

U.S. Department of Energy  
Washington, D.C.

ORDER

DOE 5633.3A

2-12-93

SUBJECT: CONTROL AND ACCOUNTABILITY OF NUCLEAR MATERIALS

1. PURPOSE. To prescribe the Department of Energy (DOE) minimum requirements and procedures for control and accountability of nuclear materials at DOE-owned and -leased facilities and DOE-owned nuclear materials at other facilities which are exempt from licensing by the Nuclear Regulatory Commission (NRC).
2. CANCELLATION. DOE 5633.3, CONTROL AND ACCOUNTABILITY OF NUCLEAR MATERIALS, of 2-3-88.
3. APPLICATION TO CONTRACTS. Except for the exclusions in paragraph 4, the provisions of this Order are to be applied to covered contractors and they will apply to the extent implemented under a contract or other agreement. A covered contractor is a seller of supplies or services that is awarded a procurement contract or subcontract and either possesses, uses, or ships nuclear materials at DOE-owned or -leased facilities; or possesses, ships, or uses DOE-owned nuclear material at an offsite facility exempt from NRC licensing and regulation.
4. EXCLUSIONS. This Order does not apply to DOE-owned nuclear materials at Department of Defense facilities or foreign facilities. To avoid duplicative or conflicting requirements, DOE facilities, projects, and programs under the cognizance of the Office of Civilian Radioactive Waste Management and subject to NRC regulation shall use the rules, standards, and criteria specified by the NRC or NRC Agreement State in lieu of this Order.
5. REFERENCES. See Attachment 1.
6. DEFINITIONS. See Attachment 2.
7. RESPONSIBILITIES. See DOE 5633.2A, CONTROL AND ACCOUNTABILITY OF NUCLEAR MATERIALS: RESPONSIBILITIES AND AUTHORITIES.
8. IMPLEMENTATION. This Order applies to nuclear materials at DOE-owned and -leased facilities and DOE-owned nuclear material at other facilities which are exempt from licensing by the NRC. Managers, DOE Field Offices, are given approval authority and responsibility for determining the scope, extent, and details of selected material control and accountability (MC&A)

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and Security

requirements. Within 9 months of the date of this Order, each Manager, DOE Field Office, shall issue a document which details how requirements in this Order will be locally implemented. The document should specify what requirements have been set by the Manager, DOE Field Office, and how these requirements are being met.

BY ORDER OF THE SECRETARY OF ENERGY:



LINDA G. SYE  
Acting Director of Administration  
and Management

REFERENCES

1. Atomic Energy Act of 1954 (42 U.S.C. 2011, et. seq.), as amended, which establishes a program for Government control of the possession, use and production of atomic energy and special nuclear material, whether owned by the Government or others.
2. Title 10 CFR Parts 1 to 199, Nuclear Regulatory Commission Regulations, which contain the regulations applicable to NRC and "Agreement State" licensees involved in activities concerning nuclear materials not subject to DOE requirements.
3. DOE 1270.2B, SAFEGUARDS AGREEMENT WITH THE INTERNATIONAL ATOMIC ENERGY AGENCY, of 6-23-92, which prescribes policies and responsibilities for compliance with the agreement, including the associated protocol, between the Federal Government and the International Atomic Energy Agency for the application of safeguards in the United States.
4. DOE 1360.2B, UNCLASSIFIED COMPUTER SECURITY PROGRAM, of 5-18-92, which establishes requirements, policies, responsibilities, and procedures for developing and sustaining a DOE unclassified security program.
5. DOE 5000.3B, OCCURRENCE REPORTING AND PROCESSING OF OPERATIONS INFORMATION, of 1-19-93, which establishes a DOE system for identification, categorization, notification, analysis, reporting, followup, and closeout of occurrence.
6. DOE 5400.1, GENERAL ENVIRONMENTAL PROTECTION PROGRAM, of 11-9-88, which establishes the environmental protection program for DOE Operations.
7. DOE 5400.3, HAZARDOUS AND RADIOACTIVE MIXED WASTE PROGRAM, of 2-22-89, which establishes DOE hazardous and radioactive mixed waste policies and requirements and to implement the requirements of the Resource Conservation and Recovery Act within the framework of the environmental programs established under DOE 5400.1.
8. DOE 5480.18A, ACCREDITATION OF PERFORMANCE-BASED TRAINING FOR CATEGORY A REACTORS AND NUCLEAR FACILITIES, of 7-19-91, which establishes a performance based training process for reactor and nonreactor nuclear facilities in DOE.
9. DOE 5480.20, PERSONNEL SELECTION, QUALIFICATION, TRAINING, AND STAFFING REQUIREMENTS AT DOE REACTOR AND NON-REACTOR NUCLEAR FACILITIES, of 2-20-91, which establishes the selection, qualification, training, and staffing requirements for personnel involved in the operation, maintenance, and technical support of DOE-owned reactors and nonreactor nuclear facilities.
10. DOE 5484.1, ENVIRONMENTAL PROTECTION, SAFETY, AND HEALTH PROTECTION INFORMATION REPORTING REQUIREMENTS, of 2-24-81, which establishes the requirements and procedures for the investigation of occurrences having environmental protection, safety, or health protection significance for DOE operations.

11. DOE 5500.1B, EMERGENCY MANAGEMENT SYSTEM, of 4-30-91, which establishes overall policy and requirements for a system that will provide for development, coordination, and direction of Department planning, preparedness, and readiness assurance for response to operational, energy, and Continuity of Government emergencies involving DOE or requiring Departmental assistance.
12. DOE 5630.11A, SAFEGUARDS AND SECURITY PROGRAM, of 12-7-92, which establishes the policy and responsibilities for the DOE Safeguards and Security Program.
13. DOE 5630.13A, MASTER SAFEGUARDS AND SECURITY AGREEMENTS, of 6-8-92, which establishes Departmental policy, requirements, and authorities for the development of Master Safeguards and Security Agreements.
14. DOE 5630.14A, SAFEGUARDS AND SECURITY PROGRAM PLANNING, of 6-9-92, which establishes a standardized approach to protection program planning, prescribes DOE policy, objectives, responsibilities, and authorities for that planning process, and consolidates site and master plan requirements.
15. DOE 5630.16, SAFEGUARDS AND SECURITY PERFORMANCE TEST PROGRAM, of 8-25-92, which establishes requirements for integrated performance testing of personnel, procedures, and equipment to demonstrate the adequacy and effectiveness of the safeguards and security performance requirements mandated under DOE Orders.
16. DOE 5630.17, SAFEGUARDS AND SECURITY (S&S) STANDARDIZATION PROGRAM, of 9-29-92, which provides policies, procedures, responsibilities, and authority for the S&S Standardization Program to ensure the most effective and efficient use and procurement of S&S equipment and systems.
17. DOE 5631.6A, PERSONNEL SECURITY ASSURANCE PROGRAM, of 9-15-92, which establishes policies, objectives, procedures, responsibilities, and authorities for a Personnel Security Assurance Program.
18. DOE 5632 series, PHYSICAL PROTECTION, which establish Departmental policies and procedures related to the physical protection of DOE property and security interests.
19. DOE 5633.2A, CONTROL AND ACCOUNTABILITY OF NUCLEAR MATERIALS: RESPONSIBILITIES AND AUTHORITIES, of 9-23-92, which establishes the responsibilities and authorities for DOE organizations with respect to material control and accountability.
20. DOE 5633.4, NUCLEAR MATERIALS TRANSACTIONS: DOCUMENTATION AND REPORTING, of 2-9-88, which establishes policies and procedures for the documentation of nuclear materials transactions, preparation of periodic summaries and reports concerning material balances of nuclear materials, reporting the status of nuclear materials held in inventory, and reporting nuclear materials transactions, material balances, and inventory data to the Nuclear Materials Management and Safeguards System (NMMSS).

21. DOE 5633.5, NUCLEAR MATERIALS REPORTING AND DATA SUBMISSION PROCEDURES, of 5-22-87, which establishes procedures for reporting nuclear material information and submitting data to NMSS.
22. DOE 5634.1B, FACILITY APPROVAL, SECURITY SURVEYS, AND NUCLEAR MATERIALS SURVEYS, of 9-15-92, which establishes requirements for the conduct of onsite security or nuclear materials surveys of facilities with DOE safeguards and security interests.
23. DOE 5639.6, CLASSIFIED COMPUTER SECURITY PROGRAM, of 9-15-92, which establishes requirements, policies, and responsibilities for the development and implementation of a Departmental program to ensure the security of information stored in classified computer systems.
24. DOE 5700.6C, QUALITY ASSURANCE, of 8-21-91, which establishes quality assurance requirements for DOE.
25. DOE 5820.2A, RADIOACTIVE WASTE MANAGEMENT, of 9-26-88, which establishes policies, guidelines, and minimum requirements for managing radioactive and mixed waste.
26. DOE, "Safeguards Seal Reference Manual," of 9-91, which provides guidance to nuclear facility personnel in selecting, procuring, and applying the proper seals for safeguarding nuclear material.
27. "DESIGN BASIS THREAT POLICY FOR THE DEPARTMENT OF ENERGY (DOE) PROGRAMS AND FACILITIES (U)," of 3-92, issued by the Director of Security Affairs, which establishes the design basis threat for protecting DOE facilities and security interests.
28. DOE/NRC Form 741/741A, NUCLEAR MATERIAL TRANSACTION REPORT, OMB Control Number 1910-1800, of 10-88, which is used for reporting values to NMSS for external transfers of nuclear material.
29. ANSI N15.19-89, "Nuclear Material Control - Volume Calibration Techniques" American National Standards Institute, Inc., 1430 Broadway, New York, NY 10018 (1989).
30. ANSI N15.36-83, "Nuclear Materials - Nondestructive Assay Measurement Control and Assurance," American National Standards Institute, Inc., 1430 Broadway, New York, NY 10018 (1983).
31. ANSI N15.41-84, "Nuclear Facilities - Derivation of Measurement Control Programs - General Requirements," American National Standards Institute, Inc., 1430 Broadway, New York, NY 10018 (1984).
32. ANSI N15.51-90, "Measurement Control Programs Nuclear Materials Analytical Chemistry Laboratory," American National Standards Institute, Inc., 1430 Broadway, New York, NY 10018 (1991).

33. ANSI N15.54-90, "Instrumentation - Radiometric Calorimeters Measurement Control Program," American National Standards Institute, Inc., 1430 Broadway, New York, NY 10018 (1991).
34. ASTM Standard C993-90, "Standard Guide to In-Plant Performance Evaluation of Hand-Held SNM Monitors," American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103 (4-26-90).
35. ASTM Standard C1112-88, "Standard Guide for Application of Radiation Monitors to the Control and Physical Security of Special Nuclear Material," American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103 (1988).
36. ASTM Standards C1169-91, "Standard Guide to Laboratory Evaluation of Automatic Pedestrian SNM Monitor Performance," American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103 (1991).
37. ASTM Standard C1189-91, "Standard Guide to Procedures for Calibrating Automatic Pedestrian SNM Monitor," American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103 (1991).
38. "Guide for Implementation of DOE 5633.3A," of 2-93, issued by the Director of Security Affairs, which provides guidance in the understanding of materials control and accountability requirements contained therein.
39. "Master Safeguards and Security Agreement Verification Team Handbook (Volume I - MSSA Verification Process)," U.S. Department of Energy, Office of Safeguards and Security (1991).
40. "Master Safeguards and Security Agreement Verification Guide (Volume II - MSSA Verification Process)," U.S. Department of Energy, Office of Safeguards and Security (1991).
41. "Metal Detector Guide", U. S. Department of Energy, Office of Safeguards and Security (2-22-90).
42. "Safeguards and Security Definitions Guide," U.S. Department of Energy, Office of Safeguards and Security (9-26-91).
43. "Sample Master Safeguards and Security and Vulnerability Assessment (Volume III - MSSA Verification Process)," U.S. Department of Energy, Office of Safeguards and Security (1991).

