

SUBJECT: ADMINISTRATIVE CHANGE TO DOE O 474.2 Admin Chg 3, *NUCLEAR MATERIAL CONTROL AND ACCOUNTABILITY*

1. EXPLANATION OF CHANGES. As a result of the four year recertification review of this directive administrative changes were identified as necessary for clarity and consistency. These changes include correcting for the organizational change and aligning language within other security orders. In addition, references throughout the Order to DOE directives were updated to reflect current citations, and web links to the Policy Information Resource tool and Nuclear Materials Management and Safeguards System User's Guide were updated to reflect their new web addresses. These changes do not represent an increase in any requirements contained in this directive.
2. LOCATION OF CHANGES.

Page	Paragraph	Changed	To
Cover Page	Bottom	Office of Health, Safety and Security	Office of Environment, Health, Safety and Security
1	2.	, (online at http://www.hss.energy.gov/nmmss/NMMSS%20User%20Guide%20-%20Final%20Version%20dtd%20October%202008.pdf)	. The NMMSS User Guide can be found at: http://www.nnsa.energy.gov/nmmss , under Information, Reports, and Forms.
7	4.f.(1)	The NMMSS Users Guide provides detailed instructions on completing forms and submitting data to NMMSS. If...	The NMMSS Users Guide provides detailed instructions on completing forms and submitting data to NMMSS, which can be found at: http://www.nnsa.energy.gov/nmmss , under Information, Reports, and Forms. If ...
8	4.g.(3)	Office of Health, Safety and Security	Office of Environment, Health, Safety and Security
8	4.g.(3)	HSS	AU
9	4.h.	HSS	AU
11	5.d.	Office of Health, Safety and Security	Office of Environment, Health, Safety and Security
11	6	http://pir.pnl.gov	http://pir.doe.gov
12	6.b.	DOE O 470.4B,	DOE O 470.4B, Admin Chg 1,
12	6.d.	DOE O 205.1B,	DOE O 205.1B, Chg 3,
12	6.e.	DOE O 243.1, Records Management Program, dated 2-3-06.	DOE O 243.1B, Chg 1,, Records Management Program, dated 7-08-13.

Page	Paragraph	Changed	To
12	6.g.	DOE O 410.2,	DOE O 410.2, Admin Chg 1,
12	6.j.	DOE-STD-1194-2011,	DOE-STD-1194-2011, CN 3,
13	7	http://pir.pnl.gov	http://pir.doe.gov
13	8	Office of Health, Safety and Security	Office of Environment, Health, Safety and Security
Attach ment 1, page 4	4.a.	(online at http://www.hss.energy.gov/nmmss/NMMSS%20User%20Guide%20-%20Final%20Version%20dtd%20October%202008.pdf)	The NMMSS Users Guide provides detailed instructions on completing forms and submitting data to NMMSS, which can be found at: http://www.nnsa.energy.gov/nmmss , under Information, Reports, and Forms. If ...
Attach ment 1, page 4	5.c.	Office of Health, Safety and Security	Office of Environment, Health, Safety and Security
Attach ment 1, page 4	5.c.	HSS	AU
Attach ment 1, page 5	6.	http://pir.pnl.gov	http://pir.doe.gov
Attach ment 2, page 3	Header on right side of table	Attachment 2	Add page number to Attachment 2 Page 3
Attach ment 3, page 3	1.u.	Characterization of MC&A in the site security plan is accurate and validated.	Characterization of MC&A in the security plan is accurate and validated.
Attach ment 3, page 4	2.d.	..., with 95 percent probability unless otherwise specified in the Site Security Plan (SSP). (For example, the SSP may describe other measures in place to mitigate the lack of detection capability).	..., with 95 percent probability unless otherwise specified in the Security Plan (SP). (For example, the SP may describe other measures in place to mitigate the lack of detection capability).
Attach ment 3, page 4	2.e.	The site/facility operator defines loss detection capability, including the probability of detecting the theft of a specified quantity within a specified timeframe, and justifies this approach in the site security plan	The site/facility operator defines loss detection capability, including the probability of detecting the theft of a specified quantity within a specified timeframe, and justifies this approach in the security plan.

Approved: 6-27-2011

Chg 1: 8-3-2011

Chg 2: 11-19-2012

Chg 3: 5-15-2015

SUBJECT: NUCLEAR MATERIAL CONTROL AND ACCOUNTABILITY

1. **PURPOSE.** This Order establishes performance objectives, metrics, and requirements for developing, implementing, and maintaining a nuclear material control and accountability (MC&A) program within the U.S. Department of Energy (DOE), including the National Nuclear Security Administration (NNSA), and for DOE-owned materials at other facilities that are exempt from licensing by the Nuclear Regulatory Commission (NRC). This order only addresses the safeguards and security of accountable nuclear materials. Nuclear Safety requirements may be found in 10 CFR 830, 10 CFR 835 and Safety related DOE Directives.
2. **CANCELLATION.** DOE M 470.4-6, Change 1, *Nuclear Material Control and Accountability*, dated 8-26-05.

NOTE: Section B of this canceled directive, Basic Requirements for Nuclear Materials Management and Safeguards System Reporting and Data Submission, has been incorporated into the *Nuclear Materials Management and Safeguards System (NMMSS) User Guide*. The NMMSS User Guide can be found at:
<http://www.nnsa.energy.gov/nmmss>, under Information, Reports, and Forms.

Cancellation of a directive does not, by itself, modify or otherwise affect any contractual or regulatory obligation to comply with the directive. Contractor Requirements Documents (CRDs) that have been incorporated into a contract remain in effect throughout the term of the contract unless and until the contract or regulatory commitment is modified to either eliminate requirements that are no longer applicable or substitute a new set of requirements.

3. **APPLICABILITY.**
 - a. **Departmental Applicability.** Except for equivalencies and exemptions in paragraph 3.c, this Order applies to DOE elements that have oversight of site and facility management, operations and offices that administer contracts for DOE MC&A programs, including those created after this Order is issued.

The Administrator of the NNSA must assure that NNSA employees comply with their responsibilities under this directive. Nothing in this directive will be construed to interfere with the NNSA Administrator's authority under section 3212(d) of the National Defense Authorization Act for Fiscal Year 2000 (50 U.S.C. §2402(d)) to establish Administration-specific policies, unless disapproved by the Secretary.

This Order does not apply to the following:

- (1) Activities regulated through a license by the Nuclear Regulatory Commission (NRC) or a state under an agreement with NRC, including activities certified by NRC under section 1701 of the Atomic Energy Act.
- (2) In accordance with the responsibilities and authorities assigned by Executive Order 12344, codified at 50 USC sections §2406 and §2511 and to ensure consistency throughout the joint Navy and DOE organization of the Naval Nuclear Propulsion Program, the Deputy Administrator for Naval Reactors (Director) will implement and oversee all requirements and practices pertaining to this DOE Order for activities under the Director's cognizance, as deemed appropriate.

b. DOE Contractors.

- (1) Except for the equivalencies/exemptions in paragraph 3.c., the Contractor Requirements Document (CRD) sets forth requirements of this Order that will apply to contracts that include the CRD (See Attachment 1).
- (2) The CRD must be included in contracts requiring the access, use, oversight, management and/or operation of accountable nuclear materials at DOE-owned or -leased facility.
- (3) The CRD must be included in all contracts for management and/or operation of DOE facilities that involve nuclear materials and contain DOE Acquisition Regulation (DEAR) clause, Title 48 Code of Federal Regulations (CFR) 952.204-2, Security Requirements.

c. Equivalencies/Exemptions for DOE 474.2.

