a measurement control program, and that the licensee will confirm by an annual audit that the contractor's measurement control program is adequate.
- If the licensee does not plan to calculate the measurement SEID annually, but proposes to rely instead on values based on either engineering estimates or calculations for a previous material balance, the licensee will have current measurement control program data to justify the standard deviations for at least the key measurement systems. The licensee will be able to show that the calculated SEID includes at least 90% of the total measurement uncertainty contribution by using sensitivity analysis of the components of the SEID. The licensee's analysis of the predicted measurement standard deviation components in the SEID, as shown in the example calculation in the Annex, shows that the SEID will be relatively insensitive to reasonable variations in the inventory composition and the standard deviations of the measurements. The predicted range of variation of the active inventory is based on production scheduling commitments and previous experience and the assumed ranges of standard deviations of the key measurements are based on historical data for those measurement systems from the licensee's measurement control files or, for applicants, from publications such as Rogers (1982) or Reilly and Evans (1977).

4.6 QUESTIONS AND ANSWERS

1. Q: What is meant by the "total MC&A measurement uncertainty"?

A: The total MC&A measurement uncertainty is the estimated SEID of the material balance due to the measurement variances. The measurement variances should include all sources of variability of the measurement and sampling processes, including random effects due to such factors as instrument and analyst differences and variations in measurement biases.

2. Q: What are some examples of sources of variance that may increase the SEID above that estimated from measurement control data?

A: There are two principal sources of variance in ID: the process variance and the measurement variance. The process variances may be caused by fluctuations in process holdups, fluctuations of unmeasured process losses, and operator errors in recording and transmitting data. Examples of measurement variations not always accounted for in measurement control program data are between-laboratory effects, sampling errors caused by inadequate control of blending or changes in the sample before analysis, and uncorrected fluctuating biases.

3. Q: Must the total measurement uncertainty for the facility be calculated at each physical inventory?

A: No. The licensee has two options. Under option one, the licensee would calculate the measurement uncertainty at each physical inventory. Under option two, the licensee would make an analysis of the total measurement uncertainty only when the new plan is submitted and when changes are made to the process or to the measurement systems used which would invalidate the previous analysis. For the second option, the licensee would also identify a sufficient set of measurement parameters which will be monitored periodically to assure that the 0.25% goal is still being achieved by the major systems that contribute to the measurement uncertainty.

4. Q: Is there any limit on how well any single measurement system must be controlled?

A: No, as long as the overall performance level of 0.25% of the active inventory is met.

5. Q: Why is there a requirement that the standard deviations and biases must be redetermined periodically?

A: A change of the measurement standard deviation or departure from the calibration point may occur gradually for a variety of reasons, and sometimes it occurs abruptly. To detect these changes before too much uncontrolled or biased measurement data has been acquired for

which remeasurements are not always possible, the state of statistical control must be checked periodically. Most methods should be checked at least monthly and some may need weekly or daily checks. Lengthening the time intervals between determinations of bias and standard deviation should be justified by sequential monitoring data, such as control chart records, showing that the method is stable over such time intervals.

Of course, methods used only periodically for SNM accountability analyses need only be monitored during the time periods actually used.

6. Q: Must measurements made by contractors be included in the 0.25% goal?

A: Yes, to the extent that they would have to be covered if the licensee were performing the measurement. The licensee is responsible for monitoring the contractor's measurement control program to assure that when uncertainty from those measurements are combined with the licensee's own measurement uncertainty, the overall goal is still met. Also, the contractor's measurement program should be included in the independent performance assessment.

7. Q: Why has the concept of active inventory been used?

A: The concept of active inventory is used to establish a performance level for control of the measurement uncertainty. Since this performance bound is intended to reflect normal plant operating conditions, it is not the intent of the definition that activities be conducted just to increase the active inventory value.

8. Q: Why is active inventory defined the way it is?

A: Active inventory as defined in §74.4(k) is used to identify that material which has an opportunity to contribute to the inventory difference and measurement uncertainty. Common terms are excluded because when a term shows up more than once in the active inventory calculation, has the same value, and that value is derived from the same measurement, that term can not contribute to the ID or measurement uncertainty (e.g., an item on beginning and ending inventories will just cancel itself in the ID calculation and does not add to the uncertainty in ID).

5.0 ACCEPTANCE CRITERIA FOR PHYSICAL INVENTORIES

5.1 RULE

- 74.31(c)(5) Unless otherwise required to satisfy Part 75 of this chapter, perform a physical inventory at least every 12 months and, within 60 days after the start of the inventory, reconcile and adjust the book inventory to the results of the physical inventory, and resolve, or report an inability to resolve, any inventory difference which is rejected by a statistical test which has a 90% power of detecting a discrepancy of a quantity of uranium U-235 established by NRC on a site-specific basis.

5.2 INTENT

The principal method of confirming the presence of SNM is to perform a physical inventory and compare it to the book inventory. If all components of the inventory are based on measured quantities and if all SNM is included, the expected difference between the book inventory and the physical inventory is zero. In any actual case, the size of the estimated inventory difference depends on measurement errors, the accuracy of the records, and non-measurement contributors. The intent of §74.31(c)(5) is to require licensees to perform annual physical inventories and resolve any inventory difference which exceeds its detection threshold.