### DEFINITIONS

1. ACCOUNTABILITY MEASUREMENT. The quantitative determination of bulk or nuclear material attributes used in nuclear materials accounting.
2. ACCURACY. A measure of the agreement between the true value and the measured value.
3. ACTUAL INVENTORY DIFFERENCE. The portion of the Inventory Difference that is not Explained Inventory Difference, expressed mathematically as  $\text{Inventory Difference} - \text{Explained Inventory Difference} = \text{Actual Inventory Difference}$ .
4. ADJUSTMENT. An entry into the nuclear material accounting records to reflect an approved, justified, and documented change.
5. ADMINISTRATIVE CHECK. A review to determine that no irregularities appear to exist and no items are obviously missing.
6. ALARM LIMITS. Established values for inventory differences of nuclear materials which when exceeded, require immediate action and reporting in accordance with DOE 5000.3B. Note: For processing, production, and fabrication operations, alarm limits will be established with a 99 percent confidence level.
7. APPARENT LOSS. The inability to physically locate or to otherwise account for any of the following:
  - a. Any identifiable or discrete item (e.g., batch, lot, or piece) containing nuclear material;
  - b. A nuclear material inventory difference in which the book inventory is larger than the physical inventory by an amount in excess of the established alarm limit;
  - c. A shipper/receiver difference involving a discrepancy in which fewer items were received than were shipped; or
  - d. A shipper/receiver difference whose magnitude exceeds the combined limit of error for the shipment and for which the receiver measures less material than the shipper.
8. BEGINNING INVENTORY. The quantity of nuclear materials on hand at the beginning of an accounting period.
9. BIAS. The deviation of the expected value of a random variable from the corresponding true or assigned value.

10. BOOK INVENTORY. The quantity of nuclear material present at a given time as reflected by accounting records.
11. CATEGORY. A designation (Category I, II, III, or IV) of a quantity of SNM or of an SNM location based on the attractiveness level of the material and the amount of material present. Precise directions for the determination of nuclear material categories are given in Chapter I, paragraph 2b.
12. CERTIFIED REFERENCE MATERIAL. A reference material, one or more of whose property values is certified by a technically valid procedure accompanied by or traceable to a certificate or other documentation which is issued by a certifying body.
13. CONFIRMATORY MEASUREMENT. A measurement made to test whether some attribute or characteristic of nuclear material is consistent with the expected attribute or characteristic for that material.
14. CONTROL LIMITS. The established values beyond which any variation, in this case inventory difference, is considered to indicate the possibility of an assignable cause. Control limits established at the 95 percent confidence level are called warning limits. Those established at the 99 percent confidence level are called alarm limits.
15. DIVERSION. The unauthorized removal of nuclear material from its approved use or authorized location. Note: The definition of "authorized locations" in the context of diversion of nuclear materials is the responsibility of the cognizant DOE Field Office.
16. ENDING INVENTORY. The quantity of nuclear materials on hand at the end of an accounting period.
17. ESTIMATE. A technically defensible approximation of the quantity of SNM based on process parameters and/or material attributes. An estimate is used when a direct measurement of nuclear material amount is not possible.
18. EXPLAINED INVENTORY DIFFERENCE. The portion of the inventory difference accounted for and reported to NMMSS in one of the following categories: redetermination of discrete items on inventory, redetermination of material in process, process holdup differences, equipment holdup differences, measurement adjustments, rounding, recording and reporting errors, shipper-receiver adjustments, identifiable item adjustments.
19. EXTERNAL TRANSFER. A transfer of nuclear material from one reporting identification symbol to another.
20. INTERNAL CONTROL SYSTEM. A system of administrative and accounting policies and procedures implemented by a facility to ensure proper functioning of the materials control and accountability system. Note: The system includes checks and balances in the division of duties designed so that the work of one will serve to verify the work of another.



21. INTERNAL TRANSFER. A transfer of nuclear materials within the same reporting identification symbol.
22. INVENTORY DIFFERENCE. The algebraic difference between the nuclear material book inventory and the corresponding physical inventory, expressed mathematically as  $\text{Book Inventory} - \text{Physical Inventory} = \text{Inventory Difference}$ . Note: The term TOTAL INVENTORY DIFFERENCE is sometimes used instead of Inventory Difference.
23. ITEM. A single piece or container of nuclear material which has a unique identification, a known nuclear material mass, and whose presence can be visually verified.
24. LIMIT OF ERROR. The boundaries within which the value of the attribute being determined lies with a specified probability. Note: The boundaries are defined to be plus or minus twice the standard deviation of the measured value unless otherwise stipulated.
25. MATERIAL ACCESS AREA. A type of security area authorized to contain a Category I quantity of nuclear material with specifically defined physical barriers, located within a Protected Area, and subject to specific access controls.
26. MATERIAL ACCOUNTABILITY ALARM. Alarm resulting from material control indicators (e.g., Shipper/Receiver Difference, Inventory Difference, etc.) exceeding established control limits.
27. MATERIAL BALANCE AREA. An area that is both the subsidiary account of the facility and a geographical area with defined boundaries, used to identify the location and quantity of nuclear materials in the facility.
28. MATERIAL CONTROL ALARM. Alarm from a loss detection element (e.g., SNM monitors, material surveillance) which may indicate an abnormal situations and/or unauthorized use/removal of nuclear material.
29. MATERIAL CONTROL AND ACCOUNTABILITY PLAN. A documented description of a site or facility's MC&A program. Note: The MC&A plan may be presented as a separate document or incorporated as part of another document.
30. MATERIAL SURVEILLANCE. The collection of information through devices and/or personnel observation to detect unauthorized movements of nuclear material, tampering with containment, falsification of information related to location and quantities of nuclear material, and tampering with safeguards devices.
31. MEASURED VALUE. A quantitative characteristic and its associated uncertainty that has been determined for nuclear materials by measurement of those materials.

32. MEASUREMENT CONTROL. The procedures and activities used to ensure that a measurement process generates measurements of sufficient quality for their intended uses.
33. NUCLEAR MATERIALS (NM). For the purposes of this Order, all materials so designated by the Secretary of Energy. At present, these materials are: depleted uranium, enriched uranium, americium-241, americium-243, curium, berkelium, californium-252, plutonium-238 through -242, lithium-6, uranium-233, normal uranium, neptunium-237, deuterium, tritium, and thorium.
34. NUCLEAR MATERIALS ACCOUNTING. The principles and/or practices of systematically recording, reporting, and interpreting nuclear material transaction and physical inventory data.
35. NUCLEAR MATERIALS CATEGORY. See CATEGORY.
36. NUCLEAR MATERIALS REPRESENTATIVE. The person responsible for nuclear materials reporting and data submission to the Nuclear Materials Management and Safeguards System.
37. NUCLEAR MATERIALS CUSTODIAN. An individual assigned responsibility for the control of nuclear material in a localized area of a facility. Note: The localized area should be limited, where practical, to a single material balance area.
38. PHYSICAL INVENTORY.
  - a. The quantity of nuclear material which is determined to be on hand by physically ascertaining its presence using techniques such as sampling, weighing, and analysis.
  - b. The act of quantifying nuclear material that is on hand by physically ascertaining its presence using techniques such as sampling, weighing, and analysis.
39. PROTRACTED THEFT OR DIVERSION. Theft or diversion resulting from repeated occurrences over an extended period of time.
40. PRECISION. A quantitative measure of the variability of a set of repeated measurements.
41. REPORTABLE OCCURRENCE. Events or conditions to be reported in accordance with the criteria defined in DOE 5000.3B. Note: Events or conditions included are emergencies, unusual occurrences, and off-normal occurrences.
42. REPORTING IDENTIFICATION SYMBOL (RIS). A unique combination of three or four letters that are assigned to each reporting organization by the DOE or the Nuclear Regulatory Commission for purposes of identification in the nuclear materials management data base. Note: The term is also used to refer to the reporting organization to which the RIS is assigned.

43. SEALED SOURCE. Nuclear material generally for use in test and calibration that has been packaged to be environmentally and critically safe.
44. SHIPPER/RECEIVER DIFFERENCE. The difference between the measured quantity of nuclear material stated by the shipper as having been shipped and the measured quantity stated by the receiver as having been received.
45. SOURCE MATERIAL. Depleted uranium, normal uranium, thorium, or any other material determined, pursuant to the provisions of Section 61 of the Atomic Energy Act of 1954, as amended, to be source material, or ores containing one or more of the foregoing materials in such concentration as may be determined by regulation.
46. SPECIAL NUCLEAR MATERIAL. Plutonium, uranium-233, uranium enriched in the isotope 235, and any other material which pursuant to the provisions of Section 51 of the Atomic Energy Act of 1954, as amended, has been determined to be special nuclear material, but does not include source material; it also includes any material artificially enriched by any of the foregoing, not including source material.
47. STANDARD REFERENCE MATERIAL. A reference material, one or more of whose property values has been certified by the National Institute of Standards and Technology (formerly the National Bureau of Standards).
48. STRATEGIC VALUE. The usefulness of a nuclear material to a potential diverter in constructing a weapon.
49. TAMPER INDICATING. An item containing SNM that is either a) protected by a tamper-indicating device, or b) constructed such that removal of SNM cannot be accomplished without permanently altering the item in a manner that would be obvious during visual inspection.
50. TAMPER SAFING. The act of applying a Tamper-Indicating Device.
51. TRANSACTION. Any recorded change affecting an inventory data base.
52. TRANSFER CHECK. The act of verifying the shipping container or item count, verifying the tamper-indicating devices integrity including the identification number, and comparing this information with appropriate documentation following the transfer of nuclear material.
53. VARIANCE PROPAGATION. The determination of the value to be assigned as the uncertainty of a given quantity using mathematical formulas for the combination of errors. Variance propagation involves many considerations, and the choice of formulas for computing the uncertainty depends upon the functional relationships of the measurement parameters involved.
54. VERIFICATION MEASUREMENT. A quantitative remeasurement to verify an existing previously reported measured value.

55. WARNING LIMITS. Established values (quantity limits) for inventory differences which, when exceeded, require investigation and appropriate action. Note: For processing, production, and fabrication operations, warning limits are established with a 95 percent confidence level.
56. WORKING STANDARD. A reference material that has been sufficiently analyzed or characterized for internal use as a calibration or control standard, and where possible, is traceable to a national measurement base.

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## CHAPTER I

### BASIC REQUIREMENTS

1. GENERAL. This chapter provides minimum requirements for the control and accountability of nuclear materials.
  - a. Nuclear materials (Figure I-1) shall be controlled and accounted for as required by this Order. A graded material control and accountability (MC&A) program shall be implemented by Managers, DOE Field Offices, using requirements for Category IV as the minimum for nuclear materials. See page I-9, paragraph 3c, for requirements for depleted uranium. The level of control and accountability shall be consistent with the economic and strategic value of these materials. Special nuclear material (SNM) shall not be received, processed, or stored at a facility until facility approval has been granted in accordance with the requirements of DOE 5634.1B. Figure I-1 provides a list of nuclear materials and reportable quantities. Page I-6, paragraph 2b defines categorization of nuclear materials for implementation of DOE's graded safeguards program. Detailed information on reporting requirements for materials accounting data and information can be found in DOE 5633.4.
  - b. A management official responsible for the control and accountability of nuclear materials shall be designated for each facility. This official shall be organizationally independent from responsibility for other programs. A Nuclear Materials Representative responsible for nuclear materials reporting and data submission to the Nuclear Materials Management and Safeguards System (NMMSS) shall be designated for each facility or site having a Reporting Identification Symbol (RIS).
  - c. For each facility, facility management shall maintain documentation defining authorities and responsibilities for MC&A functions (e.g., accounting system, measurements, measurement control, inventories, audit, material access controls, and surveillance). For each facility, there shall be a program to assure that personnel performing MC&A functions are trained and qualified to perform their duties and responsibilities, and are knowledgeable of requirements and procedures related to their functions.
  - d. An MC&A Plan shall be developed for each facility possessing nuclear materials (including facility review and frequency and change control), and approved by the cognizant Manager, DOE Field Office. The MC&A plan may, at the option of the cognizant Manager, DOE Field Office, be a separate document or a part of an existing document such as a SSSP.
    - (1) Category I and II. For facilities possessing Category I and II quantities of SNM, the plan shall reflect requirements for MC&A program planning and management, threat considerations, performance criteria, the accounting system, physical inventories, measurement control, control limits, loss detection elements, training, response to nuclear material alarms, access control, anomaly resolution, containment, and surveillance.

