

NRC INSPECTION MANUAL

NMSS

INSPECTION PROCEDURE 85404

PHYSICAL INVENTORY

PROGRAM APPLICABILITY: 2683

85404-01 INSPECTION OBJECTIVES

The objectives of this inspection procedure are to verify that an inventory program exists and ensures the following capabilities:

01.01 A physical inventory is performed at least every 12 months (no more than 370 calendar days between any two consecutive physical inventories).

01.02 The book inventory is reconciled and adjusted to the results of the physical inventory, and any inventory difference ID that is rejected by a statistical test (which has a 90 percent power of detecting a loss, over the past 12 months, of a quantity of U-235 established by the NRC on a site-specific basis) is resolved or reported (if unable to resolve) within 60 days after the start of each physical inventory.

85404-02 INSPECTION REQUIREMENTS

The inspector should ensure that the licensee has implemented an inventory program, that inventories are being conducted, and that the book inventory is reconciled to reflect the results of the physical inventory. The inspector should review the following:

02.01 Procedures for preparing the licensee facility for the physical inventory.

02.02 Procedures for conducting physical inventories.

02.03 Procedures and calculations for determination of the standard error of the inventory difference (SEID), procedures for and reports from reconciliation of IDs, and investigative reports associated with excessive IDs.

02.04 Physical inventory lists and material balance reports.

General Guidance

CRITERIA

The inventory program and its procedures must be effectively implemented. Physical inventories should be conducted at least every 370 days and also meet any frequency constraints stated in the licensee's fundamental nuclear material control (FNMC) plan. These inventories should confirm the quantity and location of special nuclear material (SNM) in the licensee's possession. The book inventory should be reconciled and adjusted to the results of the physical inventory. Each ID result should be reported to NRC within 60 days after the start of the physical inventory [pursuant to 10 CFR 74.17(a)].

Preinspection Activities

To prepare for the inspection, the inspector should:

- a. Review those portions of the FNMC plan and the license conditions pertaining to the planned inspection activities.
- b. Review the previous two material control and accounting (MC&A) inspection reports for the site.
- c. Review any unresolved or follow-up items from the previous inspections to be addressed during the current inspection.
- d. Review the content of any communications (including information notices and bulletins) to the licensee that were issued since the last inspection.

Post-Inspection Activities

Inspection follow-up activities and inspection report generation are to be performed as described elsewhere in the *NRC Inspection Manual*.

Specific Guidance

Physical Inventory Plans and Procedures

03.01 The inspector should verify that procedures for conducting physical inventories ensure appropriate assignment of responsibility and provide adequate guidance for inventorying SNM in containers and in-process equipment. The plan and procedures should contain definitive statements that specific inventory instructions will be prepared and issued in advance of each physical inventory.

The responsibility for planning, organizing, and conducting the physical inventories should be assigned to one primary manager and an alternate who are familiar with overall operation of the facility. The inventory of each plant area should be assigned to individuals who are familiar with but who have no direct responsibility for the material and operations conducted in that area. As a general rule, inventories should be conducted by teams consisting of at least two people. These people should report to the inventory manager while the inventory is being conducted.

The inspector should verify the following:

- a. The plan for conducting, verifying, and reconciling nuclear material inventories is documented and implemented.
- b. Procedures that define responsibilities and specify criteria for conducting physical inventories, including frequency and reconciliation activities, are documented and implemented.
- c. The account structure is able to localize IDs and to provide a system of checks and balances in verifying the accuracy of the data.
- d. The number of internal control areas is sufficient to identify and localize IDs and their causes.
- e. Procedures ensure that all SNM is inventoried.
- f. Procedures for determining the SNM content of environmental wastes (e.g., stack effluents and liquid waste streams) are documented and implemented.