5.3 AFFIRMATIONS

The licensee must make the following affirmations with respect to physical inventories:

- Unless otherwise required by Facility Attachments that satisfy 10 CFR Part 75, a physical inventory will be performed at least every 12 months and will be used as the basis for reconciling and adjusting the book inventory which will be done within 60 days after the start of the physical inventory.
- The inventory procedures will be clearly written and will be reviewed and approved by the individual responsible for the conduct of the inventory.
- The individual responsible for the conduct of the inventory either will be free from potential conflicts of interest or will be over-checked sufficiently to prevent compromising the validity of the physical inventory.

- Within 60 days after the start of an inventory, the inventory difference will be resolved or the inability to resolve an inventory difference, which is rejected by a statistical test that has a 90% power of detecting a discrepancy of a quantity of U-235 established by the NRC on a site specific-basis will be reported to the NRC.
- Discrepancies in the identity, quantity or location of items, objects or containers of SNM that are detected during the physical inventory will be corrected.
- Adjustments made to reconcile the book inventory to the physical inventory will be in accordance with standard accounting practices and will be traceable and auditable in the licensee's records. Corrections for known significant biases in the physical inventory values will be made before inventory accounts are changed to reconcile them to the physical inventory values.
- In the event an estimated ID indicating a discrepancy greater than the quantity of U-235 established by the NRC on a site-specific basis is not resolved, the investigation will be continued if requested by the NRC.
- The results of physical inventories and of investigations and resolution actions following an excessive estimated ID will be recorded and will be auditable.

5.4 INFORMATION TO BE INCLUDED

The Plan should contain the following information:

- A description of the procedures for performing physical inventories containing sufficient detail to demonstrate that they will provide valid inventories. The description will include a general outline of how:
 - Inventory functions are organized and how the functions are separated;
 - Inventory teams are assigned and instructed in the use of uniform procedures;
 - Source data is obtained, verified and transmitted;
 - Inventory forms are controlled;
 - Item counts verify each item while preventing counts of any item more than once;
 - Cut off procedures for production and material movement are handled; and

- Thoroughly the process vessels, equipment and piping need to be cleaned out or drained down, and how residual holdup is treated.
- A brief description of special item storage and handling or tamper-indicating methods used so that the recorded SNM content can be assumed to be valid at inventory time without remeasurements. The Annex should describe the storage facilities and identify any special features (i.e., locked doors, seals, hardening or short residence times) that facilitate detection or prevent unauthorized removals of items or SNM from items.
- A description of how item identities are confirmed and how tampering with the contents of items will be detected or prevented.
- The basis for determining which items are to be directly measured for SNM content in the physical inventory and justification of proposed alternatives to direct measurement of the SNM content. If statistical sampling is proposed as an alternative method for inventory verification, the Plan must describe the sampling plan. The description should include:
 - the method of classifying (stratifying) the types of items to be sampled
 - how the sample sizes will be calculated
 - the method or methods used for random selection of sample items
 - the plans for reconciling discrepancies in the inventory and when additional tests and remeasurements would be performed.

In addition, a list of typical inventory strata, the measurements and tests made to verify the recorded item contents and an elaboration on plans for investigating and reconciliation of indications of material shortages should be given in the Annex.

- The basis for deciding when the element and isotope factors for items, objects, or containers will be measured directly for inventory and when they may be based on or derived from other measurements. If inventory values are based on or derived from other measurements, the Annex will describe how the values and their uncertainties are determined, and the basis for their validity, and will include any supporting historical information used.
- A description of how the book inventory is reconciled and adjusted to the physical inventory.
- The basis for setting the action threshold for an excessive ID at which an investigation will be initiated in order to achieve a 90% power of detecting a discrepancy equal to the quantity of U-235 established by the NRC on a site-specific basis. The description

should include the source of the data and the statistical method used to determine the estimated standard error of the ID. The Annex should give all relevant formulas used in the computations and a detailed example of determination of the test statistic and the detection threshold.

- The Annex should contain a description of a typical inventory composition for the plant, the formulas for calculating the inventory difference, and the resolution procedures to be used.

5.5 ACCEPTANCE CRITERIA

A judgment that the licensee's Plan for physical inventories is acceptable will be based on the following criteria:

- The inventory plan will contain sufficient detail to demonstrate that the physical inventory process will be organized and coordinated so that all persons are instructed in the use of uniform procedures of checking SNM quantity and recording observations. The inventory procedure will ensure that no inventory quantity will be omitted and no quantity will be counted more than once.
- The inventory procedures provide for confirming the presence of all items by direct observation and the presence of all quantities of SNM either by direct measurement or an acceptable alternative. The proposed alternatives to direct measurement satisfy one of the following criteria:
 - The SNM content is verified by statistical sampling and measurement of representative items, objects or samples of the material. The sampling plan provides for detection of the pre-established detection goal with 90% probability. The detection goal for inventory sampling plans will be established on a site-specific basis.
 - The previous measurement results are accepted pending confirmation of the SNM content by measurements when introduced into subsequent processing steps within 60 calendar days after the start of the inventory.
 - The previous measurement results are accepted because assurance is provided that the SNM content could not have changed since they were made. Examples of alternatives for satisfying this are use of tamper-indicating seals (or encapsulation) or containment by storage in controlled access enclosures. (See Question 1 of Section 5.6.)
 - Residual holdup after cleanout or draindown may be estimated if the estimate is based on previously measured values, and it is periodically verified or validated.