MATERIAL TYPE	SNM	SOURCE	OTHER NUCLEAR MATERIALS	REPORTABLE QUANTITY
Depleted Uranium		X		Kilogram
Enriched Uranium <sup>1</sup>	X			Gram
Normal Uranium		X		Kilogram
Uranium-233	X			Gram
Plutonium-242 <sup>2</sup>	X			Gram
Plutonium-239-241	X			Gram
Plutonium-238 <sup>3</sup>	X			Tenth of a Gram
Americium-241			X	Gram
Americium-243			X	Gram
Berkelium			X	Microgram
Californium-252			X	Microgram
Curium			X	Gram
Deuterium			X	Tenth of a Kilogram
Lithium-6			X	Kilogram
Neptunium-237			X	Gram
Thorium		X		Kilogram
Tritium <sup>4</sup>			X	Hundredth of a Gram

Figure I-1  
Nuclear Materials

- <sup>1</sup> Uranium in cascades is treated as enriched uranium.
- <sup>2</sup> Report as plutonium-242 if the contained Pu-242 is 20% or greater of total Pu by weight; otherwise report as plutonium 239-241.
- <sup>3</sup> Report as plutonium-238 if the contained Pu-238 is 10% or greater of the total by weight Pu; otherwise report as plutonium 239-241.
- <sup>4</sup> Tritium contained in water (H<sub>2</sub>O or D<sub>2</sub>O) used as a moderator in a nuclear reactor is not an accountable material.



- (2) Category III and IV. For Category III and IV facilities, requirements for the scope and content of MC&A Plans are to be determined by the Manager, DOE Field Office.
- e. Planning for MC&A shall consider the potential of an insider threat, as detailed in "DESIGN BASIS THREAT POLICY FOR THE DEPARTMENT OF ENERGY (DOE) PROGRAMS AND FACILITIES (U)", of March 1992, issued by the Office of Security Affairs. Planning shall address the theft and diversion of SNM, and the unauthorized control of a weapon, test device, or improvised nuclear device, where appropriate. The MC&A program shall support activities to mitigate sabotage.
  - f. For each facility, facility management shall have and require compliance with one or more current procedural directive(s) for implementing its MC&A plan. These procedures shall be compatible with the physical protection and security requirements of the 5632 series of DOE Orders to provide an effective integrated safeguards system. These procedural directives shall be transmitted to the cognizant Manager, DOE Field Office, when issued and when revised.
  - g. Reportable occurrences shall be reported in accordance with the notification and reporting requirements contained in DOE 5000.3B.
  - h. Facility emergency plans shall address conditions that indicate possible loss of control of SNM. The emergency plan shall be consistent with safeguards and security Orders, and shall specify MC&A measures to be taken prior to resumption of operations following emergency operations. Other requirements for facility emergency plans are specified in DOE 5500.1B.
  - i. For Category I facilities and for Category II facilities within the same Protected Area (PA) for which rollup to a Category I quantity is possible, each facility's safeguards and security system shall provide defense-in-depth to assure that the failure or defeat of a single component will not increase the level of risk for the system above an acceptable level. A part of the vulnerability assessment (VA) process shall be to determine the extent to which the failure or defeat of a single component increases this risk and if the increase in risk is acceptable. When the increase in risk exceeds an acceptable level, compensatory measures shall be immediately taken and upgrades to the system shall be initiated. The acceptability of the risk shall be documented as a part of the Master Safeguards and Security Agreement (MSSA) or Site Safeguards and Security Plan (SSSP) for the facility.
  - j. For each facility an MC&A program shall be established for all nuclear materials on inventory under a three letter RIS, including those designated as uneconomical to recover. For attractiveness level D or higher SNM that has been removed from inventory as waste and for which a significant vulnerability exists, the Manager, DOE Field Office, or the cognizant Program Secretarial Officer (PSO) may require that appropriate

safeguards measures be implemented. Otherwise, materials previously removed from inventory that meet all of the following conditions are exempt from the requirements of this Order:

- (1) They have been previously declared waste;
  - (2) They have been written off the MC&A books; and
  - (3) They are under the control of a waste management organization.
- k. To terminate safeguards for nuclear materials currently on inventory and to exempt that material from the requirements of this Order, all of the following conditions must be met:
- (1) If the material is SNM, it must meet the definition of attractiveness level E material. (In some cases, it may be necessary to dispose of higher attractiveness level materials. Concurrence of both the appropriate PSO and SA-10 is required for termination of safeguards on materials which meet the definition of attractiveness level D or greater. Additionally, whenever termination of safeguards on a Category II or greater quantity of SNM is being considered, a VA must be conducted.)
  - (2) The material must be determined to be discardable by the appropriate Program Secretarial Officer.
  - (3) The material must be written off the MC&A books and removed from its nuclear processing area (or material balance area (MBA)) to a storage or disposal area containing only discardable material.
- l. Identification of a facility for decommissioning, closure, or deactivation shall not exempt the facility from compliance with requirements stated in this Order. The facility's MC&A program shall be maintained at a level appropriate to the category and attractiveness level of the nuclear material on inventory until a termination survey determines that there is no nuclear material remaining at the facility. Such a determination may be made if there is no material or the only material is waste material that meets the definition of attractiveness level E and that material has been written off the MC&A books. Requirements for termination surveys are contained in DOE 5634.1B. After a facility has transferred all its nuclear material except waste to another facility, the inventory balance is zero, and the termination survey has been completed, Form DOE/NRC 741 may still be needed for reporting shipment of waste to offsite waste-handling areas. In such cases, the capacity shall be maintained for generating Form DOE/NRC 741 for these shipments until the waste management program puts into use its own accounting system for transfers.

- m. A VA shall be performed for each facility to evaluate the potential for unauthorized accumulation of a Category I quantity of SNM from multiple locations within the same PA through either a single occurrence or protracted diversion. The VA shall include consideration of the attractiveness level of the material and the credibility of the removal scenarios. For protracted diversion, the VA shall also include consideration of the number of removal events and the total elapsed time required to accumulate the target quantity during the inventory period. Credible accumulation scenarios shall be documented in DOE-approved SSSPs.
  - n. Procedures, techniques, and standards as promulgated by the American Society for Testing and Materials (ASTM) and the American National Standards Institute (ANSI) shall be used, when such standards exist, in developing the basis for nuclear material control, measurements and measurement control, accounting, and statistical methods that are employed by a facility for safeguarding of nuclear material, unless otherwise directed by DOE Orders. Standards issued by the International Atomic Energy Agency and the NRC should also be used when appropriate and when consistent with DOE regulatory goals.
  - o. MC&A requirements contained in this Order shall apply to all DOE facilities, including new and renovated DOE nuclear facilities. The planning, design, construction, and operation of new or renovated facilities should incorporate the latest MC&A technologies, systems, and approaches. Using modern techniques and equipment to maximize material loss detection sensitivity and to increase the quality of accountability measurements will reduce the magnitude of inventory difference control limits calculated as a part of inventory difference evaluations and will increase the quality of other analyses. Performance requirements for inventory difference control limits for such facilities are contained on page I-9, paragraph 4.
  - p. The "Guide for Implementation of DOE 5633.3A" shall be considered in developing MC&A programs. This guide does not establish or originate policy. Instead, it describes methods for meeting requirements of this Order.
  - q. Nuclear materials designated as radioactive waste are subject to the requirements of this Order unless exempted from its requirements by paragraphs lj or k above. In addition to requirements of this Order, the handling, disposal, and management of nuclear materials designated as radioactive waste must be in compliance with DOE environmental and waste management regulations including DOE 5820.2A.
2. GRADED SAFEGUARDS. The following presents basic information and requirements for graded safeguards. Additional requirements will be found throughout this Order.
- a. DOE Field Offices and facilities shall establish and follow a graded safeguards program for nuclear materials. Graded safeguards is the concept of providing the greatest relative amount of control and effort to the types and quantities of SNM that can be most effectively used in a nuclear

explosive device. Categories of nuclear material for implementation of DOE's graded safeguards program are shown in Figure I-2. The "Guide for Implementation of DOE 5633.3A" contains more descriptive guidance for material attractiveness and examples of category determination.

- b. Determination of material category for an SNM location (MBA, Material Access Area (MAA), PA, facility, etc.) is required for a variety of safeguards and security purposes. In many cases, the material category is determined directly from Figure I-2. In cases where the material category determination requires consideration of multiple material types and attractiveness, directions for determining the material category are given in the following subparagraphs. When a facility can demonstrate that the accumulation of smaller quantities of SNM from within an MBA is not credible, the summation of these quantities need not be used to define the category quantity. Determination of category involves grouping materials by SNM type, attractiveness level, and quantity. Material quantities are element weights for plutonium and U-233 and isotope weights for U-235. Procedures for determining material category are as follows:
- (1) One SNM Type, One Attractiveness Level: Sum the material in the attractiveness level and determine the category from Figure I-2.
  - (2) One SNM Type, Multiple Attractiveness Levels, a Category III or greater quantity of B level material included:
    - (a) Determine the amounts of SNM for materials in each of attractiveness levels B, C, and D.
    - (b) Calculate the "effective" quantity for attractiveness levels B and C by multiplying the quantity in attractiveness levels B and C by the appropriate factors in Figure I-3.
    - (c) Sum the effective amounts in attractiveness levels B and C.
    - (d) Compare the total effective amount as calculated in subparagraph (c) above to the amounts in attractiveness level B from Figure I-2.
    - (e) Compare the amount of attractiveness level D to Figure I-2.
    - (f) The material category is the highest level of material category determined in subparagraphs (a) through (d) or in subparagraph (e).

	Attrac- tiveness Level	PU/U-233 Category				Contained U-235 Category				NonSNM Materials Category IV <sup>1</sup>
		I	II	III	IV <sup>1</sup>	I	II	III	IV <sup>1</sup>	
		(QUANTITIES IN KGS)				(QUANTITIES IN KGS)				
<b>WEAPONS</b> Assembled weapons and test devices	A	All Quantities	N/A	N/A	N/A	All Quantities	N/A	N/A	N/A	
<b>PURE PRODUCTS</b> Pits, major components, buttons, ingots, recastable metal, directly convertible materials	B	≥2	≥0.4<2	≥0.2<0.4	<0.2	≥5	≥1<5	≥0.4<1	<0.4	
<b>HIGH-GRADE MATERIALS</b> Carbides, oxides, solutions (≥ 25g/l), nitrates, etc., fuel elements and assemblies, alloys and mixtures, UF <sub>4</sub> or UF <sub>6</sub> (≥ 50% enriched)	C	≥6	≥2<6	≥0.4<2	<0.4	≥20	≥6<20	≥2<6	<2	
<b>LOW GRADE MATERIALS</b> Solutions (1 to 25g/l), process residues requiring extensive reprocessing, moderately irradiated material, PU <sub>238</sub> (except waste), UF <sub>4</sub> or UF <sub>6</sub> (≥ 20% < 50% enriched)	D	N/A	≥16	≥3<16	<3	N/A	≥50	≥8<50	<8	
<b>ALL OTHER MATERIALS</b> Highly irradiated forms, solutions (≤ 1 g/l), uranium containing < 20% U-235 (any form any quantity)	E	N/A	N/A	N/A	*	N/A	N/A	N/A	*	Reportable Quantities
		* Reportable quantities are Category IV regardless of amount.				* Reportable quantities are Category IV regardless of amount.				