Inventory Preparations

The inspector should verify that preinventory preparations will ensure an accurate determination of material in inventory and will minimize the SEID. For those items or processes for which the SNM inventory is difficult to measure or quantify, the inventory of the items or the processes should be reduced to the maximum extent practical (e.g., by draindown or cleanout) before the inventory begins. The procedures should ensure that inventory cutoff procedures, tag procedures, and post-inventory inspections ~~are~~ equally effective measures—are used to ensure that all material quantities will be accounted for and not counted more than once. Sufficient information should be provided in the procedures to show that the inventory process is organized and coordinated. The details of the plan and procedures should ensure the use of uniform and consistent practices for checking and recording the SNM status.

Before the inventory, the person with overall physical inventory responsibility should perform a preliminary inspection of the

plant areas to be inventoried, review the inventory procedures and instructions with key individuals, and supervise any needed additional training of inventory personnel. The inspection of plant areas should focus on ensuring that material is measured and properly tamper-safed, packaged, labeled, stored, or otherwise prepared for inventory, and that process equipment is dealt with according to those written procedures and instructions that have been established.

The inspector should verify the following:

- a. The procedures and methodologies associated with performing physical inventories are documented and implemented.
- b. Cutoff times for internal and external transfers of SNM are specified.
- c. Cutoff times for the termination of processing operations are specified.

Performing an Inventory

03.02 The inspector should review the physical inventory records and the inventory schedule to determine whether inventories are conducted at the frequency required in the FNMC plan. The inventory should act as a check on the book inventory and on the effectiveness of the item control program, and it should enable the licensee to adjust the accounts to accurately reflect the status of the SNM and process inventories within the facility.

The inspector should observe the physical inventory taking to determine whether the physical inventory procedures provide for verifying the location and identity of all quantities of SNM and enable the licensee to adjust the accounts to accurately reflect the status of the SNM inventory at the facility.

All items recorded during the physical inventory should have a listed SNM quantity (both element and isotope) based on measurement. Items that were not previously measured should be measured during the inventory taking process. Previously measured items should be evaluated to confirm the validity of their previously determined measured values.

Items sealed with a tamper-indicating device (TID) should be examined to ensure the integrity of the container and of the TID. Previously measured but unencapsulated and unsealed items should undergo remeasurement to validate the previous bulk or nondestructive assay (NDA) measurements of the items, either on a 100 percent basis or on the basis of a statistical sampling plan. If a statistical sampling plan is used to remeasure randomly selected items, the number of items remeasured must be

sufficient so that there will be at least a 90 percent probability of selecting and detecting at least one defective item whenever an actual loss or theft of a detection quantity (from the book inventory quantity) has occurred. If a remeasured item were previously measured by weighing, sampling, and chemical analysis, the item must be reweighed; if the contents of the item were previously established by NDA, the item must be remeasured by NDA.

The inspector should verify the following:

- a. All material flows to and from the material balance area (MBA) are documented.
- b. Physical inventories are based on measured values.
- c. The integrity of inventory items is verified.
- d. Direct or indirect SNM inventory measurements are made of material contained or held up in the process system.
- e. SNM physical inventories are conducted at least every 370 calendar days.

Establishing Control Limits

03.03 The inspector should verify the proper calculation of the SEID and of the ID control limits. Current inventory period data should be used for the estimation of the SEID. If for a given measurement system, insufficient control data were generated during the current period (because of limited use of the measurement system), data generated in immediately preceding material balance periods may be combined with current data when it can be demonstrated that the data are from the same distribution. The combined data are then used to establish the current period SNM variance for that system. The inspector should compare the total MC&A measurement uncertainty (at twice the standard error level) for the inventory period to 0.25 percent of the active inventory to determine whether the measurement systems have been sufficiently controlled. Procedures for establishing control limits should be documented and contain a detailed description of the methodology for determining ID threshold values. The statistical methods used to evaluate the inventory data shall include, as appropriate, tests of individual and cumulative differences, tests of randomness, and tests of distribution. Control limits should be recalculated at a predetermined frequency and modified if required. When an ID exceeds established control limits, an investigation should be conducted to determine the reason for the out-of-limit conditions and any deficiencies corrected.