- The previously determined SNM concentrations and isotope factors may be accepted without verification by remeasurements if a high degree of assurance is provided that no significant change has occurred. Then the SNM content may be verified by weighing or NDA. The method used must be the same or similar to that used for the previous measurement and the measurement standard deviations should be comparable.
- The SNM concentrations and isotope factors used may be determined from historical averages, controlled input specification values or empirical relationships where such values or relationships are periodically tested, and their uncertainties or bounds have been determined.
- The information in the Plan shows the detection threshold for an excessive ID will result in a 90% probability of detecting a discrepancy equal to or larger than the U-235 quantity established by the NRC on a site-specific basis. (This quantity is referred to as the detection quantity.) In general, the licensee may assume the ID distribution approximates a normal distribution, and therefore:

$$\text{Detection Threshold} = \text{Detection Quantity} - 1.3 s$$

where s is the estimated SEID. The estimated SEID should be verified annually. Acceptable methodology for estimating the measurement error contribution to the SEID by error propagation is found in Jaech (1973) and IAEA (1977). Special attention is given to inclusion of all applicable and measurable sources of error to avoid underestimating the SEID.

- IDs will be corrected for known accumulated measurement biases that are significant. Biases affecting ID by as much as 10% should be considered significant.
- The detection quantity for the plant will be proposed by each licensee and will be no greater than 1.3% of throughput for facilities involved in chemical processing, such as UF_6 conversion or scrap recovery, or 0.9% of throughput for facilities where material only undergoes physical changes, such as pressing UO_2 powder into pellets or loading pellets into fuel rods. In either case, these quantities need be no smaller than 25 kilograms of U-235. The throughput will be established from either historical experience or predicted future activity.
- The resources and level of effort to be committed to the investigation of an excessive ID will be sufficient to reassess the results of the physical inventory, the accounting records, and the measurement control program data; to confirm the relevant calculations and data analysis; and to carry out searches for unmeasured inventory such as hold-up and discards. The submittal shows the investigation can be completed within 60 days after beginning the physical inventory.

5.6 QUESTIONS AND ANSWERS

1. Q: What kinds of protection will permit prior measurement data for items to be used at inventory time?

A: Encapsulated items such as fuel rods and containers or process vessels protected with wire or paper seals provide adequate capability to detect tampering. It is not necessary that seals be numbered and accounted for if controls are applied to limit the use of the seals to designated individuals or a means of identifying the person who applied the seal (and thereby assumed responsibility for the measurement values for the item). Storage of items in controlled areas will also protect against tampering. The storage areas should be in locations where unauthorized removal of SNM from items would be obvious to other workers or where access is controlled and limited to a small number of authorized people.

2. Q: How well does the licensee have to resolve an excessive estimated ID?

A: During the two-month resolution period, the licensee will investigate any excessive ID and should be able to reconcile it to a level necessary to satisfy the performance level stated in §74.31(c)(5). If the licensee is unable to resolve the ID, then a full report of the investigation must be submitted giving a probable cause and a rationale for the cause or causes listed. In addition, the licensee shall be prepared to perform a shutdown reinventory if requested by the NRC.

3. Q: Can you give an example of how the 90% power of detection can be calculated to satisfy §74.31(c)(5)?

A: In general a normal distribution can be assumed for ID, and the estimated ID is compared against a detection threshold value where:
$$\text{Detection Threshold} = \text{Detection Quantity} - 1.3 (\text{SEID}).$$
If the estimated ID is larger than the detection threshold then resolution action is required. For current levels of active inventory, most licensees should be able to show that they satisfy this condition with simple calculations which bound their capabilities rather than by making detailed exact calculations.

4. Q: In performing the annual inventory, may the presence of all items be determined by a statistical sampling method?

A: No; 100% of the items must be accounted for by direct verification.

5. Q: Can you discuss the requirements of an acceptable inventory sampling plan or give an example?

A: Generally, the SNM contents of the items that must be verified for the annual inventory (i.e., those items not exempted from remeasurements by §74.31(c)(6)) may be checked by weighing or NDA

measurements and the previously determined SNM content can be accepted if the verification measurement does not reveal a significant discrepancy in SNM content.

In addition, the items to be verified can be chosen by statistical sampling with a sample size sufficient to ensure 90% probability of detection of a discrepancy equal to or greater than the pre-established detection goal.

Any one of several published sampling plans could be applied. A variables sampling method for inventory verification is described by Stewart (1970), Hough et al. (1974), Piepel and Brouns (1981) and the IAEA (1977). Piepel and Brouns also describe an inventory measurement method using a statistical sampling based on the method of Levy and Lemeshow (1980).

The verification methods involve estimation of the sample size required from an inventory to achieve a pre-established goal standard deviation for the sum of the differences between the new (inspectors) and previous (operators) SNM measurements on the sampled items. On the other hand, the inventory measurement method involves estimation of the sample size required to achieve a pre-established optimum goal standard error for the total inventory of the facility and an allocation of the sample size to individual, uniform strata to achieve a minimum inventory standard error.