1 The lower limit for Category IV is equal to reportable quantities in this Order.

2 See paragraphs 3b and 3c for MC&A requirements for tritium and depleted uranium.

FIGURE I-2

### Nuclear Material Safeguards Categories

Attractiveness Level	Pu/U-233 Factor	U-235 Factor
B	1	1
C	1/3	1/4

Effective Quantities  
Figure I-3

- (3) One SNM Type, Multiple Attractiveness Levels, less than a Category III quantity of B level material included:

- (a) Determine the amounts of SNM for all attractiveness levels.
- (b) Compare the total amounts in each level to the amounts in Figure I-2.
- (c) The material category level is the highest level of the material categories determined in subparagraphs (a) and (b).

- (4) Multiple SNM Types:

- (a) Determine the category for each SNM type following the above procedures.
- (b) The category is that determined for the individual SNM type that requires the highest level of protection.

c. Deviations to this Order shall be approved in accordance with DOE 5630.11A.

### 3. MC&A REQUIREMENTS FOR SOURCE AND OTHER NUCLEAR MATERIALS.

- a. Except for tritium and depleted uranium, source and other nuclear materials shall be treated as attractiveness level E materials. Therefore, the requirements for an MBA containing only source and other nuclear materials shall be that of Category IV. When source and other nuclear materials are present in MBAs containing SNM, only the SNM is used to determine the category of the MBA. However, source and other materials are subject to Category IV requirements.
- b. Tritium is a nuclear material of strategic importance; therefore, graded safeguards programs for tritium shall be established and followed equivalent to the following categorizations:
  - (1) Category III. Weapons or test components containing reportable quantities of tritium. Deuterium-tritium mixtures, or metal tritides that can be easily decomposed to tritium gas, containing greater than 50 grams of tritium (isotope) with a tritium isotopic fraction of 20 percent or greater.

- (2) Category IV. All other reportable quantities, isotopic fractions, types, and forms of tritium.
- c. Depleted uranium is a material of limited strategic and monetary value, therefore, the requirements of this Order do not apply to depleted uranium except as follows:
- (1) For MBAs containing more than 10 metric tons of depleted uranium or having transactions of depleted uranium totaling more than 10 metric tons per year, the depleted uranium shall be treated as Category IV, Attractiveness Level E, material.
  - (2) For RISs containing more than 10 metric tons of depleted uranium or having transactions of depleted uranium totaling more than 10 metric tons per year, documentation and reporting of depleted uranium transactions and inventories shall be in accordance with DOE 5633.4.
  - (3) For depleted uranium not required to be handled as Category IV, Attractiveness Level E, material, the following minimum requirements apply:
    - (a) Procedures shall be developed and implemented to prevent unauthorized transfers of depleted uranium.
    - (b) An accounting system that accurately describes depleted uranium transactions and inventories shall be maintained.
    - (c) For external transfers, the shipper shall obtain written verification and maintain documentation that the intended receiver is authorized to accept the material before the material is transferred.
  - (4) Facilities selected under DOE 1270.2B are required to meet requirements for depleted uranium defined in the Facility Attachment document. Additionally, transfers of depleted uranium involving either (a) exports or imports of depleted uranium or (b) movements of depleted uranium within the U.S. in which any part of the country control code represents a foreign country shall be tracked and reported in accordance with requirements in DOE 5633.4.

#### 4. LOSS DETECTION ELEMENT EVALUATION.

- a. Vulnerability Assessment (VA). Detailed VAs identifying and evaluating the capability for detection of a loss of a Category I quantity of SNM shall be developed by each Category I facility and approved by the head of the DOE Field Office MC&A organization. Requirements for preparation of the SSSP documents shall be used as the basis for these assessments. VAs shall cover the full threat spectrum specified in OSS guidance. Potential targets shall include all Category I areas and any Category II or III areas for which a credible scenario for unauthorized accumulation of a Category I quantity has been identified. Performance testing programs shall be developed to support and verify VAs. VAs shall be reviewed annually and updated when system

changes or new information indicate a potentially significant change in the risk of unauthorized removal of Category I quantities of SNM. Results of reviews including changes in VAs shall be documented and classified in accordance with CG-SS-2.

- b. Performance Testing. DOE 5630.16 contains requirements for the design, planning, and documentation of performance tests. MC&A performance testing programs shall meet the requirements of DOE 5630.16. For each facility, management shall establish and implement a documented testing program to verify MC&A procedures and practices and to demonstrate that material controls are effective.
- (1) These tests shall be designed to demonstrate that the system is functional and to assure that the system performs as specified and/or required. In addition, facilities shall:
    - (a) Identify those components of the MC&A system that provide the greatest effectiveness against theft and diversion;
    - (b) Design, conduct, and document tests which substantiate component effectiveness; and
    - (c) Integrate the results of these component tests into safeguards and security VAs.
  - (2) Performance testing shall include not only those elements that can detect-in-time-to-prevent but also those elements that can effectively account for SNM in order to provide assurance that safeguards and security systems are functioning properly.
  - (3) The design of the performance testing program shall be focused on testing individual detection elements. Elements identified in a VA that contribute to detection capability shall be tested on a frequency based on the level of threat/risk established by the VA.
  - (4) The design of performance tests should consider prudent judgment and use of resources.
    - (a) The scope and extent of testing should be based on the graded safeguards concept with the testing program including more testing for higher category facilities than for lower category facilities.
    - (b) Guidance for performing testing is contained in DOE's MSSA Verification Guide (Section 4.0, Performance Testing; Appendix F., Checklist for Performance Requirements; and Appendix G., MC&A Checklist). In addition, SA-10 will provide guidance for the evaluation of the detection elements of the MC&A system which will facilitate the design and validation of the performance testing program.
  - (5) Testing data and results shall be classified in accordance with CG-22-2.



(6) Corrective actions shall be taken for vulnerabilities identified during system testing.

- c. MC&A Performance Requirements. Minimum performance requirements for selected MC&A system elements are given in Figure I-4. Validation of these system elements shall be accomplished by performance testing. Testing shall be established at a frequency which, at a minimum, shall be in accordance with DOE 5630.16 and shall be documented in the MC&A plan. When these system elements fail to meet performance requirements, a corrective action plan shall be developed and where necessary compensatory measures shall be taken. Testing of access controls and material surveillance shall be facility-specific with the scope and the extent of the testing documented by facility management and approved by the Manager, DOE Field Office. A sufficient number of items and tamper-indicating devices (TIDs) shall be tested to assure that on an annual basis the performance requirements for TIDs and accounting records are met with 95% confidence for Category I and II items. Confidence levels for Category III and IV items shall be approved by the Manager, DOE Field Office. Testing to assure that TIDs are properly in place shall include checking to see that the TID has been properly applied and there is no indication that the integrity of the TID has been violated. (The testing for this requirement is not intended to require destruction of properly applied TIDs whose integrity has not been violated.) Additional guidance for testing metal detectors is given in the "Metal Detector Guide," of 2-22-90, issued by SA-10. In the performance requirement for inventory differences, "throughput" means measured output including waste, and "active inventory" means those materials in the MBA that enter into the limit-of-error calculation. Additional or more stringent performance requirements for system elements may be established by the Manager, DOE Field Office, or the responsible PSO. Paragraphs 5d(2) in Chapter I; 2c(3) and 4e(1)(f) in Chapter II; 2b, 3b(1), and 5c in Chapter III of this Order contain requirements that can be readily performance tested. Testing of system elements associated with these requirements should be included as a regular part of the performance testing program.

5. OCCURRENCE INVESTIGATION AND REPORTING. Each facility shall identify MC&A loss detection elements for each MBA and shall establish a graded program for monitoring these elements and associated data to determine the status of nuclear material inventories and to identify reportable occurrences. Reportable occurrences shall be reported as an Emergency, Unusual Occurrence, or Off-Normal Occurrence in accordance with DOE 5000.3B. The categorization of MC&A occurrences are contained in DOE 5000.3B. In addition to the reporting required by DOE 5000.3B, the DOE facility representative, as defined in DOE 5000.3B, shall notify the head of the appropriate division within the cognizant DOE Field Office responsible for the implementation of this Order. The head of the appropriate DOE Field Office division is responsible for notifying SA-10 and the local office of the Federal Bureau of Investigation of reportable occurrences for which there is both an indication of a loss of nuclear material and evidence of a malevolent act. In addition, the DOE Field Office shall independently evaluate the occurrence based upon its significance. Information related to monitoring and assessment activities shall be documented and retained.

Access Controls. Performance tests shall be designed and conducted to fully evaluate the effectiveness of access controls for Category I and II quantities of SNM. In at least 95% of the tests conducted, the tests shall demonstrate the detection of unauthorized access to Category I and II quantities of SNM.

Material Surveillance. Performance tests shall be designed and conducted to fully evaluate the effectiveness of material surveillance activities for Category I and II quantities of SNM. In at least 95% of tests conducted, the tests shall demonstrate the detection of unauthorized actions related to the control of Category I and II quantities of SNM.

Tamper-Indicating Devices (TIDs). The TID record system shall accurately reflect the location and identity of TIDs in at least 99% of the cases. The TID program shall assure that TIDs are properly in place in at least 95% of the cases.

Portal Monitoring. In addition to performance testing necessary to verify that VA or DOE Field Office detection requirements are being met, testing of portal monitors (SNM and metal) shall include all applicable tests described in ASTM guides unless otherwise directed by SA-10. When standards set in applicable ASTM guides are not met, compensatory actions shall be taken.

Accounting Record Systems. The accounting record system shall accurately reflect item identity and location in at least 99% of the cases.

Inventory Confirmation/Verification Measurements. For Category I and II items, the acceptance/rejection criteria for verification measurements and where possible for confirmatory measurements shall be based on the standard deviation for the measurement method under operating conditions. The control limits for such criteria shall be set at no wider than three times the standard deviation for the method. The Managers, DOE Field Offices, should review and approve the control limits. When limits based on three standard deviations are unreasonably large, the Manager, DOE Field Office, may require tighter limits.

Inventory Difference Control Limits. Limits-of-error for inventory differences of processes in new Category I and II facilities shall be no larger than the smaller of a Category II quantity of SNM or 2% of total throughput and active inventory.