Equivalencies and exemptions from the requirements of this Order are processed in accordance with DOE O 251.1C, *Departmental Directive Program*.

When conditions warrant, equivalencies or exemptions from the requirements in this Order, requests must be supported by a vulnerability assessment (VA) when required by the assets being protected, or by sufficient analysis to form the basis for an informed risk management decision, the analysis must identify compensatory measures, if applicable, or alternative controls to be implemented.

All approved equivalencies and exemptions under this Order must be entered in the Safeguards and Security Information Management System (SSIMS) database and incorporated into the affected security plan(s). Approved equivalencies and exemptions become a valid basis for operation when they have been entered in SSIMS and documented in the appropriate security plan, and they must be incorporated into site procedures at that time.

Many DOE safeguards and security (S&S) Program requirements are found in or based on regulations issued by Federal agencies, and codified in the CFR or other authorities, such as Executive Orders or Presidential Directives. In such cases, the process for deviating from those requirements found in the source document must be applied. If the source document does not include a deviation process, the DOE Office of the General Counsel, or NNSA Office of General Counsel if an NNSA element is involved, must be consulted to determine whether deviation from the source can be legally pursued.

4. REQUIREMENTS. The following are essential to a valid and successful MC&A program.
 - a. DOE Oversight Requirements.
 - (1) DOE line management requirements:
 - (a) the detection of nuclear materials diversion and theft or unlawful activities (i.e. unauthorized control of a weapon, test device, or materials that can be used to make an improvised nuclear device) by the site or facility operator; and
 - (b) the confirmation of the effectiveness of the MC&A programs.
 - (2) Line management must assure and assess the performance of DOE MC&A programs in providing accurate nuclear material inventory information; controlling nuclear materials to deter and detect loss or misuse; providing timely and localized detection of unauthorized removals within specified limits; providing assurance that all nuclear materials are accounted for and that theft/diversion has not occurred; and assisting in the detection and deterrence of radiological and/or toxicological sabotage involving nuclear materials that could adversely impact national security, the health and safety of employees, the public, or the environment. Programs must assess performance using the metrics identified in Attachment 3 unless alternative metrics have been documented in program or site office procedures and in the MC&A Plan.
 - (3) Oversight personnel must review and verify the validity of operator reports of nuclear material storage, processing, and use to the national system of accounting (NMMSS), and must ensure the effective regulatory control of nuclear materials as required by Public Law (P.L.) 83-703, the Atomic Energy Act of 1954, as amended.
 - b. DOE Program Planning and Administration.

A comprehensive MC&A Plan developed and implemented by the site/facility operator that defines the program at the site, must be approved by DOE line management. The Plan must provide the safeguards authorization for the

site/facility operator to possess accountable nuclear materials and must specify how those materials are accounted for and controlled on a graded safeguards basis (see Attachment 2, Table C, Graded Safeguards Table). It must include all fundamental commitments that define the bounds within which the MC&A program will function and the detailed level of performance.

DOE line management must conduct a rigorous review of the MC&A Plan prior to its approval. Approval must be for a limited time period; subsequent approval will be contingent upon compliance with commitments and practices described in the Plan and adequate performance. The Plan must include the commitments that define the bounds within which the MC&A program will function and the metrics and risk assessments that will be used to demonstrate performance. The Plan must demonstrate that the MC&A program meets the objectives listed below for each MC&A element.

- (1) Program Management Objectives. The program
 - (a) ensures that documentation is sufficient to maintain a comprehensive, effective, and cost-efficient program to control and account for nuclear materials;
 - (b) defines MC&A system elements with performance goals that reflect consequence of loss or misuse of the material managed by the program;
 - (c) must be graded based on the consequence of loss and contain control and accounting mechanisms for nuclear materials;
 - (d) establishes and maintains an evaluation program that monitors the effectiveness of the MC&A system;
 - (e) responds effectively and efficiently to material loss indicators, anomalous conditions, and degradation of system performance; and
 - (f) management ensures the integration of MC&A with Safeguards & Security and other site programs.
- (2) Material Control Objectives.
 - (a) Detect, assess and deter unauthorized access to nuclear material.
 - (b) Detect, assess and communicate alarms to response personnel, in time to impede unauthorized use of nuclear material.
 - (c) Provide loss detection capability for nuclear material and, when not in its authorized location, be able to provide accurate

information needed to assist in locating the material in a timely manner.

- (d) The material containment and surveillance program in conjunction with other security program elements must have the capability to detect, assess, and respond to unauthorized activities and anomalous conditions/events.
- (e) In coordination with security organizations, material control measures assure that appropriate protection and controls are applied to nuclear materials according to the quantity and attractiveness of the material.

(3) Measurement Objectives.

- (a) The measurements program must provide measured values with uncertainties sufficient to detect theft or diversion of nuclear material.
- (b) The measurement control program must assure the quality of measurements made for MC&A purposes.

(4) Material Accounting Objectives.

- (a) Accurate records of nuclear materials inventory are maintained and transactions and adjustments are made.
- (b) The accounting system
 - 1 provides data for reporting on nuclear material sufficient to support local, national, and international commitments;
 - 2 must accurately reflect the nuclear material inventory and have sufficient controls to ensure data integrity;
 - 3 provides data and reports on accountable nuclear material to NMMSS; and
 - 4 must use material balance areas as the basis of the accounting structure with key measurement points established to localize and identify inventory differences.

(5) Physical Inventory Objectives.

- (a) The physical inventory, in conjunction with other MC&A elements, assures that accountable nuclear materials are not missing.

- (b) The physical inventory program ensures that discrepancies between the physical inventory and the accounting records system are detected and resolved.

c. Program Integration.

The MC&A program must be integrated with other programs such as Safeguards and Security program planning and management, physical protection, protective force, information security, personnel security and response personnel. Additionally, the activities and requirements in the weapons surety, foreign visits and assignments, safety, emergency management, cyber security, intelligence, and counterintelligence programs should also be considered in the implementation of this Order.

d. DOE to Department of Defense (DoD) Special Nuclear Material (SNM) Transfers.

For DOE to DoD weapons transfers, SNM in weapons must not be transferred to DoD under 42 U.S.C. §2121(b), Material for Department of Defense Use, until DOE has received direction from the President.

- (1) Require that DOE line management not transfer nuclear material to DoD, or authorize contractor facilities to make such transfers, until it has received written authorization for specific transfers.
- (2) Require that DOE line management and the contractor retain written authorization on file for audit purposes.
- (3) Maintain memorandum inventory accounts and current inventory records for all transfers of accountable SNM in weapons to DoD by the NNSA Service Center.
- (4) Include inventory records for all quantities shipped to DoD, all quantities returned to DOE (based on the receiver's measured quantities), all quantities determined to have been consumed or lost, and inventory and loss data for reports of composition of ending inventory.
- (5) Report by September 30th each year, the NNSA Service Center transcripts of memorandum inventory accounts to the Office of the Under Secretary, Assistant Secretary for Nuclear Energy, and DOE Headquarters, for other than weapon-related inventories.

e. DOE Material at NRC Licensees' Sites.

Line management must conduct periodic reviews and assessments of the nuclear material holdings at NRC licensees' sites to ensure that NMMSS reporting requirements are being met, unneeded materials are identified and returned to

DOE, appropriate disposition paths are identified, and accurate material characterizations are made, thereby enhancing data quality and assurance.