Verification methods based on an attribute test, which are somewhat simpler than the variables sampling methods, can also be used. One way to apply the method is as follows:

- Group or stratify the inventory into fairly uniform item sizes.
- Calculate a sampling fraction for each stratum by the method based on a binomial distribution with an acceptance number of zero;

$$\frac{n}{N} = 1 - \beta^{\bar{x}/g}$$

where

n = number of items in the sample

N = total number of items in the stratum

β = the desired probability of not detecting a discrepancy of g/\bar{x} items missing from the population N (for this case $\beta = 0.1$)

g = the pre-established detection goal for the inventory verification. A reasonable value for g is one-half the detection goal for IDs.

\bar{x} = The average SNM content of an item (if the range of item sizes in a stratum is greater than about 25%, the largest item size should be used instead of the average).

(The above formula gives conservative values for n . A more optimum formula is

$$n = (N - \frac{d-1}{2})(1 - \beta^{1/d}) \text{ and } d = g/\bar{x}$$

Note also that the detection goal may be applied independently to each stratum without loss of detection capability.)

- Select the n items by a random selection procedure and weigh each item (or measure it by NDA if the previous measurement was by NDA).
- Regard the difference between the remeasured and previous results

$$d_i = x_{i1} - x_{i2}$$

as a reject if d_i exceeds 4 times the standard deviation of d .

- If no rejects are detected in the n items, accept the previously measured values for all items in the stratum. If one or more rejects are detected, investigate and reconcile the discrepancy, which may require remeasurements of both net weight and the element factor and correction of the records, and proceed with additional tests of the faulty stratum. The additional tests may include further sampling (using a Stage 2 sampling plan) or remeasurement of all N items and reconciliation of all significant differences.

6.0 ACCEPTANCE CRITERIA FOR ITEM CONTROL

6.1 RULE

- 74.31(c)(6) Maintain current knowledge of items when the sum of the time of existence of an item, the time to make a record of the item, and the time necessary to locate the item exceeds 14 days. Store and handle, or subsequently measure, items in a manner so that unauthorized removals of substantial quantities of material from items will be detected. Exempted are items individually containing less than 500 grams of U-235 up to a total of 50 kilograms of U-235, solutions with a concentration of less than 5 grams of U-235 per liter, and items of waste destined for burial or incineration.

6.2 INTENT

The intent of this section is to require licensees to implement item control procedures that protect against unauthorized and unrecorded removal of material from items and that enable timely location of an item. Items are known quantities of SNM in well-defined containment such as canisters, or fixed units, e.g., fuel assemblies. In order to promptly locate a given item, sufficient current information must be recorded. These item control requirements apply only to items for which the total length of time that the item exists including the length of time it takes to locate it after having been recorded will exceed 14 days. For example, if an item has been in existence for 10 days, the licensee must be capable of making a record of the item and locating the item within 4 days to be exempt from the current knowledge requirement. Conversely, if it takes the licensee 4 days to make a record of the item and locate it, then an item which will exist for less than 10 days need not be formally entered into the current knowledge system. Also in order to eliminate the need to keep records for insignificant quantities of SNM, solutions and waste containers are exempt. The licensee is permitted some flexibility in controlling items by allowing exemption of up to 50 kilograms U-235 in items containing less than 500 grams U-235 each.

6.3 AFFIRMATIONS

The licensee must make the following affirmations with respect to maintaining current knowledge of items and detecting unauthorized removals:

- A record system will be established and maintained to provide a knowledge of the current status of items for all items for which the sum of the time of existence of the item and the time required to locate the item, including any time required to complete or update the records of the item, would exceed 14 days. For items subject to this commitment the item control and records system will provide the capability to promptly locate and confirm the existence of any

specific item or group of items upon demand. The item record system will be secured in such a manner that the record of an item's existence cannot be destroyed or falsified without a reasonable probability of detection.

- Each item will be stored and handled in a manner that enables detection of or provides protection against unauthorized or unrecorded removals of SNM; otherwise the SNM content will be measured at inventory time or when the item is destroyed, i.e., taken out of an item status.
- The SNM contents of items that are remeasured at inventory time will be determined by methods capable of detecting a loss or removal of a substantial quantity from any single class of items with a probability of 90 percent. (See Section 5.5 for issues dealing with the loss of a substantial quantity.) A "substantial quantity" for detection of inventory discrepancies will be established on a site-specific basis (see Section 5.6, Q.5).
- All incidents involving missing or compromised items or falsified item records will be investigated. (A compromised item is one for which there is evidence of tampering or which is found outside its assigned controlled access area.)
- The contents of a compromised item or an unsealed, unencapsulated item located after it has been missing will be reconfirmed by measurements.

6.4 INFORMATION TO BE INCLUDED

To be complete, the Plan should contain the following information:

- A brief description of the item control and accounting measures that provide capability to locate an item when required. The estimated times and supporting rationale to complete and update the item control records and to complete the major steps for locating items should be given in the Annex.
- A description of the storage and handling measures to be used to protect against or detect unauthorized removals of SNM from an item.
- A brief description of the item record system showing how items are identified, what information is recorded, the mechanism for entering source data in the system, how changes in location or the destruction of items are recorded, and how protection against simultaneous removal of an item and all records of that item is provided.
- The types of items and categories or classes of material in items that the licensee proposes to exempt from the item control requirements and the rationale for such exemptions.