Figure I-4  
Performance Requirements for MC&A Elements

6. ADMINISTRATIVE CONTROLS. For each facility, management shall establish a graded program to ensure the integrity and quality of MC&A systems and procedures, and to periodically review and evaluate these systems. This program shall be described in the facility's MC&A plan and specifically address the following criteria:

- a. Facility MC&A procedures shall be reviewed and approved (prior to implementation) by facility operations management at a level of authority sufficient to ensure compliance by operations personnel. Procedures shall be consistent with the approved facility MC&A Plan, and procedures shall be distributed to all applicable organizations and individuals in the facility having MC&A responsibilities.
- b. For each facility, management shall establish procedures for emergency conditions and periods when MC&A system components are inoperative. These procedures shall be designed to assure that access to or removal of SNM would be detected during these periods.
- c. For each facility, management shall establish controls that limit access to the accounting system and nuclear materials accounting data. For automated systems, controls shall be designed to deter and detect unauthorized access to the data bases and data processing systems that, through tampering, modification, or alteration could lead to defeat of the accounting system. Nuclear materials accounting data shall be protected in accordance with applicable classification, automated data processing, and computer security regulations.
- d. The facility nuclear materials accounting system shall include checks and balances, and be structured to ensure:
  - (1) Identification of omission(s) of data for any reportable transaction.
  - (2) Timely detection (normally within 24 hours but in no case later than the subsequent inventory reconciliation) of errors/discrepancies in records associated with a Category I or II quantity of SNM including where possible detecting falsified data and identifying the responsible person(s).
  - (3) Detection of data discrepancies and errors to ensure that no discrepancies exist in control indicator accounts.
  - (4) The completeness of the nuclear materials accounting system records.
- e. For each facility possessing nuclear materials, facility management shall establish a program to periodically review and assess the integrity and quality of the MC&A system. The assessment program shall address normal operations and emergency conditions. The frequency of these assessments shall be on a graded basis, consistent with requirements of DOE 5634.1B, and approved by the Manager, DOE Field Office. The results of all assessments shall be classified if appropriate, reported to facility management, and each noted deficiency shall be addressed and corrected. The assessment shall be performed by personnel who are knowledgeable in MC&A. Assessments shall be

on a graded safeguards basis; at a minimum, the assessment program shall address the following:

- (1) Identification of abnormal situations.
  - (2) Loss mechanisms, loss detection capabilities, and the localization of inventory differences.
  - (3) Selection, maintenance, calibration, and testing functions to assure proper equipment and system performance.
  - (4) MC&A system checks and balances, including separation of duties and responsibilities, that are used to identify irregularities and detect tampering with materials or MC&A system components.
  - (5) Change controls, including authorization requirements, to detect unauthorized or inappropriate modification of system components, procedures, or data. The change control system shall address requirements for review, authorization, documentation, notification, and controls on equipment selection, procurement, and maintenance.
  - (6) Procedures and/or checks to assure the reliability and accuracy of MC&A data and information.
  - (7) Performance testing conducted by the facility. This portion of the assessment should address the design of performance tests and the results obtained by the testing program since the last assessment.
  - (8) Procedures for emergency conditions and for periods when MC&A system components are inoperative.
  - (9) Material control, material access, and material surveillance procedures.
  - (10) The physical inventory program and reconciliation practices.
  - (11) Accounting system procedures, capabilities and sensitivities.
  - (12) Identification of personnel with MC&A responsibilities who should be included in the facility personnel security assurance program, consistent with national security requirements and DOE 5631.6A.
  - (13) Measurement control program.
  - (14) TID programs.
- f. Reviews shall be conducted prior to start-up of new facilities or operations, and whenever changes are made in facilities, operations, or MC&A features that might alter the performance of the MC&A system.
- g. In addition to the assessments in subparagraph f above, internal audits of the facility's MC&A function shall be conducted by an organization independent of MC&A to assess compliance with internal plans and procedures. The frequency of these audits shall be approved by the Manager, DOE Field Office.

CHAPTER II  
MATERIALS ACCOUNTABILITY

1. GENERAL. This chapter describes the requirements for nuclear materials accountability and shall be applied in a manner consistent with the graded safeguards concept. The chapter is subdivided into five functional areas: accounting systems, inventories, measurements and measurement control, material transfers, and material control indicators.
2. ACCOUNTING SYSTEMS. Each facility shall have a system that provides for tracking nuclear material inventories, documenting nuclear material transactions, issuing periodic reports, and assisting with the detection of unauthorized system access, data falsification, and material gains or losses. The accounting system shall provide a complete audit trail on all nuclear material from receipt through disposition. The Generally Accepted Accounting Principles, as promulgated by Financial Standards Accounting Board, shall be used in the design and operations of the nuclear material accounting system unless otherwise directed by DOE Orders.
  - a. Accounting System Data Base and Procedures. For each facility procedures shall be maintained describing the structure and operation of the nuclear materials accounting system. The procedures shall accurately reflect current nuclear material accounting practices. Specific requirements for accounting procedures include the following:
    - (1) A description of the inventory data base, including procedures for updating the inventory data and reconciling the inventory data with the results of physical inventories, and a description of the required data elements for each applicable material type.
    - (2) Identification of the accounting reports and their frequency, distribution and timeliness, consistent with accounting requirements.
    - (3) Identification of the organizational responsibilities for the management and operation of the accounting system.
    - (4) Recording, reporting, and submission of data to NMMSS by material type and reporting unit, as specified in DOE 5633.4 and DOE 5633.5.
  - b. Account Structure.
    - (1) A facility shall consist of one or more MBAs established to identify the location and quantity of nuclear materials in the facility. For each facility, readily retrievable accountability data shall be maintained by MBA that reflects quantities of nuclear materials on inventory, quantities of nuclear material received and shipped, and other adjustments to inventory.

- (2) The MBA account structure shall provide the capability to localize inventory differences and provide a system of checks and balances for verifying the accuracy of the accountability data and records.
- (3) One individual in each MBA shall be designated by management to be responsible for ensuring that MC&A policies are implemented in that MBA.
- (4) Material types, processes, and functions shall be considered in establishment of MBAs. The number of MBAs shall be sufficient to identify and localize inventory differences and their causes.
- (5) An MBA boundary shall not cross an MAA boundary. Each MBA should conform to the single geographical area concept and be an integral operation. If more than one geographical area is included in one MBA, all of these areas must be under the administrative control of the same individual, and the activities in these areas must be associated with an integral operation.

c. Records and Reports.

- (1) For each facility, management shall maintain records, submit data, and issue reports as required by DOE 5633.4 and facility procedures. These reports shall accurately describe all nuclear material transactions and inventories. Inventory adjustments shall be identified by MBA and shall be reported consistent with requirements of this Order, DOE 5633.4 and DOE 5633.5.
- (2) Nuclear materials records shall be updated only by authorized personnel, and the records system shall provide an audit trail for all transactions affecting the nuclear materials data base.
- (3) The MBA records system shall be capable of being updated daily or upon demand for all nuclear materials transactions. (This requirement is for the updating of records based on reports or information; it is not a requirement on how quickly a facility must be able to complete measurements.) In addition, the records system shall be capable of generating book inventory listings for all SNM within 3 hours. For all other nuclear material, the timing for generation of book inventories shall be within 24 hours. Validating the accuracy of the accounting record system shall be conducted according to testing methodology, testing frequency, and record maintenance requirements contained in DOE 5630.16 and applicable Department guidance. Performance requirements for accounting record system accuracy are contained in Chapter I, paragraph 4.

### 3. INVENTORIES.

#### a. Periodic Physical Inventories.

- (1) Physical Inventories. Each facility's management shall implement a physical inventory program for nuclear materials consistent with the requirements defined below. Minimum physical inventory frequencies for MBAs are provided in Figure II-1.
- (2) Conduct of Inventories. For each facility, there shall be documented plans and procedures defining responsibilities for performing inventories and specifying criteria for conducting, verifying, and reconciling inventories of nuclear material. Verification of the presence of items during inventories may be performed on a statistical sampling basis. Sampling plans shall be consistent with the graded safeguards concept. Parameters for statistical sampling plans and inventory stratifications used with statistical sampling plans shall be defined by the facility management and approved by the Manager, DOE Field Office. Materials not amenable to measurement by the site shall be identified in the facility's MC&A Plan. Inventory values for these materials shall be based on measured values made at other sites or technically defensible estimates. Justification and supporting documentation for these inventory values shall be included as part of the MC&A Plan or the SSSP.
- (3) Holdup Inventory. Holdup inventory shall be measured, where feasible, or estimated on the basis of throughput, process data, modeling, engineering estimates, or other technically defensible factors as a regular part of inventory for facilities with Category I, II, and III quantities of SNM and for facilities with Category IV quantities of SNM that have more than 5 kilograms of SNM as holdup on a regular basis. The method, justification, and supporting documentation should be included either in the MC&A Plan or the SSSP.
- (4) Bimonthly Physical Inventories. For each facility, bimonthly physical inventories shall be performed for Category I and II MBAs as indicated in Figure II-1. Inventories shall be based on measured values and, where feasible, measurements or estimates of holdup shall be made so that holdup quantities can be used in determining inventory values or explaining the inventory difference. (Estimates of holdup should be made in accordance with paragraph 3a(3) above.) Materials not amenable to measurement by the site shall be identified in the facility's MC&A Plan. Inventory values for these materials shall be documented and justified as described in paragraph 3a(2). Material undergoing processing and recovery operations, and which is inaccessible for measurements by sampling, should be accounted for by use of process data, vessel level and density measurements, and calculated concentration values. This process monitoring, in addition to material control procedures,

MBA CATEGORY	MINIMUM FREQUENCY
I	Bimonthly <sup>1</sup>
II	Bimonthly
III	Semiannually
IV	Annually

In addition to the above requirements, inventory checks for Category IA items not in storage shall be performed weekly for physical count verification, and monthly for serial number verification. Inventory checks for stored Category IA items shall consist of a physical count whenever the storage area is accessed and a serial number verification on a monthly basis.

For facilities having multiple MBAs with varied inventory frequencies, the bimonthly, semiannual, and annual inventories shall be performed simultaneously to provide a complete facility inventory at least once annually.

Category IV non-SNM nuclear material in Category I, II, and III MBAs shall be inventoried on a schedule defined by the Manager, DOE Field Office, but at least annually. These inventories shall be scheduled to assure that a complete facility inventory is performed at least once per year.

<sup>1</sup> Bimonthly here means once every two months.

Figure II-1  
Minimum Physical Inventory Frequency by MBA



measurements, and specific action criteria, subject to the approval of the Manager, DOE Field Office, should be used routinely to track materials in process until operations permit a complete inventory.

- (5) Semiannual Physical Inventories. For each facility, semiannual physical inventories shall be performed of Category III MBAs as indicated in Figure II-1. Inventories shall be conducted as described for bimonthly physical inventories. (See Figure II-1, for information relative to scheduling semiannual inventories.)
  - (6) Annual Physical Inventories. For each facility, annual physical inventories shall be performed of Category IV MBAs as indicated in Figure II-1. Inventories shall be conducted as described for bimonthly physical inventories. (See Figure II-1, for information relative to scheduling annual inventories.)
  - (7) Physical Inventory Reconciliation Program. For each facility, management shall implement a physical inventory reconciliation program designed to provide assurance that all nuclear material has been accounted for and that the facility's record system reflects the physical inventory. Upon completion of the physical inventory, the book inventory for each MBA shall be compared with and, if necessary, adjusted to the physical inventory.
  - (8) Deviations to inventory frequency requirements described in Figure II-1 may be approved in accordance with DOE 5630.11A for inventories containing large numbers of items, items stored in high radiation fields, critical assemblies and other situations (e.g., dynamic, in-process, or continuous inventories) where alternative control mechanisms provide assurance that unreported changes in inventories would be detected. Inventory values shall be determined in time to provide for computation and reconciliation of inventories and determination of inventory differences, consistent with DOE reporting requirements stated in DOE 5633.4 and approved inventory frequencies.
- b. Special Inventories. At each facility, management shall establish and implement procedures for conducting special inventories as a result of routine disassembly of critical assemblies, changes in custodial responsibilities, missing items, inventory differences exceeding established control limits, abnormal occurrences, or at the request of authorized facility personnel or the cognizant DOE Field Office.
- c. Inventory Verification/Confirmation Measurements.
- (1) At each facility, management shall establish and implement a system for performing inventory verification measurements on SNM items that are not tamper-indicating. A confirmatory inventory measurement shall be performed on SNM items that are tamper-indicating. Such measurements are

intended to detect diversion or theft of material and shall use a statistically-based sampling plan applied in a manner consistent with the graded safeguards concept. Parameters for statistical sampling plans and inventory stratifications used with statistical sampling plans shall be defined by facility management and approved by the Manager, DOE Field Office. The Manager, DOE Field Office, may establish a material quantity threshold for inventory verification/confirmation measurements. It is recognized that certain materials are not amenable to verification measurements (See page II-11, paragraph 5a(4)). Such materials shall be documented in the MC&A Plan and, for these materials, confirmatory measurements of two material attributes may be substituted for the verification measurement.

- (2) Documented acceptance/rejection criteria for inventory confirmation/verification measurements shall be established based on valid technical and, where technically feasible, on valid statistical principles. For Category I and II items, acceptance/rejection criteria shall be consistent with performance requirements for confirmation/verification measurements stated in Figure I-4. A response plan shall be prepared and implemented for evaluating and resolving all verification/confirmation measurements that fail acceptance criteria. Items that fail the confirmation/verification measurement criteria shall not be processed prior to resolution of the discrepancy. Performance requirements for inventory confirmation/verification measurements are contained in Chapter I, paragraph 4.