- (1) DOE program offices, with responsibility for DOE-owned nuclear material at NRC licensees' sites, must obtain written verification that the licensee continues to possess the materials and verify that the NMMSS records are correct for these materials.
- (2) DOE program offices must ensure that the verifications be obtained at least every 12 months, but are not required for materials that have already been identified in the licensee's most recent material balance report, provided the report was submitted to NMMSS within the last 12 months.
- (3) The Office of Nuclear Materials Integration in the National Nuclear Security Administration must obtain written verification from the licensee that they continue to possess the materials and verify that the NMMSS records are correct for DOE-owned materials at NRC licensees' sites for which no DOE programmatic owner has been assigned.

f. Reporting to NMMSS.

- (1) Facilities must report data to the NMMSS electronically. The NMMSS Users Guide provides detailed instructions on completing forms and submitting data to NMMSS, which can be found at: <http://www.nnsa.energy.gov/nmmss>, under Information, Reports, and Forms. If electronic means are unavailable, reporting using paper forms is permitted; however, it must be coordinated through DOE line management. Under emergency conditions or if a special, non-standard report is required, paper forms may be used.

NOTE: In this Order, paper forms and numbers (e.g., DOE/NRC Form 741, Nuclear Material Transaction Report) are mentioned for instructional purposes. The fact that a paper form is available does not relieve the facility from the requirement to report electronically.

- (2) Facilities must ensure that when a reportable quantity of an accountable nuclear material is recovered during deactivation, decommissioning, or decontamination, the recovered material will be reported to NMMSS, even when the material has been previously written off the NMMSS records. DOE/NRC Form 741 must be used and is available electronically.

g. Termination of Safeguards.

Sites/facilities requests to terminate regulatory control of nuclear materials must be reviewed by their Program Office DOE line management and the Office of Nuclear Materials Integration who will approve or disapprove the request.

Safeguards can be terminated on nuclear materials provided the following conditions are met.

- (1) Determine that the nuclear material is of no programmatic value to DOE.
- (2) Require that designated facilities and nuclear materials for safeguards termination are assigned the proper categorization and attractiveness levels according to Attachment 2, Table C, Graded Safeguards Table and Attachment 2, page 4, Using the Graded Safeguards Table
- (3) Meet the criteria for attractiveness level E. When termination of safeguards for attractiveness level D or higher SNM is requested, approval is received from the departmental element after consultation with the Office of Environment, Health, Safety and Security (AU). For NNSA facilities, approval is received from the Associate Administrator for Defense Nuclear Security after consultation with AU.
- (4) Require that when disposal of a Category II or greater quantity of SNM is being considered, DOE line management for both the shipping and receiving facilities must concur in a security analysis for theft or diversion of the material performed jointly by the shipping and receiving site/facility operators.
- (5) Ensure that the nuclear material being written off the accounting record system will be written off as a transfer to decontamination and decommissioning (D&D) or a waste management reporting identification symbol (RIS).
- (6) Ensure that the nuclear material for which safeguards have been terminated is not co-located with accountable nuclear materials.
- (7) Ensure the requirements associated with the level of security specified by DOE line management as a condition of termination of safeguards are implemented effectively.
- (8) When the site/facility operator requests termination of safeguards for a nuclear material facility, the following must be done:
 - (a) DOE line management conducts a termination survey to ensure that no accountable nuclear material remains.
 - (b) Ensure that the only remaining material is waste or residual holdup that meets the definition of attractiveness level E.
 - (c) Ensure that nuclear material has been written off the accounting record system as a transfer to a waste management RIS or D&D organization RIS.

h. Implementation.

Within six months of the effective date of this Order, sites must provide an implementation plan for approval from their Program Secretarial Office. Requirements that cannot be implemented within six months of the effective date of this Order or within existing resources must be documented by line management and submitted to the relevant program officers; the Under Secretary of Energy, the Under Secretary of Science or the Under Secretary for Nuclear Security/Administrator, NNSA; and AU. The documentation must include timelines and resources needed to implement this Order and include a description of the vulnerabilities and impacts created by the delayed implementation of the requirements.

5. RESPONSIBILITIES.: The responsibility for management and implementation of safeguards and security programs resides with the appropriate Under Secretary. The Under Secretary serves as DOE line management and has the authority to commit security resources, direct the allocation of security personnel, and approve security implementation plans and procedures in the accomplishment of specific work activities. Delegations must be documented and disseminated to concerned parties in a manner determined by the Under Secretary.

a. Secretarial Program Offices, including NNSA.

- (1) Serve as DOE line management for programs, operations, and facilities under their jurisdiction. This authority may be delegated to actual line management with documentation of the approval authority.
- (2) Ensure that each contractor and subcontractor under their jurisdiction who may use or possess accountable nuclear materials is required by contract to develop and maintain an MC&A Plan.
- (3) Through contracting officers, require that the CRD associated with this order be included in all contracts with license-exempt contractors holding DOE-owned nuclear material.
- (4) Ensure that MC&A programs are operating within the limits of approved MC&A plans and establish programs for periodic assessment of program effectiveness, using the program metrics in Attachment 3 or documented alternative metrics.
- (5) Conduct safeguards and security reviews of nuclear materials distributed abroad to the extent provided for in international agreements, and participate in international discussions regarding safeguards policies and procedures with other DOE organizations involved in international programs.

- (6) Prepare reports and provide data for reports to the Secretary on the status of regulatory control of DOE-owned nuclear materials, as required by the Atomic Energy Act.
 - (7) Develop and allocate MC&A budgets or require Crosscuts budgets for overhead and for Work for Others-funded MC&A, including budgets for the infrastructure that supports safeguards missions.
 - (8) Ensure that MC&A personnel under their cognizance are managed, trained, and qualified to perform their duties.
 - (9) Develop and propagate programmatic implementation of requirements (describing specific “how to” instructions/guidance) for subordinate federal MC&A activities/organizations.
 - (10) Develop and propagate contractor implementing instructions through contracting officers to the MC&A contractors.
 - (11) Ensure that MC&A programs exhibit the characteristics required in paragraph 4 above, by using the program metrics in Attachment 3 or by documenting alternative metrics in the MC&A Plan to evaluate the MC&A program,
 - (12) Manages the development and maintenance of NMMSS by:
 - (a) collecting data relative to nuclear materials including those for which the United States has a safeguards interest both domestically and abroad;
 - (b) processing the data; and
 - (c) issuing reports to support the safeguards and management needs of DOE, NRC, and other government organizations, including those associated with international treaties and agreements (e.g., IAEA).
- b. Site Offices Oversight. If site offices are responsible for oversight of a site/facility possessing nuclear material, oversight entails the following responsibilities.
- (1) Review and approve MC&A Plans that conform to this Order and any additional direction provided by DOE line management. Confirm site compliance with the approved plans and periodically assess the effectiveness of the operators' programs against the metrics provided in Attachment 3 or documented alternative metrics.
 - (2) Detect anomalies indicative of unauthorized activities or diversion of nuclear material.

- c. Federal Staff at Government-Owned, Government-Operated Sites. If Federal staff are responsible for the operation of a site/facility possessing accountable nuclear materials, this operation entails the following responsibilities.
 - (1) Develop, implement, and maintain MC&A programs that conform to this Order and any additional direction provided by DOE line management.
 - (2) Identify MC&A responsibilities and authorities for each organization at the site/facility.
 - (3) Identify needed MC&A resources, supported by system assessment results, and submit budgets to the Secretarial Office for approval.
 - (4) Report MC&A program deficiencies, anomalous conditions, and incidents that potentially impact the protection of nuclear materials to the DOE line management in accordance with preapproved reportable timelines (MC&A Plan).
 - (5) Ensure completion of corrective action plans with root-cause analysis to resolve issues.
- d. The Office of Environment, Health, Safety and Security.
 - (1) Develops, after coordination with Secretarial Offices and field organizations, MC&A policies, standards and guidance affecting field organizations, DOE license-exempt contractors and subcontractors.
 - (2) Provides technical advice, analyses, and recommendations in developing international safeguards policies and procedures. In connection with international agreements, recommends corrective action to assure compliance with overall safeguards policies, procedures, and standards.
 - (3) In consultation with Secretarial Offices and field organizations, manages programs for providing required technology, equipment, and methodologies to improve MC&A.
 - (4) Develops and implements MC&A training courses at the National Training Center for DOE and contractor personnel.