The ID and SEID should be examined by the inspector to determine whether the estimates are traceable to the accounting and

measurement control program records and whether the estimates are generated as approved in the FNMC plan. The method used for estimating the SEID for the typical material balance must meet several requirements:

- a. All reasonable and probable sources of measurement error for the key measurement systems affecting IDs are included.
- b. The selection of the key measurements whose variances are to be included in calculating the standard error is justified by an analysis of the relative magnitudes of the variance components of a typical ID and their comparative effect on the SEID.
- c. Any measurement error standard deviations not actually determined by the measurement control program are shown to be reasonable either by comparison with published state-of-the-art measurement performance in similar applications or with available records of past performance data from the licensee facility.
- d. The calculation of the SEID is performed in accordance with a recognized error propagation method.

The inspector should verify the following:

- a. Procedures for establishing ID control limits and requiring investigations when those limits are exceeded are documented and implemented.
- b. Procedures for establishing ID control limits are based on variance propagation or other valid statistical techniques.
- c. IDs exceeding control limits are evaluated and resolved.
- d. Statistically based ID control limits are compared with the historical ID data to validate the completeness of the data inputs.

Inventory Reconciliation

The inspector should verify that after the inventory taking is completed, the inventory records are checked for correctness and the book records are reconciled and adjusted to the results of the inventory. The inspector should verify that the licensee's reconciliation includes both the central accounting records and the subsidiary journals.

Bias corrections should be applied to individual items or the ID in accordance with the licensee's FNMC plan and applicable critical MC&A procedures. The emphasis of bias correction should be to obtain an unbiased value for the total plant ID quantity.

Each bias correction that is greater than its uncertainty at the 95 percent confidence level should be considered to be statistically significant. All affected items and associated records should be corrected if the effect on the individual items is greater than the rounding error associated with the accounting records. Bias correction need not be considered if the measurement system bias is less than the uncertainty of the control standard(s) for that measurement system. Bias corrections applied to individual items (as accounting ledger entries) are not to be applied as a correction to the ID.

When applying a bias correction to ID, bias correction information from prior periods must be maintained and accurately tracked so that it can be correctly applied to SNM listed under each term in the plant ID expression (i.e., beginning inventory, ending inventory, additions to inventory, and removals from inventory).

The effect of prior period adjustments should be taken into account before the significance of the current period ID is assessed. The appropriate procedure for dealing with these discrepancies is, for the purposes of IDEvaluation, to modify the ID quantity by adding or subtracting a quantity of SNM equivalent to the adjustment before assessing the significance of the current period ID.

The inspector should verify the following:

- a. A physical inventory reconciliation is conducted after each inventory to ensure that SNM has been accounted for and that the facility's record reflects the results of the physical inventory.
- b. Measured values for inventory purposes are determined in time to provide for computation and reconciliation of inventories and determination of IDs, consistent with established inventory procedures.
- c. All adjustments to the records are evaluated.
- d. Inventory adjustments are supported by measured values or other technically defensible bases.
- e. A program for statistical reviews of inventory adjustments is documented.
- f. The investigation and reporting of IDs are consistent with 10 CFR 74.17(a), the licensee's FNMC plan, and applicable critical MC&A procedures.

Loss Detection and Reporting

The inspector should evaluate monitoring and assessment activities for loss detection elements and their associated data to determine the status of SNM inventories and to identify abnormal situations. The false alarm rate and the resolution efficiency should be compared with those for a well-run facility. Abnormal situations indicating theft, attempted theft, or unlawful diversion of SNM should have been reported to the NRC Operations Center within 1 hour of discovery. The inspector should determine that the licensee can quickly generate an inventory listing in response to an alarm situation.

