Fermilab

Fermilab Nuclear Materials Control & Accountability

Implementation Plan

FNAL NMC&A-1

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A. Introduction and Purpose

The purpose of Fermilab's Nuclear Materials Control and Accountability (NMC&A) Program (Ref. 1) is to provide a reconciled nuclear materials inventory and an audit trail from receipt through disposition. Fermilab's Nuclear Materials Control and Accountability Program describes the structure and operation of Fermilab's nuclear materials accounting system, organizational responsibilities, nuclear materials inventory database, nuclear materials data flow and information process, reconciliation of nuclear materials inventory, nuclear material transactions and reports, physical inventories, access controls, internal audits, occurrence investigation, and reporting.

Chapter 2 of the Fermilab Site Security Plan (Ref. 2) describes the security and access controls associated with Fermilab's inventory of nuclear materials.

B. Nuclear Materials Program Description and Responsibilities

The majority of Fermilab's nuclear materials inventory consists of depleted uranium contained in the D Zero calorimeter and other D Zero prototype modules. This depleted uranium is in the form of metal plates. Both pure metal and uranium/niobium-alloyed plates are used in the D Zero hadron calorimeter and prototype modules. Fermilab also has several Americium-Beryllium (Am-241Be) and Californium-252 (Cf-252) sealed neutron sources. These neutron sources are used for instrument calibration and related studies. Fermilab has deuterium gas contained in cylinders and tanks. Fermilab has no reportable quantities of special nuclear materials (SNM).

Fermilab's Environment, Safety and Health (ES&H) Section is responsible for managing and operating the Nuclear Materials Control and Accountability Program. The ES&H Section reports to the Directorate. The Nuclear Materials Representative (NMR) and Nuclear Materials Representative Alternate are members of the Radiation Physics Team of the ES&H Section. Division/Section/Center (D/S/C) Heads are responsible for nuclear materials in use or storage within their areas.

Fermilab's Nuclear Materials Representative is responsible for maintaining accounting system records, nuclear material inventory databases, data input to Safeguards Management Software (SAMS), data submission to Nuclear Materials Management and Safeguards System (NMMSS), and completion of inventory reports. The NMR coordinates nuclear material physical inventories, on site transfers, transaction reports, material balance reports, forecast and inventory assessment reports, excess material declarations, inventory adjustments, updates to nuclear materials control and accountability procedures, and maintenance of nuclear materials logs.

The ES&H Section Radiation Protection Group Leader appoints the NMR, the NMR Alternate, and the Source Physicist.

Both the ES&H Section Radiation Protection Group Leader and the NMR sign material balance reports. The NMR or Alternate signs nuclear materials transaction reports.

Fermilab's deuterium inventory data is obtained from the Particle Physics Division

(PPD). The NMR or NMR Alternate maintains a file on all correspondence from Particle Physics Division regarding deuterium inventory. Deuterium pressure gauges are measured when deuterium is in use or when losses are suspected.

Radioactive and sealed neutron sources are contained in a radioactive source inventory database. The Source Physicist is responsible for maintaining and updating this database. The Source Physicist enters all new sealed sources into the inventory, deletes sealed sources to be disposed, updates loaned sources, returns, and transfers.

The depleted uranium inventory database contains data for each discrete item of depleted uranium. This database is updated whenever there is a receipt, shipment, or transfer of depleted uranium. Database additions, deletions, and changes are controlled by the system log-on password. Only persons authorized to make database entries have access to this password.

C. Hazard Evaluation

Nuclear materials at Fermilab are graded as Category IV, Attractiveness Level E as defined by relevant DOE Orders. Nuclear materials safeguards categories are outlined in DOE M 470.4-6, Table I-4, Graded Safeguards (Ref. 3). Graded Safeguards Category IV materials are considered to be the least hazardous type of nuclear materials. Likewise, attractiveness E materials are considered to be low grade.