6. REFERENCES.

References commonly used in the Safeguards and Security Program are located on the Policy Information Resource website <http://pir.doe.gov>

- a. DOE P 470.1A, *Safeguards and Security Program*, dated 12-29-10.
- b. DOE O 470.4B, Admin Chg 1, *Safeguards and Security Program*, dated 7-21-11.

- c. DOE O 473.3, *Protection Program Operations*, dated 6-29-11.
 - d. DOE O 205.1B, Chg 3, *Department of Energy Cyber Security Program*, dated 5-16-11.
 - e. DOE O 243.1B, Chg 1, *Records Management Program*, dated 7-08-13.
 - f. DOE O 410.1, *Central Technical Authority Responsibilities Regarding Nuclear Safety Requirements*, dated 8-28-07.
 - g. DOE O 410.2, Admin Chg 1, *Management of Nuclear Materials*, dated 8-17-09.
 - h. DOE O 470.3B, *Graded Security Protection (GSP) Policy*, dated 8-12-08.
 - i. DOE O 534.1B, *Accounting*, dated 1-6-03.
 - j. DOE-STD-1194-2011, CN 3, *Nuclear Material Control and Accountability*, dated June 2011.
 - k. Executive Order 12344, Naval Nuclear Propulsion Program.
 - l. P.L. 83-703, Atomic Energy Act of 1954, codified, as amended at 42 U.S.C. §§ 2011-2286i, 2297f-2297g-4.
 - m. Title 10 Code of Federal Regulations (CFR) Part 712, Human Reliability Program.
 - n. Title 41 CFR Subpart 109-1.53, Management of High Risk Personal Property.
 - o. Title 41 CFR Subpart 109, Department of Energy Property Management Regulations (DOEPMR).
 - p. Title XXXII of P.L. 106-65, National Nuclear Security Administration Act.
 - q. Title 10 CFR Part 830, Nuclear Safety Management.
 - r. Title 10 CFR Part 835, Occupational Radiation Protection.
 - s. C.W. Coates, B.L. Broadhead, A.M. Krichinsky, R.W. Leggett, M.B. Emmett, J.B. Hines, *Radiation Effects on Personnel Performance Capability and a Summary of Dose Levels for Spent Research Reactor Fuels*, ORNL/TM-2005/261, Oak Ridge National Laboratory (December 2005).
7. DEFINITIONS. Definitions of commonly used terms are provided in Attachment 4. Terms used in the DOE safeguards and security programs are defined and located on the Policy Information Resource website address of <http://pir.doe.gov>.

8. CONTACT. Questions concerning this Order should be directed to the Office of Security Policy, Office of Environment, Health, Safety and Security, at (301) 903-5122.

BY ORDER OF THE SECRETARY OF ENERGY:



DANIEL B. PONEMAN
Deputy Secretary

**CONTRACTOR REQUIREMENTS DOCUMENT DOE 474.2
NUCLEAR MATERIAL CONTROL AND ACCOUNTABILITY**

This Contractor Requirements Document (CRD) establishes the requirements for Department of Energy (DOE) contractors whose contracts included this CRD. The nuclear material control and accountability (MC&A) requirements in this CRD apply to any site management contractor that possesses or handles accountable nuclear materials.

Regardless of the performer of the work, the contractor is responsible for complying with the requirements of this CRD. The contractor is responsible for flowing down the requirements of this CRD to subcontractors at any tier to the extent necessary to ensure the contractor's or subcontractor's compliance with the requirements.

In addition to the requirements set forth in this CRD, contractors are responsible for complying with Attachments 2, 3, and 4 to DOE O 474.2 referenced in and made a part of this CRD and which provide(s) program requirements and/or information applicable to contracts in which this CRD is inserted.

All contractors with this CRD incorporated in their contracts must comply with the following requirements.

1. Contractor Site/Facility Operator. Contractors responsible for the management and/or operation of a site/facility possessing accountable nuclear materials must comply with the following requirements.
 - a. Develop, document, implement, and maintain an MC&A program that conforms to the DOE-Approved MC&A Plan and any additional direction provided by the DOE line management.
 - b. Identify MC&A responsibilities and authorities for each organization at the site/facility.
 - c. Identify needed MC&A resources, supported by system assessment results, and submit budgets to the DOE line management for approval.
 - d. Report MC&A program deficiencies, anomalous conditions, and incidents that potentially impact the protection of nuclear materials to the DOE line management in accordance with preapproved reportable timelines (MC&A Plan).
 - e. Develop corrective action plans with root-cause analysis to resolve issues.
2. The contractor site/facility operator must develop, implement and maintain a DOE approved MC&A plan that describes the MC&A program, including provisions for accurate nuclear material inventory information; controlling nuclear materials in order to deter, detect and respond to loss or misuse; providing timely and localized detection of unauthorized removals within specified limits; providing assurance that all nuclear materials are accounted for and that theft/diversion has not occurred; and protection

against radiological and/or toxicological sabotage involving nuclear materials that could adversely impact national security, the health and safety of employees, the public, or the environment.

3. The contractor's MC&A plan must comply with and support the conduct of the MC&A program/site office implementation instructions and requirements of the DOE -approved MC&A plan at sites under their cognizance. The contractor's MC&A program must meet the requirements listed below for each of the following MC&A program elements as determined by the DOE line management.

a. Program Management Objectives. The program—

- (1) ensures that documentation is sufficient to maintain a comprehensive, effective, and cost-efficient program to control and account for nuclear materials;
- (2) defines MC&A system elements with performance goals that reflect consequence of loss or misuse of the material managed by the program;
- (3) must be graded based on the consequence of loss and contain control and accounting mechanisms for nuclear materials;
- (4) establishes and maintains an evaluation program that monitors the effectiveness of the MC&A system;
- (5) responds effectively and efficiently to material loss indicators, anomalous conditions, and degradation of system performance; and
- (6) ensures the integration of MC&A with Safeguards and Security and other site programs.

b. Material Control Objectives

- (1) Detect, assess and deter unauthorized access to nuclear material.
- (2) Detect, assess and communicate alarms to response personnel in time to impede unauthorized use of nuclear material.
- (3) Provide loss detection capability for nuclear material and when not in its authorized location, be able to provide accurate information needed to assist in locating the material in a timely manner.
- (4) The material containment and surveillance program in conjunction with other security program elements must have the capability to detect, assess, and respond to unauthorized activities and anomalous conditions/events.

- (5) In coordination with security organizations, material control measures assure that appropriate protection and controls are applied to nuclear materials according to the quantity and attractiveness of the material.

c. Measurement Objectives.

- (1) The measurements program must provide measured values with uncertainties sufficient to detect theft or diversion of nuclear material.
- (2) The measurement controls program must assure the quality of measurements made for MC&A purposes.

d. Material Accounting Objectives.