- A brief description of the approach to ensure that the combined quantities of U-235 in exempted items each containing less than 500 grams of U-235 will remain under the total allowance of 50 kilograms of U-235.

6.5 ACCEPTANCE CRITERIA

A judgment that the licensee's Plan for the control of items subject to the requirements of §74.31(c)(6) is acceptable will be based on the following criteria:

- The licensee's planned item record system will uniquely identify items. The records will include information on the chemical form, quantity of material (element and/or isotope), physical description, identification label or number, and location. The system will provide reasonable assurance of detecting falsification or destruction of records of an item's existence. Groups of items that are produced, stored, processed, or otherwise handled together as a unit, such as a batch or subplot of material, may be exempt from the requirement for identification of each item if the group of items will be uniquely identified and group identity, composition and quantity will be maintained constant.
- The record of the status of an item can be completed or updated in sufficient time to allow the licensee to meet the requirements for promptly locating an item.
- The licensee has shown in the submittal that the location information to be kept on an item will provide the capability to locate and confirm the presence of any specific item within 3 calendar days, or an item or all items of a group of items within 14 calendar days when identified by only one of its attributes (chemical or physical form, physical description, quantity of SNM, location or item number).
- For items that will not be remeasured at inventory time, the item control procedures will provide reasonable assurance that the SNM contents given in the records are valid and that unauthorized removal of SNM from the item has not occurred. Remeasurement is not needed if the SNM content of the item was measured previously and reasonable assurance is provided that the SNM content has not subsequently changed. How such assurance can be provided is discussed in Section 5.5 and 5.6. The previous measurement of the SNM content of every item will be made directly, but the element and isotope fractions may be determined indirectly or by sampling procedures including:
 - Analysis of composites or measurements of representative items, objects or samples selected by statistical sampling; or

- Use of concentration and enrichment factors determined from historical averages, controlled input specification values or empirical relationships where such values or relationships are periodically tested, their uncertainties or bounds have been determined to be with about 1% of the factor value, and where diversions with material substitution are improbable. However, heterogeneous materials, such as ammonium diuranate, may not be assigned common factors unless the quantities are small, such as less than about 200 g of contained U-235. Justifications for any materials assigned common factors without batch-by-batch verification analyses should be presented in the Annex.
- The Plan makes provisions for determining the total quantity of U-235 in items exempted from control on the basis that they contain less than 500 grams U-235 each.
- Items exempted from item control procedures will satisfy one of the following conditions:
 - Items that will be in existence for only a short period of time, as defined in §74.31(c)(6);
 - Waste destined for burial or incineration;
 - Solutions containing less than 5 grams U-235 per liter; or
 - Items individually containing less than 500 grams U-235 each up to a total of 50 kilograms U-235;
- A current accounting will be maintained of the total quantity of SNM contained in items that are exempted from item control. The accounts will identify the quantities by material type category and separate listing by material type category of controlled and exempted material will be feasible.

6.6 QUESTIONS AND ANSWERS

1. Q: What is an item?

A: An item is created any time a finite quantity of SNM is contained in a fixed volume. All items, however, do not necessarily need to be included in the current knowledge requirement. Items which exist for a short period and will soon be destroyed for further processing may not need to be formally recorded. Items that are going to be in existence for less than 14 days and which can be located promptly when necessary are exempt from the current knowledge requirement. However, if the time to update the item records plus the time to locate the item combined with the time since the item was created exceeds 14 days, the formal item controls must be applied. In addition if an "exempted" item is held longer than expected and it

becomes evident that the 14-day limit will be exceeded, the item must be reclassified as a "controlled" item.

2. Q: Do items have to be tamper-safed according to Regulatory Guide 5.15?

A: No. Tamper-safing is not required as long as a valid inventory is taken with reasonable assurance that the value previously assigned to an item is still correct. For items where it may be questionable whether the item is still intact, such as items sitting around for a long period of time, alternative measures to tamper-safing may be used (e.g., increased surveillance of items, seals which do not necessarily satisfy Regulatory Guide 5.15, and controlling access to items).

3. Q: Why is there a limit on the item control system exemption?

A: All waste destined for burial or incineration and solutions containing less than 5 g/l of U-235 are exempted from the item control system without a limit. The limit only applies to other items individually containing less than 500 grams of U-235. This was intended to allow the licensee to have flexibility in exempting unattractive theft targets. The type of items exempted will depend upon a licensee's particular operation. However, to assure that a large portion of the licensee's inventory is not exempted, an overall limit was established.

4. Q: Does the requirement for maintaining current knowledge of items apply when a physical inventory is being taken?

A: Yes. The current knowledge capability should be able to assist in the assessment of an alleged material theft where such an allegation could be received at any time.

5. Q: How well does current knowledge have to be assured?

A: Two of the criteria for acceptance of a licensee's item control plan will apply. First, item records must be kept separate from the item so that an unauthorized removal would not go undetected. Thus, while totally separate centralized records are not required, the items and records should be stored such that it would be difficult to remove an item and all records of that item or to remove a record and all items on that record.

Second, items must be stored and handled in a manner such that unauthorized removals of SNM from them are difficult or are likely to be detected. Items of SNM where the current material content may be subject to question should be remeasured at least at inventory time. Examples of such material are: 1) material stored in an area where unexplained discrepancies have occurred, 2) material which has received no control during the inventory period, and 3) material in a container with a broken seal.