4. MEASUREMENTS AND MEASUREMENT CONTROL. At all facilities possessing nuclear material, measurement and measurement control programs shall be implemented. The object of measurement and measurement control is to establish nuclear material values and to assure the quality of the data. Measurements programs used to determine Category I or II inventories of SNM or used to determine a Category I or II SNM throughput over a 6 month period shall address the topics identified in this paragraph and shall be consistent with facility-specific measurement program objectives. For other measurement and measurement control programs (those used only to determine Category III or IV inventories), the scope and content of the programs shall be approved by the Manager, DOE Field Office. For Category I and II facilities, these programs shall address the topics identified in this paragraph and shall be consistent with facility-specific measurement program objectives.

- a. Organization. The measurement and measurement control program shall be organized to facilitate efficiency of operation and quality of performance and be independent from operations.
- b. Selection and Qualification of Measurement Methods. The objective is to ensure that measurement methods selected for use are capable of measuring the material in question to the desired levels of precision and accuracy, as approved by the Manager, DOE Field Office, and consistent with a graded safeguards approach. To this end, each facility's management shall select, qualify, and validate measurement methods capable of providing the desired

levels of precision and accuracy. Selection and qualification of a measurement method shall be the responsibility of the facility management. Target values for the accuracy and precision of nuclear material measurements recommended and endorsed by recognized national and international nuclear organizations may be used by contractors and DOE Field Offices as guidance for desirable levels of accuracy and precision. The Manager, DOE Field Office, shall review the documentation of this process and shall approve the precision and accuracy goals. Each facility shall have procedures to ensure that only qualified measurement methods are used for accountability purposes.

- c. Training and Qualification of Measurement Personnel. The objective is to assure that the individuals responsible for performing measurements have sufficient knowledge to perform the measurements in an acceptable manner.
  - (1) Training. Each facility shall have a documented plan for the training of measurement personnel. The plan shall be reviewed annually and updated as necessary to reflect changes in measurement technology and shall specify training, qualification, and requalification requirements for each measurement method.
  - (2) Qualification. Each facility shall have a documented qualification program that ensures that measurement personnel demonstrate acceptable levels of proficiency before performing measurements, and that measurement personnel are requalified according to requirements in the training plan. For destructive analysis of nuclear material, this proficiency shall be demonstrated, at a minimum, once per day for each method that the individual will use that day.
- d. Measurement Systems. The objective of the measurement system is to provide nuclear material values for inventories and transactions.
  - (1) Sampling. The objective of the sampling program is to ensure that the small portion of bulk material taken for measurement is representative of the bulk material. Each facility shall have documented sampling plans for each measurement point used for accountability purposes. The plans shall be based on valid technical and statistical principles and shall take into account material type, measurement requirements, and any special process or operational considerations.
    - (a) The basis of the sampling plan shall be documented and validated through studies of the materials or items being sampled.
    - (b) The sampling plan shall specify at a minimum the sampling procedure, number of samples required, size of samples, mixing time and procedure (when applicable), provisions for retaining archive samples, and estimates of variance associated with the sampling method.
    - (c) Sampling procedures shall be documented and reviewed annually or whenever changes are made to the sampling process or in material type or composition of the material being sampled.

(2) Measurement Methods. For each facility, measurement methods shall be developed, documented, and maintained for all nuclear material on inventory except for those materials not amenable to measurement and specified as such in the facility's MC&A plan (see page II-11, paragraph 5a(4)). These methods shall be written to provide clear direction to the analyst or operator, and shall be validated initially and revalidated whenever changes are made.

- (a) In determining inventory values and consistent with the graded safeguards concept, the selection of the measurement methods shall assure that the contribution of the measurement error to the uncertainty of the inventory difference is minimized.
- (b) Verification measurements, when used to adjust accountability records, shall have accuracy and precision comparable to, or better than, the original measurement method.
- (c) For confirmatory measurements, the measurement method used shall be capable of determining the presence or absence of a specific attribute of the material, consistent with valid acceptance/rejection criteria.
- (d) All measurement methods shall be calibrated using Standard Reference Materials (SRM), Certified Reference Materials (CRM), or secondary standards traceable to the national measurement base, and revalidated as necessary.
- (e) Equipment and instrumentation used in performing measurements shall meet precision and accuracy requirements under in-plant conditions.
- (f) Documentation of measurement data shall be maintained to provide an audit trail from source data to accounting records.

e. Measurement Control. The objective of measurement control is to assure the effectiveness of measurement systems and the quality of measured values used for accountability purposes and to obtain precision and accuracy values for use in the determination of inventory difference control limits and shipper/receiver limits of error.

(1) Measurement Control Programs. For each facility, measurement control programs shall be developed and implemented for all measurement systems used for accountability purposes. A measurement control program, as referred to herein, shall include at a minimum the following elements:

- (a) Scales and Balances Program. All scales and balances used for accountability purposes shall be maintained in good working condition, recalibrated according to an established schedule, and checked for accuracy and linearity on each day that the scale or balance is used for accountability purposes.
- (b) Analytical Quality Control. Data from routine measurements shall be analyzed statistically to determine and ensure accuracy and precision of the measurements.

- (c) Sampling Variability. The uncertainty associated with each sampling method, or combination of sampling and measurement method, shall be determined and maintained on a current basis.
- (d) Physical Measurement Control. The precision and accuracies of volume, temperature, pressure, and density measurements shall be determined and assured.
- (e) Instrument Calibration. Instrumentation shall be calibrated using appropriate standards, when available, or at a minimum, measurement values shall be compared with more accurate measurement systems values on a prescribed basis, with the frequency being defined by demonstrated instrument performance.
- (f) Reference Materials (Standards). All calibration and working standards used in a measurement control program shall be traceable to the national measurement base through the use of SRMs or CRMs and shall have smaller uncertainties associated with their reference values than the uncertainties of the measurement method in which they are used. Working standards used in a measurement control program shall be representative of the type and composition of the material being measured when the material matrix affects the measured values.
- (g) Sample Exchange Programs. Each facility's measurement control program shall include participation in appropriate interlaboratory control programs to provide independent verification of internal analytical quality control.
- (h) Statistical Controls. For each measurement method used for accountability purposes, control limits shall be calculated and monitored, and documented procedures shall exist to correct out-of-limits conditions. Control limits shall be established at the two sigma level (warning limits) and three sigma level (alarm limits). Control data exceeding the two sigma limits shall be investigated, and, when warranted, timely corrective action shall be taken. Whenever a single data point exceeds the three sigma level, the measurement system in question shall not be used for an accountability measurement until the measurement system has been demonstrated to be within statistical control. For measurement methods relying substantially on operator technique, control limits shall include uncertainties for each analyst/method combination. Statistical control limits shall be monitored to assure that they are consistent with target values agreed to by the facility management and the Manager, DOE Field Office.
- (i) Measurement Method Qualification. Each facility shall have a documented method qualification program that ensures that a measurement method shall demonstrate acceptable performance before being used for performing accountability measurements. For destructive analysis and nondestructive assay (NDA) of nuclear material, this performance shall be demonstrated, at a minimum, once

per day that each method is used. For NDA measurement systems where meeting this requirement is impractical or unnecessary, the control measurement frequency shall be at least one of every five measurements, unless otherwise approved by the Manager, DOE Field Office.

- (j) Measurement Control Procedures. Documented measurement control procedures shall be developed at each facility for all measurement methods used for accountability, and each facility shall have a program to assure that measurement control procedures are followed.

- (2) Statistical Programs. Each facility shall have a documented program for the statistical evaluation of measurement data for determining control limits, calibration limits, and precision and accuracy levels for each measurement system used for accountability. The objective is to ensure the quality of measurement and measurement control data and to provide estimates of uncertainty on inventory and inventory control statements. The program, at a minimum, shall contain the following elements:

- (a) Valid statistical techniques to determine the total random error and the measurement biases generated for each measurement system or sampling/measurement system, and to determine control limits, rejection limits, and outlier criteria.
- (b) A valid statistical technique to develop sampling plans for inventory and measurement of nuclear material.
- (c) Analyses of measurement control data and reporting to the responsible organization at specified times and frequencies.
- (d) Documentation of all major assumptions made in each data evaluation process.

- 5. MATERIAL TRANSFERS. Each facility shall have a program to control and account for inter- and intra-facility transfers of nuclear materials. This program shall include documented procedures that specify requirements for authorization, documentation, tracking, verification, and response to abnormal situations that may occur during transfer of nuclear materials. For additional details, see DOE 5633.4 and DOE 5633.5. DOE 5633.4 and its accompanying manual provide specific directions for preparing and submitting DOE/NRC Form 741 and DOE forms required for documenting external transfers for materials accounting purposes.

- a. External Transfers.

- (1) The shipper shall obtain written verification and maintain documentation that the intended receiver is authorized to accept the material before the material is transferred.
- (2) Transfers of nuclear material between facilities having different RISS shall be documented on DOE/NRC Form 741. These shall be prepared and distributed to the principals of the transaction and the cognizant DOE Field Office, preferably on the day of the transfer but within 24 hours, or on the first workday after the transfer should it occur on a

nonworkday. However, Managers, DOE Field Offices, may direct DOE contractors to discontinue the routine distribution of DOE/NRC Form 741 to their offices.

- (3) Immediately after receipt, shipments shall be subjected to a transfer check. Transfer checks shall consist of confirmation of shipping container or item count, validation of TIDs integrity and identification, and comparison with shipping documentation to provide assurance that the shipment was received intact. For purposes of transfer checks, receipt occurs whenever the transfer vehicle is unloaded or the transfer vehicle's integrity is breached (TIDs removed or broken) at the receiving facility. Documented procedures shall specify actions to be taken in the event discrepancies are detected. Records of transfer checks shall be maintained and subjected to audit and shall be retained at least until the next annual DOE safeguards survey. (For accountability purposes, material in transit at the end of a reporting period shall be included in the receiver's reported inventory, even though physical receipt of the material has not yet occurred.)
- (4) Measurement Requirements for External Transfers of Nuclear Materials.  
All unirradiated Category I and II quantities of SNM transferred between facilities having different RISs shall have independently measured values determined by the shipper and receiver except when the RISs are both located on the same site and have the same site contractor. The Manager, DOE Field Office, may require measured values for other categories of nuclear material transfers, consistent with the strategic and/or monetary value of the material, or as required for environmental, safety, and operational controls. Material received shall not be put into the process prior to completion of required accountability measurements, unless a deviation is approved or the criteria defined on page II-14, paragraph 5a(4)(g), apply. When accountability measurements are required and materials are to be put in the process prior to making the accountability measurements, an agreement should be reached between the shipper and receiver as to how significant shipper/receiver differences will be handled. It is recognized that, for certain materials such as weapon assemblies or subassemblies, and certain reactor fuel elements, receiver verification measurements cannot be performed without destroying the item. These materials shall be identified in the facility's MC&A Plan. Managers, DOE Field Offices, shall approve specific materials for which this requirement applies. For these materials, confirmatory measurements by NDA shall be performed in accordance with page II-13, paragraphs 5a(4)(e) and (f).
  - (a) The shipper shall independently determine the measured values prior to shipment unless the integrity of the item and of the existing measured values have been assured. The shipper's measured values shall be documented on DOE/NRC Form 741/741A.
  - (b) Receiver's accountability measurements for Category I and II quantities of SNM transfers shall be accomplished in accordance with the requirements contained in Figure II-2. Receiver's accountability measurements for transfers involving other categories of nuclear material, where required by the Manager, DOE Field Office, (see paragraph 5a(4)), shall be performed in accordance with the

Material Category and Attractiveness Level	Material <sup>1</sup> Confirmation	Accountability <sup>2</sup> Measurements
IA	3 working days	Shipper's value
IB	5 working days	10 calendar days
IC, II	10 working days	30 calendar days
III	10 working days	120 calendar days or on input to process
IV	10 working days	On statistical bases within 180 days or on input to process

Figure II-2  
Shipper/Receiver Measurement Requirements

<sup>1</sup> Material Confirmation. Confirmatory measurement by NDA and gross weight check and item count (if not done in transfer check). Confirmatory measurements are not required for all materials. Where confirmatory measurements are required, they shall be performed within the timeframes of this table. Amounts less than 50 grams fissile may be accepted at shipper's values.