- (1) Accurate records of nuclear materials on inventory are maintained, and transactions and adjustments are made in a timely manner.
- (2) The accounting system
 - (a) provides data and reports on nuclear material sufficient to support local, national, and international commitments.
 - (b) must accurately reflect the nuclear material inventory and have sufficient controls to ensure data integrity.
 - (c) provides data for reporting on accountable nuclear material to NMMSS.
 - (d) must use material balance areas as the basis of the accounting structure with key measurement points established to localize inventory differences.
 - (e) must provide a complete audit trail for all accountable nuclear material from receipt through disposition.

e. Physical Inventory Objectives

- (1) The physical inventory in conjunction with other MC&A elements assures that accountable nuclear materials are not missing.
- (2) The physical inventory program ensures that discrepancies between the physical inventory and the accounting records system are detected and resolved.

4. Reporting to NMMSS

- a. Contractors must report data for accountable nuclear material to the Nuclear Materials Management and Safeguards System (NMMSS) electronically. The

NMMSS User Guide provides detailed instructions on completing forms and submitting data to NMMSS, which can be found at: <http://www.nnsa.energy.gov/nmmss>, under Information, Reports, and Forms. If electronic means are unavailable, reporting using paper forms is permitted; however, it must be coordinated through the DOE line management. Under emergency conditions or if a special, non-standard report is required, paper forms may be used.

NOTE: In this CRD, paper forms and numbers [e.g., DOE/NRC Form 741, Nuclear Material Transaction Report] are mentioned for instructional purposes. The fact that a paper form is available does not relieve the facility from the requirement to report electronically.

- b. Ensure that when a reportable quantity of an accountable nuclear material is recovered during deactivation, decommissioning, or decontamination, the recovered material must be reported to NMMSS, even when the material has been previously written off the NMMSS records. DOE/NRC Form 741 must be used.

5. Termination of Safeguards.

Site/facilities requests to terminate regulatory control of nuclear materials must be reviewed by their Program Office DOE Line Management and the Office of Nuclear Materials Integration who will approve or disapprove the request. DOE may consider termination of safeguards on nuclear materials provided the following conditions are met.

- a. Determine that the nuclear material is of no programmatic value to DOE.
- b. Require that designated facilities and nuclear materials for safeguards termination are assigned the proper categorization and attractiveness levels according to Attachment 2 Table C, Graded Safeguards Table and Instructions for Using the Graded Safeguards Table.
- c. Meet the criteria for attractiveness level E. When termination of safeguards for attractiveness level D or higher special nuclear material (SNM) is requested, approval is received from the departmental element after consultation with the Office of Environment, Health, Safety and Security (AU). For National Nuclear Security Administration (NNSA) facilities, approval is received from the Associate Administrator for Defense Nuclear Security after consultation with AU.
- d. Require that when disposal of a Category II or greater quantity of SNM is being considered, DOE line management for both the shipping and receiving facilities must concur in a security analysis for theft or diversion of the material performed jointly by the shipping and receiving site/facility operators.

- e. Ensure that the nuclear material being written off the accounting record system will be written off as a transfer to decontamination and decommissioning (D&D) or a waste management reporting identification symbol (RIS).
 - f. Ensure that the nuclear material for which safeguards have been terminated is not co-located with accountable nuclear materials.
 - g. Ensure that the level of security specified by DOE line management as a condition of termination of safeguards is implemented effectively.
 - h. When the site/facility operator requests termination of safeguards for a nuclear material facility, the following must be done:
 - (1) DOE line management conducts a termination survey to ensure that no accountable nuclear material remains.
 - (2) Ensure that the only remaining material is waste or residual holdup that meets the definition of attractiveness level E.
 - (3) Ensure that nuclear material has been written off the accounting record system as a transfer to a waste management RIS or D&D organization RIS.
6. DEFINITION Definitions of commonly used terms are provided in Attachment 4. Terms used in the DOE safeguards and security programs are defined and located on the Policy Information Resource website address of <http://pir.doe.gov>.
7. Note: A violation of the provisions of this directive relating to the safeguarding or security of restricted data or other classified information may result in a civil penalty pursuant to subsection a of section 234(b) of the Atomic Energy Act of 1954 (42 U.S.C. §2282(b)). The procedures for the assessment of civil penalties are set forth in Title 10 Code of Federal Regulations (CFR) Part 824, "Procedural Rules for the Assessment of Civil Penalties for Classified Information Security Violations."
8. The contractor must submit a request for acceptance of SNM in foreign reactor fuel without measurement through DOE line management to be approved by the Under Secretary or his/her designee.
9. Where the contractor is required to submit a plan, procedure, or requirement to DOE line management for approval, the submission must be made in a timely manner and the contractor must not operate under the plan, procedure, or requirement until it has been approved by DOE line management.
10. The contractor must ensure that all the above provisions apply to subcontractors performing materials control and accountability functions.

CONTROL AND ACCOUNTABILITY FOR SPECIAL NUCLEAR MATERIALS

This Attachment provides information associated with DOE O 474.2 as well as information applicable to contracts in which the associated CRD (Attachment 1 to DOE O 474.2) is inserted.

Special nuclear materials (SNM) in this table must be controlled and accounted for in a graded manner consistent with the Graded Security Protection policy and Graded Safeguards Table.

Table A. Special Nuclear Materials **

Material Type	Reportable Quantity*	Weight Field Used for Element	Weight Field Used for Isotope	Material Type Code
Enriched Uranium	gram	total U	U-235	20
Uranium-233	gram	total U	U-233	70
Plutonium-242 ¹ (Pu)	gram	total Pu	Pu-242	40
Plutonium-239-241	gram	total Pu	Pu-239 + Pu-241	50
Plutonium-238 ²	tenth of a gram	total Pu	Pu-238	83
Uranium in Cascades	gram	total U	U-235	89

*Reportable quantity is the minimum amount of material subject to the requirements of this Order. Facilities with less than a reportable quantity of a material are exempt from the requirements of the Order for that material. Facilities with a reportable quantity of material that exceed a reporting unit or more of material are to report transactions and inventories to NMMSS. A reporting unit is the mass unit that site/facility accounting systems must use for reporting inventories and transactions.

¹Report as Pu-242 if the contained Pu-242 is 20 percent or greater of total plutonium by weight; otherwise, report as Pu-239-241.

²Report as Pu-238 if the contained Pu-238 is 10 percent or greater of total plutonium by weight; otherwise, report as Pu-239-241.

** Although classified as other accountable nuclear material, separated Am-241, separated Am-243, and separated Np-237 must be controlled and accounted for as SNM

Other Accountable Nuclear Materials in this list must be controlled and accounted for financial and materials management purposes and being protected in a graded manner consistent with their strategic and monetary importance.

Table B. Other Accountable Nuclear Materials

Material Type	Reportable Quantity*	Weight Field Used for Element	Weight Field Used for Isotope	Material Type Code
Depleted Uranium (U)	kilogram	total U	U-235	10
Normal Uranium	kilogram	total U	-	81
Americium-241 ⁴ (Am)	gram	total Am	Am-241	44
Americium-243 ⁴	gram	total Am	Am-243	45
Berkelium ³ (Bk)	microgram	-	Bk-249	47
Californium-252 (Cf)	microgram	-	Cf-252	48
Curium (Cm)	gram	total Cm	Cm-246	46
Deuterium ¹ (D)	tenth of a kilogram	D ₂ O	D ₂	86
Enriched Lithium (Li)	kilogram	total Li	Li-6	60
Neptunium-237 ⁴ (Np)	gram	total Np	-	82
Thorium (Th)	kilogram	total Th	-	88
Tritium ² (H-3)	gram	total H-3	-	87

*Reportable quantity is the minimum amount of material reportable to the Nuclear Materials Management and Safeguard System (NMMSS).

¹For deuterium in the form of heavy water, both the element and isotope weight fields will be used; otherwise, report isotope weight only.

²Tritium contained in water (H₂O or D₂O) used as a moderator in a nuclear reactor is not an accountable material.