7.0 ACCEPTANCE CRITERIA FOR RESOLVING SHIPPER/RECEIVER DIFFERENCES

7.1 RULE

74.31(c)(7) Resolve, on a shipment basis and, when required to satisfy Part 75 of this chapter, on a batch basis, shipper/receiver differences that exceed both twice the combined measurement standard error for that shipment and 500 grams of U-235.

7.2 INTENT

The intent of this section is to require the material control and accounting system to promptly detect and resolve all significant shipper/receiver differences. The shipper/receiver value is important in determining when shippers and receivers values are acceptable for establishing the book inventory of the facility.

7.3 AFFIRMATIONS

The licensee must make the following affirmations with respect to resolving shipper/ receiver differences:

- A capability will be provided for timely detection of significant discrepancies in SNM shipments.
- Each shipment received will be inspected for loss or damage to the container or seals to determine if SNM could have been removed. If the integrity of a shipping container is questionable, the presence of all items that were packaged in the container will be verified.
- Confirmatory measurements of the quantity of SNM received in each shipment will be performed and the shipper/receiver difference will be tested for statistical significance. Occurrences of significant shipper/receiver differences and missing items will be reported to the shipper promptly.
- Measurement results for shipments and receipts will be corrected for biases that are significant at the 0.05 level.
- A significant shipper/receiver difference, e.g., one that exceeds both twice the combined measurement standard deviation for that shipment and 500 grams of U-235, will be promptly investigated and resolved on a shipment basis or on a batch basis when required to satisfy 10CFR 75.4(d).
- Significant shipper/receiver differences will be reported to the NRC either as being unresolved or with the conclusions of the resolution procedures.

7.4 INFORMATION TO BE INCLUDED

To be complete, the Plan should contain the following information:

- A description of the licensee's plans for detecting and investigating significant shipper/receiver differences, including an estimate of the time required to complete the investigation. The Annex should describe the procedures for inspecting shipments, and the measurement methods and their uncertainties that will be used to confirm SNM in the shipment.
- A description of the statistical test of hypothesis for determining if a shipper/receiver difference is significant. An example should be given in the Annex showing a typical calculation and statistical test to determine if a shipper/receiver difference is significant.

7.5 ACCEPTANCE CRITERIA

A judgment that the licensee's Plan for resolving shipper/receiver differences is acceptable will be based on the following criteria:

- Each shipping container will be inspected within 1 working day after receipt. If the integrity of a container is questionable, the presence of all items that were packaged in the shipping container will be confirmed within 2 working days after receipt.
- Confirmatory measurements of scrap shipments will be performed by the receiver to determine the amount of U-235 received within a time period consistent with the accountability needs of the shipper.
- The test for significance of a shipper/receiver difference will be based on hypothesis tests.
- The planned investigation procedure for significant shipper/receiver differences is sufficiently comprehensive to ensure that the difference will be resolved. Comprehensiveness is sufficient if the licensee shows the capability to verify records, resample, perform remeasurements, establish liaison with the shipper, provide samples to a referee laboratory, and perform the statistical analysis needed to evaluate the measurements.

7.6 QUESTIONS AND ANSWERS

1. Q: Where is a "batch" defined?

A: The definition for a batch is given in 10 CFR 75.4(d).

2. Q: Does "resolving shipper/receiver differences on a shipment basis" mean per DOE/NRC Form 741 or per truckload?

A: A shipment basis means per DOE/NRC Form 741.

3. Q: What constitutes resolution of a shipper/receiver difference?

A: A shipper/receiver difference is resolved when the shipper and the receiver agree on the quantity of SNM transferred in the shipment. The value agreed upon is then the accountability value used by both the shipper and receiver. In the event that the parties do not reach an agreement, the NRC must be notified.

4. Q: What is the basis for accountability measurements by a scrap recovery plant?

A: Scrap recovery plants carry scrap receipts at book values until they have dissolved the scrap and can sample at their accountability tank. The accountability value is the sum of the SNM in solution and in residues.

5. Q: Where does one obtain guidance on hypothesis tests for shipper/receiver differences?

A: Discussion of shipper/receiver difference tests is found in ANSI Standard N15.17 (1974); Jaech (1973); Johnston, Brouns and Stewart (1982), and Regulatory Guide 5.28 (1974).

8.0 ACCEPTANCE CRITERIA FOR PERIODIC ASSESSMENT OF THE MC&A SYSTEM

8.1 RULE

- 74.31(c)(8) Independently assess the effectiveness of the material control and accounting system at least every 24 months, and document management's action on prior assessment recommendations.

8.2 INTENT

The intent of this section is to require management to periodically review the performance of the MC&A system and evaluate its overall effectiveness. It is intended that the reviews will be performed by knowledgeable, technically competent individuals free from conflicts of interest and that the deficiencies will be brought to the attention of the plant management so that the deficiencies will be corrected.