<sup>2</sup> Accountability Measurements. Quantitative determination of material quantities (generally within designated measurement uncertainty limits); resultant measurement values are entered into receiver's accountability records with the exception of those materials described in paragraph 5a(4)(c) below and 5a(4)(g), page II-14. Accountability measurements are not required for all materials. Where accountability measurements are required, they shall be performed within the timeframes of this table. Amounts less than 50 grams fissile may be accepted at shipper's values.



requirements shown in Figure II-2. The Manager, DOE Field Office may require that precision and accuracy goals be met for measurement of shipments and receipts. If receiver's accountability measurements cannot be accomplished consistent with requirements in Figure II-2, then confirmatory measurements as outlined in paragraph 5a(4)(f) below apply.

- (c) Shipper's values may be entered into the receiver's accountability records for nuclear material transfers when the shipper's values are more accurate than those which can be reasonably obtained by the receiver. However, the receiver must perform an accountability measurement within the timeframe specified in Figure II-2 to maximize loss detection sensitivity.
- (d) For shipments of unirradiated SNM containing greater than 250 grams of a single SNM type and for each discrete item exceeding 250 grams, limits of error at the 95 percent confidence level shall be assigned to their measurements by the shipper/receiver, for both the element and isotope values. Limits of error need not be reflected on the DOE/NRC Form 741 for external transfers for which verification measurements cannot be performed (refer to paragraph 5a(4)). For other shipments, the shipper and receiver may estimate the limits of error. Limits of error are also required for all measurements of external transfers of tritium that exceed 2 grams except as noted above.
- (e) Shippers and receivers shall provide a system for performing confirmatory measurements on external transfers of SNM. Whenever accountability measurements cannot be performed within timeframes specified in Figure II-2, confirmatory measurements are required for all transfers of Category I and II SNM and for any other materials for which the Manager, DOE Field Office, requires shipper/receiver accountability measurements. Documented acceptance/rejection criteria, based upon valid statistical principles, shall be established and used to evaluate confirmatory measurement data. A response plan for investigation and resolution of confirmatory measurements that fail acceptance criteria shall be developed and implemented; all outliers shall be investigated and resolved.
- (f) Where delays in completion of the receiver's measurement will result in a protracted delay in closure of the transaction, a confirmatory measurement may be used to effect a "safeguards closure" of the transaction, and documented by an "A-B" entry on the DOE/NRC forms 741 and 741A. Such a safeguards closure may be used when the integrity of the shipment is assured, and only accountability measurement differences are possible between shipper and receiver. When the receiver's accountability measurement performed subsequent to a safeguards closure indicates a shipper/receiver difference, the difference may be resolved by mutual agreement of the Managers of shipper's and receiver's DOE Field Offices, with an adjustment (correcting entry) to the DOE/NRC Form 741/741A. The safeguards closure may be applied only when all of the following conditions are met:

- 1 No discrepancies are found in the verification of the piece count, identification number and integrity of the TIDs, and gross weight of the items or containers received, and there is no evidence indicating theft or diversion of the material.
- 2 The shipper's and receiver's confirmation measurements are performed using "comparable" methods and the results of the measurements are within the established limits of agreement. The term "comparable" here means that the methods measure the same nuclear material attribute and the results of the methods can be compared on a technically valid basis.
- 3 A shipper/receiver agreement, approved by both Managers, of DOE Field Offices, is in effect for the transaction, establishing the criteria for closing transactions based on confirmatory measurements.

(g) For nuclear materials that are "difficult to measure" and for which no representative standards are available, limited processing is acceptable in order to perform a receipt measurement, as approved by the Managers of shipper's and receiver's DOE Field Offices with SA-10 concurrence. Limited processing can include homogenization and dissolution. Difficult to measure materials shall be identified in the facility's MC&A Plan.

b. Internal Transfers.

- (1) Each facility's management shall provide a graded system of measurements and records to reflect the flow of material between MBAs within that facility and between it and other facilities on the same site.
- (2) The facility control system shall be designed to monitor transfer activities and to deter and/or detect unauthorized removal of material during transfers. The system should flag abnormal situations, e.g., when inappropriate transfers of quantities and/or materials are made, when unauthorized personnel receive or ship materials.
- (3) Transfers shall be documented on nuclear material transfer forms, or an electronic equivalent, that contain required information, are prepared and distributed within established timeframes, and are signed by authorized custodians or their alternates.
- (4) Materials shall be subjected to a transfer check within one workday after receipt. These checks shall include verification of shipping container or item count, TIDs integrity, and identification number. These transfer checks shall be compared to appropriate documentation. All irradiated SNM requires only a transfer check.
- (5) If the isotope content of SNM (excluding uranium enriched below 20 percent U-235) transferred between MBAs is 50 grams (fissile) or more,

the transfer shall be measured, or a confirmatory measurement made, by the receiver. Measurements are not required for transfers that:

- (a) Consist of assembled components in which the SNM is physically inaccessible;
- (b) Are sent to laboratories or NDA measurement areas for analysis or examination under conditions which provide adequate internal controls to maintain a continuous awareness of the location and integrity of the SNM until it is returned;
- (c) Are tamper-safed and contain only Category III or IV quantities of material; or
- (d) Consist entirely of small items containing less than 25 grams each and for which unauthorized accumulation of a Category III quantity of material is not credible. Measurements shall be accomplished in accordance with the schedules shown in Figure II-2. Difficult to measure materials may be subject to measurement requirements in accordance with paragraph 5a(4)(g).

- (6) Documented acceptance/rejection criteria shall be established and used to evaluate measurement data for internal material transfers. In addition, procedures shall specify notification and response requirements if material removal or another abnormal situation is detected. These requirements shall be consistent with page I-11, paragraph 5, and DOE 5000.3B.

6. MATERIAL CONTROL INDICATORS. Each facility's management shall implement a program for assessing the material control indicators described below in order to provide assurance that losses and unauthorized removals of nuclear materials are detected. Each facility shall have documented plans specifying responsibilities and providing procedures for evaluating material control indicators.

- a. Shipper/Receiver Difference Assessment. Each facility shall have written procedures for evaluating shipper/receiver differences, and for investigating and reporting significant shipper/receiver differences.

(1) A shipper/receiver difference is defined to be significant when:

- (a) It involves a discrepancy in the number of items regardless of the quantity of nuclear material;
- (b) It is statistically significant. (Determination of whether shipper/receiver difference are statistically significant is only required for those shipments for which accountability measurements are made by both the shipper and receiver.) A shipper/receiver difference is defined to be statistically significant when the magnitude of the difference exceeds either of the following:

- 1 The limit obtained by a statistical combination of the valid limits of error for the shipper's and receiver's measured values;  
or

- 2 The square root of two (approximately 1.4) times a single valid limit of error when either the shipper's or receiver's limit of error is not valid. (When both shipper's and receiver's limits of error are determined not to be valid, the limits of error must be recalculated and the statistical significance of the shipper/receiver difference must be reevaluated.)
- (2) Shipper/receiver difference data shall be subjected to trend analysis to detect measurement bias and/or material loss. Analyses shall be designed to detect statistically significant cumulative shipper/receiver differences and to trigger investigations whenever these differences are detected.
- (3) The receiver shall notify its DOE Field Office and the shipper of any shipper/receiver difference determined to be significant. Both shipper and receiver shall investigate their measurements and limits of error. Such investigations shall be completed within 30 working days after the receiver's accountability measurements unless a time extension is granted by mutual agreement of the involved Managers, DOE Field Offices. All investigations shall be documented.
- (4) Significant shipper/receiver differences involving a discrepancy in the number of items shall be reported in accordance with DOE 5000.3B and the requirements contained in Chapter I, paragraph 5.
- (5) When shipper/receiver differences are determined to be statistically significant, but the quantities and strategic or monetary values are insufficient to warrant an investigation and subsequent correction to transfer documents, and when the receiver is DOE or one of its contractors or subcontractors, the difference need not be investigated and each party shall record its own quantitative value. For the purposes of this paragraph, differences of less than 50 grams fissile or less than 5 grams of tritium are considered to be insufficient to require an investigation unless there are special circumstances. The authority to invoke the stipulations of this paragraph shall rest mutually with the Managers of the shipper's and receiver's DOE Field Offices.
- (6) Resolution of statistically significant shipper/receiver differences may be achieved through any of the following:
- (a) If both shipper's and receiver's DOE Field Office obtain adequate assurance that the measurements and limits of error are valid, and the investigation indicates that theft or diversion has not occurred, then each facility shall record its own quantitative values; or
  - (b) If either the shipper or receiver agrees to accept the other's value, then the shipper or receiver shall prepare a corrected copy of the shipping document using the other's data; or
  - (c) If the results of the investigations do not result in a satisfactory resolution, the OSS shall arbitrate the matter and recommend the action to be taken; or

(d) In the case where contracts specify other procedures for arbitration, they shall prevail.

- (7) The receiving facility shall not process SNM contained in a shipment involving an unresolved significant shipper/receiver difference unless a shipper/receiver agreement allowing this has been approved by both the Managers of the shipper's and receiver's DOE Field Offices.

b. Inventory Difference Evaluation.

- (1) Each facility shall have a documented program for evaluating all SNM inventory differences, including those involving missing items. Programs for evaluation of inventory differences for other nuclear materials may be established at the option of the Manager, DOE Field Office. Procedures shall be provided for establishing control limits and requiring investigation when those limits are exceeded. Warning limits will be set at the 95 percent confidence level. Alarm limits will be set at the 99 percent confidence level. All inventory differences exceeding warning or alarm limits shall be reported in accordance with DOE 5000.3B and Chapter I, paragraph 5. Assessments of inventory differences shall include statistical tests (e.g., tests of trends and biases), and shall be applied, as appropriate, to both total inventory difference and actual inventory difference on an individual and cumulative basis for each nonstorage MBA.
- (2) Procedures for establishing control limits for inventory differences shall be based on variance propagation using current data. The data should reflect operating conditions for the material balance period of the inventory. Alternatively, other statistically-valid techniques may be used but must be justified on the basis of factors such as limited data, low transfer rates, categories, and major process variations. The methodology shall be approved by the cognizant Manager, DOE Field Office. Historical inventory difference data shall be evaluated for comparison with the statistically based limits, where applicable. Where the propagated or otherwise statistically based methods do not yield control limits consistent with historical data, efforts shall be made to resolve the discrepancies between the two.
- (3) Each facility shall have documented procedures for responding to and reporting missing items and inventory differences in excess of control limits. The reporting and investigation of inventory differences shall be consistent with the requirements specified in Chapter I, paragraph 5.

c. Evaluation of Other Inventory Adjustments.

- (1) Each facility's management shall establish a documented program for evaluating all inventory adjustments entered in the accounting records. The program shall include written procedures including equations for applying radioactive decay and fission/transmutation adjustments. A program for holdup adjustments must be justified on the basis of measurements or other factors. Procedures shall be outlined for the statistical review of inventory adjustments using techniques such as tests of trends, biases, and correlation.

- (2) Procedures shall be implemented to assure that all inventory adjustments are supported by measured values or other technically defensible bases. The program shall include procedures for measuring/monitoring environmental waste such as stack effluents and liquid waste streams as required by DOE 5400.1.
- (3) Procedures shall be established for reporting reviews of inventory adjustments, including abnormal situations, to the Manager, DOE Field Office.