³Berkelium must be accounted for at the site level. It is not required that it be reported to NMMSS.

⁴Americium and Np-237 contained in plutonium as part of the natural in-growth process are not required to be accounted for or reported until separated from the plutonium. If separated, these materials must be controlled and accounted for as SNM.

Table C. Graded Safeguards Table

	Attractiveness Level	Pu/U-233 Category (kg)				Contained U-235/Separated Np-237/Separated Am-241 and Am-243 Category (kg)				All E Materials Category IV
		I	II	III	IV ¹	I	II	III	IV ¹	
WEAPONS Assembled weapons and test devices	A	All	N/A	N/A	N/A	All	N/A	N/A	N/A	N/A
PURE PRODUCTS Pits, major components, button ingots, recastable metal, directly convertible materials	B	≥ 2	$\geq 0.4 < 2$	$\geq 0.2 < 0.4$	< 0.2	≥ 5	$\geq 1 < 5$	$\geq 0.4 < 1$	< 0.4	N/A
HIGH-GRADE MATERIALS Carbides, oxides, nitrates, solutions (≥ 25 g/L) etc.; fuel elements and assemblies; alloys and mixtures; UF ₄ or UF ₆ ($\geq 50\%$ enriched)	C	≥ 6	$\geq 2 < 6$	$\geq 0.4 < 2$	< 0.4	≥ 20	$\geq 6 < 20$	$\geq 2 < 6$	< 2	N/A
LOW-GRADE MATERIALS Solutions (1 to 25 g/L), process residues requiring extensive reprocessing; Pu-238 (except waste); UF ₄ or UF ₆ ($\geq 20\% < 50\%$ enriched)	D	N/A	≥ 16	$\geq 3 < 16$	< 3	N/A	≥ 50	$\geq 8 < 50$	< 8	N/A
ALL OTHER MATERIALS Highly irradiated ³ forms, solutions (< 1 g/L), compounds; uranium containing $< 20\%$ U-235 or $< 10\%$ U-233 ² (any form, any quantity)	E	N/A	N/A	N/A	Reportable Quantities	N/A	N/A	N/A	Reportable Quantities	Reportable Quantities

¹The lower limit for Category IV is equal to reportable quantities in this Order.²The total quantity of U-233 = (Contained U-233 + Contained U-235). The category is determined by using the Pu/U-233 side of this table.³In this Order “highly irradiated is defined in Attachment 4(Definitions).

USING THE GRADED SAFEGUARDS TABLE

The Graded Safeguards Table on the previous page must be used when determining the categorization and attractiveness level of accountable nuclear material.

Determination of category involves grouping materials by type, attractiveness level, and quantity. Material quantities are element weights for plutonium and isotope weights for uranium-235 (U-235) and uranium-233 (U-233). For the purposes of category determination, quantities of plutonium Material Type Code 40 and Material Type Code 50 are combined and considered as one material type. The Material Types can be found in Tables A and B. Directions for determining the material category when multiple material types and attractiveness levels must be considered are provided in the following paragraphs.

1. One Material Type, One Attractiveness Level. Sum the material in the attractiveness level and determine the category from Attachment 2, Table C, Graded Safeguards Table.
2. One Material Type, Multiple Attractiveness Levels (where a category III or greater quantity of B-level material is 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 Attachment 2, Table C-1, Effective Quantities.
 - c. Sum the effective amounts in attractiveness levels B and C.
 - d. Compare the total effective amount, as calculated in section 2.c. above, to the amounts in attractiveness level B from Attachment 2, Table C, Graded Safeguards Table.
 - e. Compare the amount of attractiveness level D to Attachment 2, Table C, Graded Safeguards Table.
 - f. The material category is the highest level of material category determined using the procedures in sections 2.a. through 2.d. or in section 2.e., (above).
3. One Material Type, Multiple Attractiveness Levels (where less than a category III quantity of B-level material is included).
 - a. Determine the amounts of SNM for all attractiveness levels.
 - b. Compare the total amounts in each level to those in Table C, Graded Safeguards.
 - c. The material category level is the highest level of the material categories determined using the procedures in sections 3.a. and 3.b.(above).

4. Multiple Material Types.

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

Table C-1. Effective Quantities

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

5. Roll-up

Roll-up is the accumulation of smaller quantities of SNM to a higher category, based upon Table C, Graded Safeguards. Unless it has been demonstrated by a vulnerability assessment that roll-up is not credible, SNM must be safeguarded and protected based on the total quantity of SNM for a location (e.g., MAA, PA, building, or group of buildings.)

NUCLEAR MATERIAL CONTROL AND ACCOUNTABILITY (MC&A) PERFORMANCE METRICS

This Attachment provides information associated with DOE O 474.2 as well as information applicable to contracts in which the associated CRD (Attachment 1 to DOE O 474.2) is inserted.

Listed in this attachment are performance metrics for an MC&A program that are listed by topical area and are to be used to evaluate the MC&A Plan. These MC&A performance metrics provide an acceptable method to evaluate an MC&A program during surveys and assessments. Alternative metrics that are documented in the MC&A Plan may be used to evaluate meeting the objectives of this Order.

Sites/offices approving the MC&A Plan should use the performance metrics to judge whether implementation of the plan will meet the required objectives. The MC&A Plan must accurately describe the implementation of these performance metrics. Sites/offices can elect to vary implementation by describing why any specific metric is not used or is not able to be met and document in the MC&A plan.

1. PROGRAM MANAGEMENT METRICS.

- a. The program management element of MC&A focuses on the scope and effectiveness of management relative to program planning, policy implementation, and program review to assure that a graded, cost-effective MC&A program is implemented.
- b. The graded safeguards concept is used to provide the greatest relative amount of control and accountability for the types and quantities of special nuclear material (SNM) that can be most effectively used in a nuclear explosive device.
- c. Plans/procedures are established that define operations for all MC&A program elements which includes the utilization of resources during implementation. The MC&A Plan provides the safeguards authorization basis for the site/facility operator.
- d. Configuration management of the MC&A Plan and associated procedures is maintained, and the MC&A Plan reflects current operating conditions.
- e. The MC&A Plan includes descriptions of all MC&A program elements.
- f. Key measurement points are established during design of facilities or process systems or changes to process lines, and documented in project documentation. Key measurement points are included in operational (process and transfer) procedures.
- g. The MC&A Plan describes the program objectives and how the objectives will be met. During review of the MC&A Plan, DOE line management evaluates the

effectiveness of program implementation in meeting the stated objectives by requesting and then reviewing performance tests.

- h. Management structure and assignment of duties and authorities are clearly defined.
- i. Persons responsible for each MC&A function have sufficient authority to effectively implement their responsibilities. An individual does not have sole authority to oversee, evaluate performance, or audit information for which he/she is responsible.
- j. The MC&A program is sufficiently independent of operations to ensure that accounting data and reports provided by operation organizations are complete and correct.
- k. Requirements for MC&A training are established to meet Department requirements and assure that personnel with MC&A functions are trained and knowledgeable of their duties and responsibilities.
- l. The level of resources and personnel necessary to maintain an effective MC&A program are identified, and are available to implement and maintain the program.
- m. Performance goals are established for each defined program element that, when met, clearly demonstrate that program objectives are met.
- n. The responsibility of each program element in deterring the loss or misuse of nuclear material is defined.
- o. The overall MC&A system effectiveness is evaluated using a methodology that considers each MC&A program element, its importance to overall system effectiveness, performance, and its interaction with other program elements.
- p. The effectiveness of each program element and the overall system is determined at a defined frequency, and evaluation of effectiveness uses objective performance criteria such as, risk assessments, performance testing results and evaluations of practice versus procedure.
- q. Internal review and assessment and performance testing programs are defined that have elements of schedule, comprehensiveness, conduct, evaluation, reporting, and follow-up. Performance testing of essential elements is addressed. Essential elements are defined at each site based upon mission, operations, and material.
- r. The MC&A program contains a formal process for responding to material loss indicators, anomalous conditions, and degradation of system performance.