The inspector should verify the following:

- a. Procedures for responding to abnormal conditions are documented and designate who is responsible for initiating and executing response actions.
- b. The status of SNM can be established in response to alarm situations.
- c. Procedures for conducting special inventories are documented and implemented, when necessary.
- d. Special inventory procedures address the circumstances requiring a special inventory.
- e. Indicators of missing SNM are responded to in accordance with documented procedures.

Determining Inventory Accuracy and Adequacy

03.04 The inspector should examine a random sample of items to ensure the existence of an adequate audit trail and to ensure that adjustments to reconcile the book inventory to the physical inventory are performed in accordance with commonly accepted accounting practices and that the adjustments are traceable and capable of being audited. A random sample of items on the inventory should be selected by the inspector and found as a check of the accuracy of the inventory.

The SNM quantity value on the physical inventory listing for each component in the material balance should be based on measurements. The SNM content of groups of like items can be determined by averaging typical contents as determined by measurements of representative item samples of that material at the time of the inventory if the licensee has demonstrated that any additional uncertainty resulting from this averaging method is included in the SEID estimator. Prior measurement values may be accepted for inventory provided they were determined by measurement systems subject to the licensee's measurement control program, and the containers were either immediately tamper-safed after the measurement or provided protection equivalent to tamper-safing. For items not protected by TIDs (or equivalent),

the items must have their previous measurement values confirmed either on a statistical sampling plan basis (i.e., by remeasuring an ample number of randomly selected items), or a 100 percent basis (i.e., all applicable items remeasured). Such remeasurements need only involve a remeasurement for gross or net weight provided a gross or net weight measurement were part of the original SNM determination.

The inspector should review the records of tamper-safing devices to verify that continuity of knowledge has been maintained for each item. If an item had a broken TID replaced, the inspector should review the methods used to protect the information on the quantities of SNM contained in the item.

The inspector should verify, by observation of the physical inventory taking, that the periodic physical inventories enable the licensee to adjust accounts to accurately reflect the status of the SNM inventory within a facility. The inspector should verify the following:

- a. Physical inventory records are reviewed to verify that all SNM values are based on measurements.
- b. Records of tamper-safing devices or equivalent controls are reviewed to ensure that continuity of knowledge has been maintained for each item.

85404-04 REFERENCES

Regulations

10 CFR 74.31(a)(1), (2), and (3); 10 CFR 74.31(c)(5).

Regulatory Guides and Reports

NUREG-1065, Rev. 2, "Acceptable Standard Format and Content for The Fundamental Nuclear Material Control Plan Required for Low-Enriched Uranium Facilities," November 1995.

NUREG/CR-5890, "Material Control and Accounting Loss Detection during Transition Periods and Process Upset Conditions," March 1987.

NUREG/CR-5003, "Design of a Material Control and Accounting System to Protect Against Concealment of Diversion by Falsification and Collusion," October 1987.

NUREG/CR-5002, "Methods for Recurring Loss Tests," September 1987.

NUREG/CR-4497, "NRC PAGE Applications Manual," April 1986.

NUREG/CR-4604, "Statistical Methods for Nuclear Material Management," December 1988.

NUREG/CR-4107, "Sequential Test Procedures for Detecting Protracted Materials Losses," July 1985.

NUREG/CR-2483, "Evaluation of Simultaneous Testing Procedures for Nuclear Materials Control and Accounting," March 1982.

NUREG/CR-2466, "Statistical Sampling Plans for Prior Measurement Verification and Determination of the SNM Content of Inventories," March 1982.

NUREG/CR-1785, "Performance Evaluation of Loss Detection Schemes for Uranium Recovery Plants," November 1981.

NUREG/CR-0662, "Computational Tools for Material Control Assessment and Design of Processing Monitors: An Overview," February 1979.

B. W. Smith and P. T. Reardon, "Developing a Strategy for Licensee Investigation of an Excessive Inventory Difference," *Journal of Nuclear Materials Management*, July 1980.

TID-26298, "Statistical Methods in Nuclear Material Control," 1973.

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