DOE M 470.4-6, Nuclear Material Control and Accountability, sets forth requirements for control and accountability of nuclear materials. This DOE manual prescribes material types, material type codes, reportable quantities of nuclear material to be controlled and accounted for, data submission, and reporting requirements.

A hazard evaluation and a vulnerability assessment have been performed for nuclear materials at Fermilab. The hazard evaluation for depleted uranium is contained in Section VI of Fermilab Hazard Assessment (Ref. 4). The results of this evaluation indicate that buildings which house depleted uranium within a calorimeter are classified as low risk in accordance with DOE Order 5480.23, Change 1.

Fermilab Security Department conducted a vulnerability assessment (Ref. 5) for each building that contains hazardous materials (including nuclear materials). Americium-Beryllium (Am-241Be) and Californium-252 in the form of sealed neutron sources are stored at the Radiation Physics Calibration Facility (RPCF). These sources are stored in a locked concrete vault within a locked cave. The threat of material theft, loss, diversion, dispersion, or sabotage has been evaluated. To mitigate these threats, the RPCF has a lock and security intrusion alarm system that is under ES&H Section control.

Deuterium gas is stored in cylinders and tanks within locked areas at the Railhead. These areas have been evaluated in the same manner as other areas of the ES&H Section and were found to have no potential for sabotage. Even though accessibility to this area is low, the vulnerability assessment indicates a moderate threat to target susceptibility. To mitigate these threats, fences and gates are locked and razor wire is used to prevent entry.

If loss, theft, diversion, dispersion, or sabotage of material should occur, the investigation and reporting procedures listed in Fermilab's NMC&A Program are followed.

D. Personnel Training and Qualification

The National Training Center (NTC) has approved Fermilab's Safeguards and Security Training Program. As part of the NTC training approval process, Fermilab's scope and level of nuclear materials control and accountability training is tailored to the NMR and NMR Alternate's assigned duties and responsibilities. This training is based on an analysis of skills, prior experience, and training in nuclear materials control and accountability. A task analysis and training needs assessment is documented for Fermilab's nuclear materials program (Ref. 6). The training needs assessment identifies functions, responsibilities, and tasks performed by the NMR and NMR Alternate. The training is selected from self-study, on-the-job training (OJT), attendance at National Training Center courses, completion of NTC correspondence courses, and NTC computer based training. To ensure that all training objectives are met, a Training Approval Program (TAP) Self-Evaluation Checklist is documented per DOE Training Approval Program requirements.

Additionally, an on the job training (OJT) program for the NMR Alternate has been established. OJT for the NMR Alternate includes a review of completion of material balance reports and other pertinent reports, on site transfers, nuclear material transaction reports, and other training deemed necessary by the NMR. On the job training for the NMR Alternate is validated and documented on R.P. Form # 100 (Ref 7).

Training functions for the NMR and NMR Alternate are reviewed periodically. The NMR or NMR Alternate maintains training documentation.

E. Program Improvement Processes

The key measures used to evaluate Fermilab's nuclear materials control and accountability program improvement processes are timeliness, completeness and accuracy of reports, monitoring, access authorization, cost-effectiveness, and successful prevention of loss of nuclear materials.

Reporting errors are identified by Nuclear Materials Management and Safeguards System (NMMSS). Fermilab's materials accounting record system accurately reflects the item identity and material location in at least 99% of the cases.

The Nuclear Materials Representative updates the nuclear materials accounting procedures and Chapter 2 of the Fermilab Site Security Plan as needed to reflect program/policy changes or as requested. Revisions to these documents may reflect modifications to DOE orders or updates may be based on recommendations from DOE Chicago Operations Office, Safeguards and Security Services (CH SSS) reviews or self-assessments.

F. Documents, Records, and Reports

Fermilab Nuclear Materials Control and Accountability Program is the primary document which describes Fermilab's nuclear materials accountability and control policies. The Radioactive Sealed Source Control and Accountability Program (Ref. 8) is the document which describes control and accountability of radioactive sources, including sealed neutron sources. These documents are reviewed periodically and updated as needed to reflect program/policy changes.