- s. The MC&A program responds appropriately to off-normal events both during normal operating conditions and during performance tests.
- t. Potential or actual incidents or events of MC&A concern are appropriately reported.
- u. Characterization of MC&A in the security plan is accurate and validated.
- v. MC&A personnel validate key Vulnerability Assessment (VA) parameters affecting MC&A implementation.
- w. Deficiencies or anomalies identified in the MC&A program are reported to all affected organizations.
- x. Changes to site operations are evaluated for impact to MC&A programs prior to implementation.
- y. The MC&A program includes a provision for maintaining MC&A systems in fully operational status when needed, and includes documentation of maintenance, calibration and recalibration.
- z. The MC&A system provides a complete audit trail for all nuclear material from receipt through disposition. Records are maintained in compliance with DOE standards.

2. MATERIAL CONTROL METRICS.

An effective material control program element ensures that the use of nuclear materials are controlled and properly protected, that nuclear materials are not removed from an authorized location without approval, and there is timely detection of an unauthorized removal.

- a. Material balance areas (MBAs) are established so that an MBA does not cross a material access area (MAA) boundary unless alternative measures are described in the MC&A Plan, and the responsibility for all additions, removals, and inventory of nuclear materials is vested in an individual, the MBA custodian.
- b. Inter-MBA transfers of nuclear materials must be independently checked to assure that the transfer is authorized and that the material being transferred agrees with the accounting data.
- c. An MBA custodian, unless alternative measures are described in the MC&A Plan, must not be responsible for multiple MBAs when transfers of nuclear material occur between those MBAs (i.e., a single custodian must not serve as both shipper and receiver for material transfers for the same nuclear material).
- d. The site/facility operator can demonstrate that a loss of a Category I quantity will be detected within sufficient time to allow effective reporting and execution

of response measures, with 95 percent probability unless otherwise specified in the Security Plan (SP). (For example, the SP may describe other measures in place to mitigate the lack of detection capability).

- e. Losses must be localized to a specified area. The site/facility operator defines loss detection capability, including the probability of detecting the theft of a specified quantity within a specified timeframe, and justifies this approach in the security plan.
- f. Control measures are in place for nuclear material in use and in storage that deter, detect, assess and report loss or misuse. The control measures include defining the required communications.
- g. For Category II, III, and IV MBAs, the MC&A program routinely monitors the movement of SNM to prevent rollup from occurring outside appropriate security areas.
- h. Access to nuclear materials is limited to authorized individuals and authorized actions.
- i. The Graded Safeguards Table (Attachment 2, Table C) is used to categorize nuclear materials and their locations.
- j. Process differences and item losses or gains that exceed identified thresholds are detected and resolved.
- k. The mechanism for termination of safeguards is documented and implemented.
- l. Controls on nuclear material located within an MBA are only terminated when approved by the DOE line management.
- m. Nuclear materials for which safeguards have been terminated are not co-located with accountable nuclear materials, and are written off the books by a transfer to a waste reporting identification symbol (RIS). The waste organizations RIS is under the control of a waste management or decontamination and decommissioning (D&D) organization where the material is accounted for and protected in accordance with DOE waste management regulations.
- n. Until the DOE line management has approved termination of safeguards for a facility, the MC&A program is maintained at level commensurate with the category and attractiveness of the material deemed to have been present.
- o. When a facility uses tamper-indicating devices (TIDs) for MC&A purposes, they are procured, stored, distributed, and applied according to a documented program.

- p. When shipping nuclear material, an accountability value is established or a previously established accountability value is confirmed if the material has been contained in a vault under effective material surveillance measures.
- q. For external transfers, the shipper obtains written verification and maintains documentation that the intended receiver is authorized to accept the material before it is transferred.
- r. Shipper-receiver differences that involve item losses or gains or exceed identified thresholds are detected and resolved.
- s. Waste streams are monitored using methods capable of detecting diversion of SNM.

3. MEASUREMENTS METRICS.

The measurement program element provides quantitative and qualitative data about nuclear materials for accounting, inventories, and transfers. Measured values are essential for establishing category levels and determining protection requirements for nuclear materials.

- a. The quantity of all nuclear material types present on inventory is determined using identified measurement systems, measurement services, technically justified values or accepted shipper's values when approved by the DOE line management.
- b. Measurements and measurement uncertainties are determined and reported for each measured value using methodologies and statistical terminology accepted by voluntary consensus standards bodies. Other methodologies are only used with sufficient justification and approved in the MC&A plan.
- c. Sources of measurement error that are key contributors to the total measurement limit of error for a material balance period are identified and used to estimate systematic and random errors.
- d. The proper functioning of measurement systems is checked against standards before use in accordance with approved procedures.
- e. Key measurement points are established during construction of or changes to process lines, and documented in project documentation. Key measurement points are included in operational (process and transfer) procedures.
- f. The site/facility operator demonstrates that uncertainties remain applicable and are consistent with target values established by the site.
- g. Measurement methods are qualified, formally documented, periodically validated, and approved in the MC&A plan.

- h. Potential sources of sampling error for bulk measurements are identified and samples are representative of the materials being sampled. If sampling is required to establish accountability measurements, the program describes how the representativeness/homogeneity is determined and periodically tested or updated.
- i. Capability exists to confirm type and quantity of nuclear material present. For each type of nuclear material at the site, measurement methods are identified which are capable of confirming presence of nuclear materials and verifying nuclear material quantities. Nuclear materials not amenable to verification measurement must be identified and documented in the MC&A Plan.
- j. Measurements are traceable to the National Institute of Standards and Technology (NIST) or New Brunswick Laboratory (NBL) standards.
- k. Measurement systems are calibrated on a defined frequency, including the frequency and methodology for recertifying the measurement standards.
- l. The measurement program identifies target values for each MC&A measurement method, referencing national and international sources as applicable and defines the methodology, including frequency, by which uncertainties are compared to the target values and performance is assessed.
- m. A methodology exists for ensuring that measurement systems are in control when accountability measurements are made, and evidence exists that accounting values are established only when measurement systems are in control.
- n. A statistical control system exists that includes establishing control limits, determining out-of-control conditions, returning control to out-of-control measurement systems, and analyzing trends and outliers.
- o. The technical basis for the measurement and measurement control program is documented, and the documentation is either included or referenced in the MC&A Plan.

4. MATERIAL ACCOUNTING METRICS.

Nuclear material accounting encompasses the principles and practices of systematically recording, reporting, and interpreting nuclear material transactions and physical inventory data to assure that material is being used only for authorized purposes and the inventory of nuclear materials is consistent with (or conforms to) the inventory records.

- a. Shipments, receipts, transfers, changes in physical form, chemical/isotopic composition, location, and adjustments of the site nuclear material inventory are approved and accurately recorded and entered into the accounting system within a site-specific defined timeframe.