8.3 AFFIRMATIONS

The licensee must make the following affirmations with respect to independent assessment and evaluation of the MC&A system effectiveness:

- The capabilities and performance of the MC&A system will be reviewed and its effectiveness will be independently assessed at least every 24 months.
- The review and assessment will be performed either by qualified individuals from outside or qualified individuals from inside the facility organization whose work assignments and positions within the organization will not impair their ability to make objective judgments of the MC&A system capabilities and performance.
- The assessment team leader will have no responsibility for managing or performing any of the MC&A system functions.
- The results of the assessment and recommendations for corrective action, if any, will be documented and reported to the plant manager and other managers affected by the assessment. Management will review the assessment report and take the necessary actions to correct MC&A system deficiencies.
- Management's actions on recommendations from the review and assessment will be documented.

8.4 INFORMATION TO BE INCLUDED

To be complete, the Plan should contain the following information with respect to independent assessments:

- A description of the plans for conducting the independent assessments of the MC&A system including:
 - A statement of the objectives of the assessment program;
 - The scope of the reviews to be performed giving the areas of the MC&A system to be covered and the level of detail required;
 - How the audit will be conducted and the areas that will be treated by observation; testing; review of data, procedures or records, etc;
 - The policies for selecting the assessment team listing the required qualifications, restrictions and limitations to be applied in order to assure independence and objectivity of the team; and
 - A description of the sampling plan used for selecting records to be audited as part of the assessment.
- The organizational positions responsible for initiating the assessment, approving the membership of the assessment team, and implementing the recommendations of the assessment.
- The Annex will include a typical assessment schedule showing time and effort to be devoted to different areas to indicate the expected intensity of the assessment.

8.5 ACCEPTANCE CRITERIA

A judgment that the licensee's program for independent assessment of the MC&A system is acceptable will be based on the following criteria:

- The periodic assessments will be comprehensive and sufficiently detailed to enable the assessment team to rate the MC&A system effectiveness, capability, and performance by comparison with the expected and required performance. The overall objectives will be to determine that the MC&A system, as designed and implemented, is continuing to meet the overall safeguards objectives and to identify weaknesses or deficiencies in the system design or performance that may need correcting.

- The areas to be reviewed will encompass the entire MC&A system and the level of detail of the reviews will be sufficient to ensure that the assessment team has adequate information to make reasoned judgments of the MC&A system effectiveness which includes:
 - Organizational effectiveness and management responsiveness to possible SNM losses;
 - Staff training and competency to carry out MC&A functions;
 - Soundness of the material accounting records;
 - Capability to promptly locate items;
 - Timeliness and effectiveness of shipper/receiver difference evaluations and resolution of excessive shipper/receiver differences;
 - Soundness of the inventory taking procedure;
 - Effectiveness of the measurement control program in monitoring the key measurement systems and its sufficiency to meet the requirements for controlling standard error of the ID;
 - Capability to confirm the presence of special nuclear material; and
 - Capability to resolve indications of missing material and aid in the investigation and recovery of missing material.
- Every record or report need not be examined, but, by using generally accepted auditing principles, representative samples of each type of record and report must be checked. The selection of samples of the records to be examined should be random.
- Personnel assigned to the assessment team will have an understanding of the objectives and the requirements of the MC&A system and will have sufficient knowledge and experience to be able to judge the adequacy of the parts of the system they are asked to review. The team will have authority to investigate any aspect of the MC&A system and will be given access to all information needed to do this.
- The team members ~~will~~ be selected from the facility staff or from outside the facility, but an individual member will not participate in the assessment of the parts of the MC&A system for which that person has direct responsibility. Also, an individual will not assess the parts of the system that are the responsibility of team members assessing his or her area.

- The leader of the assessment team will have no responsibilities for performing or managing the functions being assessed.
- The responsibility and authority for the assessment program and for initiating corrective actions will lie; 1) at least one level higher in the organization than the MC&A manager or 2) the on-site plant manager.

8.6 QUESTION AND ANSWER

1. Q: What should be included in the assessment of each key MC&A area?

A: The assessment should include an independent review of the MC&A system in each key area which provides information concerning the soundness, adequacy, and actual application of material controls and assurance of satisfactory accounting procedures and practices. The assessment should emphasize the system's performance and effectiveness rather than technical compliance with the Plan. The reliability of data and information within the MC&A system should be evaluated and assessment made of the quality of the source data and records. The assessment should include recomputation of quantities, tracing of selected transactions through the accounting process, and a thorough review of corrections and adjustments. The responsibilities and procedures for corrective action should be defined and the response of management to the recommendations resulting from the assessment should be documented.

9.0 ACCEPTANCE CRITERIA FOR RECORDKEEPING

9.1 RULE

74.31(d) Recordkeeping. Each licensee shall establish records that will demonstrate that the requirements of paragraph (c) of this section have been met and maintain these records for at least 3 years unless a longer retention time is required by Part 75 of this chapter.

9.2 INTENT

The intent of this section is to require the establishment, maintenance, and protection of a recordkeeping system that will demonstrate that the system capability requirements described in §74.31(c) have been met. Records are to be retained for at least 3 years thereby providing a means for assessing the performance of the MC&A system and inspecting for compliance with regulations.

9.3 AFFIRMATIONS

The licensee must make the following affirmations with respect to recordkeeping:

- A record system will be established and those records necessary to show that the MC&A system requirements of §74.31(c) have been met will be maintained for at least 3 years. The records referred to in §§75.22 and 75.23 and generated while the licensee was under IAEA safeguards will be retained for at least five years by the licensee. Records of the following will be maintained current and will be retained for at least three years:
 - Management structure, MC&A job descriptions, and MC&A policies and procedures;
 - Accounting source data records(a);
 - Records of shipments and receipts and investigations of significant shipper/receiver differences plus the information used to resolve them;

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- (a) The accounting source data normally consist of shipping and receiving forms, physical inventory forms, and the forms used for initially recording measurement and measurement control data. After an item is destroyed, the item location record needs to be retained for an additional 14 days but then may be destroyed.