### CHAPTER III

#### MATERIALS CONTROL

1. GENERAL. This chapter describes the requirements for material control. The chapter is subdivided into four functional performance areas: access controls, material surveillance, material containment, and detection/assessment. The graded materials control program shall be formally documented in the MC&A Plan. Requirements for the control of SNM are stated in both DOE 5632.2A and this Order. Some requirements stated are in one Order but not both. All requirements shall be met regardless of the Order in which they appear.
2. ACCESS CONTROLS. Each facility shall have a graded program for controlling personnel access to: nuclear materials; nuclear materials accountability, inventory, and measurement data; and data generating equipment and other items/equipment where misuse or tampering could lead to compromise of the safeguards system. The graded access control system shall consider the quantity and attractiveness of the material in the area and impacts of threats, as well as other control systems that are in place and which may mitigate these threats. These access controls may range from extensive and complex access control systems for Category IA areas and materials to simple administratively controlled access systems for Category IV areas. For facilities that have Category III and IV areas containing attractiveness level B and C material outside of a PA, the facility's management shall assure that these areas do not possess a Category I or II quantity of SNM unless a VA demonstrates that an unauthorized accumulation of a Category I quantity of material from these facilities is not credible. Personnel security assurance programs shall be used as a component in the prevention of the theft or diversion of SNM and shall be considered in assessments of vulnerability related to theft of Category I quantities of SNM. Testing of access control systems and procedures shall be conducted according to testing methodology, testing frequency, and record maintenance requirements contained in DOE 5630.16 and applicable Department guidance. Performance requirements for access controls are contained on page I-9, paragraph 4.
  - a. Materials Access. Each facility shall have a documented program to ensure that only properly authorized personnel have access to nuclear materials. This program shall address procedures and mechanisms to detect/respond to access by unauthorized personnel. In order to minimize the potential for unauthorized access to nuclear material, the amount of material in use shall be limited to that necessary for operational requirements, and excess material shall be stored in repositories or kept in enclosures designed to assure that access will be limited to authorized individuals.

- (1) Category I. Category I quantities of SNM shall be used or stored only within a MAA enclosed within a PA. Routine access and egress shall be restricted to defined portals/pathways which are subject to material and personnel controls.
  - (2) Category II. Category II quantities of SNM shall be used or stored only within a PA.
  - (3) Category III. Category III quantities of SNM and tritium shall be under the control of a facility-designated custodian when in use, or stored in a locked and locally alarmed repository, a locked room, or a locked Departmental-approved security container. When unattended the locked repository, room, or container shall be under the protection of a Departmental-approved intrusion detection alarm system, or patrolled at intervals not to exceed 2 hours. Alternatively, the security container, locked room or repository may be located in a PA.
  - (4) Category IV. Category IV quantities of nuclear material shall be under the control of a facility-designated custodian when in use and shall be stored in a locked area or stored under a material surveillance program approved by the Manager, DOE Field Office.
- b. Data Access. Each facility shall have a graded program to assure that only authorized persons have the ability to enter, change, or access material control and accountability data and information.
  - c. Equipment Access. Each facility shall have a graded program to control access to data-generating and other equipment used in material control activities, thereby assisting in providing assurance of the integrity of equipment and data used for material control. Such equipment includes measurement equipment, data recording devices, and tamper-indicating devices. An access control program comparable to that required for classified computer systems may be required if such controls are necessary to assure the integrity of the data system.
  - d. Other Considerations. Access controls similar to those described in paragraphs 2b and c above shall be designed to protect against data/equipment falsification or manipulation and shall detect unauthorized activities during emergency or other unusual conditions.
  - e. Unclassified Computer Systems. Where MC&A data and data-generating equipment involve unclassified computer systems, these systems shall meet the requirements of DOE 1360.2B. Additionally, MC&A program officials responsible for planning and protection of these unclassified systems shall work within the context of DOE's Unclassified Computer Security Program. The Unclassified Computer Security Program should be the means for providing access controls and other protective resources for assuring the integrity of unclassified data and data-generating systems.



3. MATERIAL SURVEILLANCE. Each facility's management shall establish a graded surveillance program for monitoring nuclear materials and detecting unauthorized activities or anomalous conditions and for reporting material and facility status. The objective is the detection and assessment of conditions that may adversely affect safeguards, e.g., to detect anomalies and to report alarm conditions. The surveillance program shall address both normal and emergency conditions, and shall provide for periodic testing. Testing for material surveillance systems and procedures shall be planned and documented in accordance with DOE 5630.16. Performance requirements for material surveillance of Category I and II quantities of SNM are contained in Chapter I, paragraph 4.
  - a. Material Surveillance Mechanisms. Specific material surveillance methodologies may include the following:
    - (1) Automated means (e.g., monitoring devices, sensors or other instrumentation) to detect anomalies and to report alarm conditions.
    - (2) Visual surveillance/direct observation (e.g., two-person rule, monitoring by external personnel) to provide assurance that only authorized activities occur and to assess SNM movements or inventory status. Visual surveillance requires reasonable assurance that activities are observable and that the observer will recognize, correctly assess and report activities that are unauthorized or are inconsistent with established safeguards requirements. There shall be documented procedures for implementing the two-person rule.
    - (3) Process logs, inventory records, or other information to indicate anomalies and trigger investigatory actions.
  - b. Material Surveillance Programs. Surveillance procedures shall describe the methodologies and operational/control points on which the program is based and shall provide for investigation, notification, and reporting of anomalies. Alternatives to the material surveillance requirements specified below may be approved in accordance with DOE 5630.11A for facilities that rely primarily on other MC&A and/or security measures.
    - (1) Category I and II. The material surveillance program for Category I and II quantities of SNM shall assure that materials are in authorized locations and shall detect unauthorized material flows and transfers. Evaluations of Category I locations shall be performed to determine system capabilities to assess material losses from MAA and PA boundaries. Evaluations of Category II locations shall be performed to determine system capabilities to assess material losses from the PA boundary. Material surveillance procedures for all areas having Category I or II quantities of SNM shall include the following:
      - (a) Only Q-cleared, knowledgeable, and authorized personnel (i.e., individuals who are capable of detecting incorrect or unauthorized actions) shall be assigned responsibility for surveillance of SNM.
      - (b) Controls shall be sufficient to ensure that one individual cannot gain access to a secure storage area.

- (6) Provide a record system to document ingress/egress to repositories; and
- (7) Define procedures for conducting inventories and daily administrative checks.

d. Processing Areas. The facility shall have controls for nuclear materials being used or stored in processing areas. The controls for in-process areas shall:

- (1) Be formally documented;
- (2) Describe activities and locations for storing material;
- (3) Identify components used to detect unauthorized activities or conditions;
- (4) Include procedures for moving material into or out of the processing area;
- (5) Describe control procedures for both normal and emergency conditions;
- (6) Describe response actions to be taken in abnormal situations; and
- (7) Provide for audit of the processing controls on a periodic basis to assure system effectiveness.

5. DETECTION/ASSESSMENT. Each facility shall have the capability to detect and assess the unauthorized removal of nuclear materials, consistent with the graded safeguards concept. The system shall be interfaced with the facility's physical protection and other organizational systems, as appropriate, and shall be able to detect removal of SNM from its authorized location (theft/diversion/errors) and provide notification to the protective force and other organizations to respond when such events are detected.

a. Tamper-Indicating Devices. The reliance on TIDs as a safeguards measure is directly dependent on the environment in which the tamper-indicating device resides and the material being tamper-safed. Each facility shall have a documented program, administered by the MC&A organization, for control of TIDs and to assure that TIDs are used to the extent possible to detect violations of container integrity. DOE-wide standardized TIDs should be used when available through DOE standardized procurement (see DOE 5630.17). Testing of TID integrity, location, and application and the TID record system shall be conducted according to testing methodology, testing frequency, and record maintenance requirements contained in DOE 5630.16 and applicable Department guidance. Performance requirements for TIDs are contained in Chapter I, paragraph 4, of this Order. The Safeguards Seal Reference Manual, issued by SA-10, can facilitate in the selection, application, and verification of TIDS. The TID control program shall specify, as a minimum, the following elements:

- (1) Acquisition/procurement/destruction;
- (2) Types of TIDs utilized;

- (3) Assurance of unique TIDs identification;
- (4) Storage;
- (5) Issuance;
- (6) Personnel authorized to apply, remove, and dispose of TIDs;
- (7) Containers on which TIDs are to be applied;
- (8) Procedures for application of TIDs;
- (9) Frequency and method of TIDs verification;
- (10) Response procedures for TIDs violations;
- (11) Assurance that TIDs cannot be reused after violation;
- (12) Frequency and method of internal program audits; and
- (13) Procedures for reporting TID violations.

b. Portal Monitoring.

- (1) A physical or electronic search shall be separately conducted of vehicles, personnel, packages, and all other containers at all routine exit points from MAAs and PAs that contain Category I quantities (or Category II quantities where rollup to a Category I quantity is possible) to protect against the unauthorized removal of SNM. Such searches shall be capable of detecting shielded SNM (e.g., using a combination of SNM and metal detectors) and shall meet detection requirements for metal and SNM determined by the Manager, DOE Field Office. Procedures used shall be based upon considerations of the material type, portability, size, and configuration of the SNM in the MBA/MAA/PA, and shall assure that unalarmed portals without the means to detect SNM are not used.
- (2) The detection level of the monitors shall be based upon detection of the typical SNM product in the area and a realistically determined number of removals associated with theft of a Category I quantity of material. All detectors and related calibration standards shall be maintained and controlled to ensure that portal monitors are capable of meeting detection requirements. Periodic performance testing of portal monitors shall be conducted in accordance with Chapter I, paragraph 4b. Planning and documentation of performance testing shall meet the requirements of DOE 5630.16. Performance requirements for portal monitors (both SNM and metal) are contained in Chapter I, paragraph 4. Controls shall be established to prevent unauthorized access to portal monitor instrumentation and cabling. A written response plan shall be prepared and implemented to provide evaluation and resolution of all alarm conditions, including requirements for notification in accordance with DOE 5000.3B (and the requirements contained in Chapter I, paragraph 5,) in the event of unresolved alarms or malevolent actions. Controls

shall be established to ensure detection capabilities during emergency conditions.

c. Waste Monitors.

(1) For purpose of detecting the theft or diversion of SNM, all liquid, solid, and gaseous waste streams leaving an MAA shall be monitored for SNM unless a specified deviation is granted. (Additional monitoring may be required for environmental or waste management purposes. The additional monitoring should be performed in accordance with applicable environmental and waste management regulations.) Monitoring instrumentation may be semi-quantitative, provided that the monitors used are capable of detecting gamma/neutron radiation characteristics of the specified material type. The facility's waste monitoring equipment shall be maintained and controlled to ensure that the equipment is capable of detecting specified amounts of SNM. Instrumentation used to monitor waste and equipment removed from an MAA must be able to detect, in combination with other detection elements, the removal of a Category I quantity of SNM through a credible theft or diversion scenario.

(2) A response plan for evaluating and resolving situations involving any discharge exceeding facility-specific limits approved by the Manager, DOE Field Office, shall be established and implemented. The plan shall provide for reporting in accordance with DOE 5000.3B and the requirements contained in Chapter I, paragraph 5 of this Order, if the situation is not satisfactorily resolved or if there is an indication of malevolent action.

d. Daily Administrative Checks. A facility-specific daily administrative checks program shall be implemented for each Category I MBA (or multiple MBAs where rollup to a Category I quantity of SNM is credible). The scope and extent of the checks shall be determined and approved by the DOE Field Office based upon recognized vulnerabilities. The administrative checks program shall specify the detection objectives, performance procedures, documentation requirements, and response actions.

e. Other Detection/Assessment Mechanisms. For each facility, systems capable of detecting and/or assessing SNM removals shall be established consistent with the loss detection elements evaluation requirements in Chapter I, paragraph 4. Detection/assessment mechanisms may be based on item identification, number of items, verification of intact TIDs, confirmation that no access has occurred, process monitoring, near-real time accountability, control procedures for use and movement of material, or any other approved technique for identifying anomalies. These monitoring and control systems shall provide sufficient information to correctly assess the alarm, localize the removal, and estimate the quantity and form of the diverted or stolen material.





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