- b. At least one RIS is established for the site with an assigned nuclear material representative who is responsible for reporting data to NMMSS.
- c. Each site has established a set of MBAs. All accountable quantities of nuclear material at the site is assigned to an MBA unless safeguards have been terminated in accordance with safeguards termination requirements.
- d. Each MBA has an assigned MBA custodian and defined key measurement points for transfers and inventory that facilitate localization of inventory difference.
- e. Accounting system data is sufficiently accurate and timely to confirm that a planned movement of nuclear materials would not exceed the approved Category level.
- f. Inventory adjustments are calculated and evaluated according to a defined methodology.
- g. The accounting system provides continuity of knowledge for nuclear materials from receipt through disposition by maintaining an audit trail that includes documentation of transfers, adjustments, measurement results with measurement method, the identity of individuals making changes to the accounting system and the date and time such changes are made. Entries are fully supported by source documentation.
- h. Accounting and source records for physical inventory listings include item identification, material type, form, quantity with uncertainty, attractiveness, location, gross weight, net weight, isotope, element concentration and enrichment for nuclear materials in all MBAs, as appropriate for the types and quantities of material held at the site.
- i. The accuracy of the accounting system is determined annually using a statistically valid methodology and provides 95 percent confidence that there are no more than 1 percent errors.
- j. To meet emergency and special needs, the accounting system is capable of generating a book inventory listing for SNM within 3 hours and for all accountable nuclear materials within 24 hours.
- k. Data integrity is assured by backing up accountability data at a specified frequency and periodically testing disaster recovery capability.
- l. The accounting system provides detection capability for data falsification and unauthorized access to the accounting system and source documents
- m. Accounting information is sufficient for calculating shipper/receiver and inventory differences, evaluating their significance, and investigating and resolving significant differences.

- n. Data fields used in the nuclear material accounting system are consistent with Table A and B and provide information sufficient to comply with national and international reporting objectives. Instructions for reporting are contained in the *Nuclear Materials Management and Safeguards System (NMMSS) User Guide*.
- o. Nuclear material in transit at the end of a reporting period is included in the receiver's inventory.
- p. The inventory report or Material Balance Report (MBR) is submitted electronically at least annually to NMMSS, and no later than 15 calendar days after last day of the month. In lieu of submitting an MBR, the nuclear material representative requests an MBR (DOE/NRC Form 742) from NMMSS.
- q. Reconciliation of facility data with NMMSS data, including reconciling transaction submission to NMMSS after submission of September 30 inventory data, is completed no later than November 15th.
- r. The nuclear materials are accounted for using the units specified in Table A and B.

5. PHYSICAL INVENTORY METRICS.

Physical inventory are performed at the end of an accounting period to determine whether or not nuclear materials reported by the accounting system are present. The results of the physical inventory are used to adjust the accounting records to the quantities present at the beginning of the next accounting period.

- a. Unless an alternative inventory frequency is documented with supporting justification based on the effectiveness and timeliness of process and item monitoring, access controls, and material surveillance measures, the frequency for SNM inventories is:
 - (1) Every 60 days(calendar days) for Category I and II process MBAs
 - (2) Every 6 months for Category I and II non-processing MBAs
 - (3) Every two years (24 months) for Category III or IV MBAs
- b. Inventory of other accountable nuclear materials (in Table B) are conducted biennially at the RIS-level unless otherwise specified by the DOE line management.
- c. If statistical sampling is used to inventory areas involving activities other than processing to determine that items identified in the accounting records are present, the sampling plans specify the population, confidence level, minimum detectable defect, definition of a defect, and action to be taken if a defect is encountered.

- d. The inventory process is comprehensive and includes planning, preparation, conduct, and reconciliation.
- e. Nuclear material accounting records are appropriately adjusted to reflect actual locations and quantities determined by the physical inventory. All nuclear materials are assigned to the proper accounts.
- f. Measured values for SNM are assured or verified at the time of the physical inventory, unless technically defensible estimates are required for incomplete processing of items.
- g. The inventory program ensures that item integrity has not been compromised.
- h. The inventory program includes measurement of holdup or a determination that holdup quantities have not changed since the previous measurement.
- i. Inventory reconciliation is complete within 30 days from initiating the inventory taking, following receipt of all inventory information, measurement data, and sample analyses.
- j. Emergency or special inventories are conducted as needed to support detection of loss of nuclear material during emergency conditions and changes in custodial responsibilities, and as otherwise directed by DOE.
- k. Inventory difference is determined for nuclear material types by MBA.
- l. The uncertainty of the inventory difference is calculated and statistically significant inventory differences are investigated and resolved.
- m. Protracted theft or diversion is detected by analyses of cumulative inventory differences over multiple inventory periods.
- n. Simultaneous inventories of Category I and II MBAs must address the potential for an undetected site wide inventory difference.
- o. Potential substitution materials for SNM located in a Category I or II MBA are inventoried at the same frequency as the SNM.
- p. Category I and II items that are not tamper-indicating and are not in a storage MBA are measured at the time of inventory, unless other methods of inventory verification are approved and documented in the MC&A Plan for a specific item or type of item.

DEFINITIONS

This Attachment provides information associated with DOE O 474.2 as well as information applicable to contracts in which the associated CRD (Attachment 1 to DOE O 474.2) is inserted.

Central Technical Authority (CTA) is the Under Secretary for Energy, Science and the Principal Deputy Administrator for the National Nuclear Security Administration (NNSA) whom were designated to serve as the Department's CTAs with respect to the activities under their purview, as designated by the Secretary of Energy, April 26, 2005 memorandum. Responsibilities can be found in Department of Energy (DOE) Order (O) 410.1, Central Technical Authority Responsibilities Regarding Nuclear Safety Requirements, dated 8-28-07.

Accountable Nuclear Material for purposes of this Order refers to all nuclear materials that are accountable which are listed in Attachment 2, Tables A and B. These materials differ in protection strategy but are accountable at the sites and reported electronically to the Nuclear Materials Management and Safeguards System (NMMSS).

Documented in the Nuclear Materials Control and Accountability (MC&A) Plan encompasses both actual inclusion and inclusion by reference.

DOE line management refers to DOE and NNSA Federal employees who have been granted the authority to commit resources or direct the allocation of personnel or approve implementation plans and procedures in the accomplishment of specific work activities.

DOE Technical Standard-1194-2011, Nuclear Material Control and Accountability describes an approach for meeting the program performance objectives, metrics, and requirements in this order. It is intended to provide assistance in MC&A program planning and implementation, but is not mandatory unless specifically mandated by DOE line management through contracts or other line management.

Highly Irradiated is material sufficiently radioactive to ensure a high probability of failure of task(s) by an adversary. The determination of high probability of failure of task(s) must be coordinated with the sites risk assessment and/or other assessments performed by the site.

Line management refers to DOE and NNSA Federal and contractor employees who have been granted the authority to commit resources or direct the allocation of personnel or approve implementation plans and procedures in the accomplishment of specific work activities.

Other accountable nuclear materials for purposes of this Order, refers to nuclear materials other than SNM that are listed in Attachment 2 Table B, Other Accountable Nuclear Materials.

Recovered for purposes of this order is the term use for terminated material in an activity that does not result in returning the material to a different disposal site in which it is managed as terminated material.

Responsible Departmental element refers to the Departmental Element with responsibility for safeguards and security of the nuclear materials to which a requirement is being applied.

Site/facility operator refers to the corporate or governmental entity responsible for the day-to-day operations involving storage, processing, or use of nuclear material at the site/facility. For contractor-operated facilities, this refers to the site/facility contractor. For DOE-operated facilities, this refers to the DOE organization operating the facility.

Special nuclear materials are defined for this order as plutonium, uranium-233, uranium enriched in the isotope 235, and any other material which, pursuant to 42U.S.C. 2071, Determination of Other Material as Special Nuclear Material (Section 51, as amended, of the Atomic Energy Act of 1954), 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. These materials are listed in Attachment 2 Table A, Special Nuclear Materials.