- Measurement data for receipts, shipments, discards, and inventory;
 - Calibrations of measurement systems, measurement control data, bias estimates, and the statistical analyses of the measurement control data;
 - Data used to demonstrate that measurement system performance achieves the standard deviation limits required by §74.31(c)(4);
 - Physical inventory listings and inventory work sheets;
 - Calculations of detection thresholds for excessive ID;
 - Calculations of the standard error of the estimated ID and information used to reconcile excessive IDs;
 - Reports of investigations and resolution of indications of loss of SNM; and
 - The results of independent assessments and management action taken to correct any deficiencies identified.
- Sufficient protection and redundancy of the record system will be provided so that an act of record alteration or destruction will not eliminate the capability to provide a complete and correct set of SNM control and accounting information that could be used to confirm the presence of SNM, resolve indications of missing material, or aid in the investigation and recovery of missing material.
 - Ready traceability will be provided for all SNM transactions from source data to final accounting records.
 - All retained MC&A records will be readily accessible.

9.4 INFORMATION TO BE INCLUDED

To be complete, the Plan should contain the following information:

- A general description of the MC&A record system giving the record-keeping policies and defining the data and information to be routinely recorded, which documents need authorizing signatures, and the kinds of records to be retained in order to meet the recordkeeping requirements. The Annex should include a flow chart showing how data flows from the source documents to final accounting reports and typical forms and report formats used throughout the MC&A system.

- A description of any records system design features that facilitate traceability and enable auditing.
- A description of the overchecks for preventing or detecting missing or falsified data and records, ensuring completeness of the records, and locating data discrepancies and errors.
- The plan for reconstructing lost or destroyed SNM records.
- A description of any access controls used to assure that only authorized persons can update and correct records.

9.5 ACCEPTANCE CRITERIA

A judgment that the licensee's Plan for recordkeeping is acceptable will be based on the following criteria:

- The submittal shows that key material accounting and original source data documents and relevant reports and documents will be retained for three years or as long as needed to show continuing compliance with 10 CFR Part 74. (For example, records of the organizational structure can not be destroyed if the structure is still the same.)
- The source data will be retained in its original form until the physical inventory and any subsequent ID investigations have been completed. After this time, any readable facsimile is acceptable for the remainder of the required retention period. All other records may be retained as hard copy, microfiche, permanent computer readable forms, or other permanently readable forms.
- The retained records and reports will contain sufficient detail to enable NRC inspectors to determine that the control and accounting of the SNM has complied with the requirements of §74.31(c) and has met the general performance objectives of §74.31(a).
- The records will be retrievable, sufficiently complete and detailed to permit auditing all parts of the MC&A system, and traceable back to original source data.
- The records of the data that is the basis of the estimated SEID will permit traceability to the sources of the variances due to calibrations, bias adjustments and random effects in the measurements. These records may be summaries of calibrations, bias tests, and variance monitoring data or control charts.
- The record system will have sufficient redundancy to enable reconstruction of lost or missing records so that knowledge of the SNM

inventory is always available. The primary records, as contrasted with duplicate or backup records, will be provided security against fire or water damage, vandalism, and access to unauthorized persons.

- Overchecks or other controls including access controls for updating and correcting records will be provided to prevent or detect errors in the records that would affect inventory difference and item location.

9.6 QUESTIONS AND ANSWERS

1. Q: What is an acceptable record?

A: The following are characteristics of an acceptable record:

- Permanence for the applicable record keeping period;
- The capability to determine the location of all pertinent data;
- Retrievability in a time period necessary to fulfill the capabilities;
- Readability of retrieved data; and
- Traceability to provide an audit trail.

2. Q: What are some examples of overchecks or controls that would protect inventory difference or item location records from errors or losses?

A: Some examples are:

- Minimize the number of people authorized to make data entries;
- Use verification methods for data entry for shipments, receipts, waste discards, and item records (Item records may be verified by random sampling rather than on a 100 percent basis if the error rate is low.)^(a);
- Overcheck calculations, at least by random sampling;
- Use double entry bookkeeping;
- Retain duplicate records in a separate secure location so that a single individual or a single event cannot alter both sets of records; and
- Use two-person inventory teams.

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14 ABSTRACT (200 words or less) This report documents a standard format suggested by the NRC for use in preparing fundamental nuclear material control plans as required by the Low Enriched Uranium Reform Amendments (portions of 10 CFR Part 74). The report also describes the necessary contents of a comprehensive plan and provides example acceptance criteria which are intended to communicate acceptable means of achieving the performance capabilities of the Reform Amendments. By using the suggested format, the license applicant will minimize administrative problems associated with the submittal, review and approval of the FNMC plan. Preparation of the plan in accordance with this format will assist the NRC in evaluating the plan and in standardizing the review and licensing process. However, conformance with this guidance is not required by the NRC. A license applicant who employs a format that provides an equal level of completeness and detail may use their own format.					
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MAY 1984