Nuclear materials records and reports are completed and disseminated in accordance with DOE M 470.4-6, Nuclear Material Control and Accountability.

Nuclear materials records and reports are generated by the Nuclear Materials Representative or NMR Alternate and maintained in the ES&H Section files. Nuclear materials records are documented in the ES&H Section records inventory. The following is a description of some records and reports generated and maintained for Fermilab's nuclear materials program.

1. Forecast of Nuclear Materials Requirements Report

   The Nuclear Materials Representative or NMR Alternate prepares an Annual Forecast of Nuclear Materials Requirements Report for all existing, authorized, and contemplated research and development projects having or needing nuclear materials. The Forecast of Nuclear Material Requirements Report is completed in accordance with DOE Order 5660.1B, Chapter I (Ref. 9). This report is sent to DOE Fermi Site Office for transmittal to DOE CH SSS.

2. Review of Nuclear Materials Inventory Adjustments Report

   Fermilab's NMR or NMR Alternate conducts a review of inventory adjustments at the end of each fiscal year. The review is conducted in accordance with DOE M 470.4-6. The report is sent to DOE Fermi Site Office for transmittal to DOE CH SSS.

3. Annual Assessment of Nuclear Materials Inventory Report

   Fermilab's NMR prepares the Annual Assessment of Nuclear Materials Inventory (NMIA) Report for each project number. The assessment report is completed for all material types in accordance with a guidance document provided by the National Nuclear Security Administration (NNSA). This guidance document prescribes reporting requirements and these requirements may vary from year to year. The inventories assessed in this report are taken from the 9/30 Material Balance Reports. The NMIA Report is sent to DOE Fermi Site Office for transmittal to DOE CH SSS by 1/15 unless a different due date is specified via letter received from DOE Chicago Operations Office, Safeguards and Security Services.

4. Nuclear Material Transaction Reports (NRC/DOE Form 741)

   Nuclear Material Transaction Reports document shipments and receipts of nuclear materials. This report is completed in accordance with DOE M 470.4-6. Nuclear

Material Transaction Reports are sent to DOE Fermi Site Office for transmittal to DOE Chicago Operations Office, Safeguards and Security Services.

5. Nuclear Material Balance Reports (NRC/DOE Form 742)

   The NMR or NMR Alternate completes a quarterly Material Balance Report (MBR) in accordance with DOE M 470.4-6.The report is recorded on Nuclear Material Balance Report, DOE/NRC Form 742. This report is submitted to DOE Fermi Site Office for transmittal to DOE Chicago Operations Office, Safeguards and Security Services. Safeguards Management Software files are electronically submitted to NMMSS each quarter to reflect Fermilab's nuclear materials inventory.

6. Nuclear Materials Physical Inventory Report

   Each division/section/center that has nuclear materials under its control provides assistance to the Nuclear Materials Representative to complete the physical inventory verification.

   All nuclear materials contained in sealed neutron sources are physically inventoried and leak tested monthly by the ES&H Section Hazard Control Technology Team (HCTT). ES&H Section personnel compare the database inventory to the physical inventory for the above materials by correlating the source inventory number listed on the printout with the label attached to the neutron source. This inventory is recorded on the Sealed Neutron Source Physical Inventory Log, R.P. Form # 47 (Ref. 10). This report is forwarded to the NMR.

   The NMR or NMR Alternate is responsible for reconciliation of nuclear materials. Reconciliation is accomplished by making corrections to the radioactive source inventory database and/or the depleted uranium database.

   The Nuclear Materials Physical Inventory Report is completed and forwarded to DOE Fermi Site Office for transmittal to DOE Chicago Operations Office by March 15th of every year.

7. Non-Routine Nuclear Materials Physical Inventories

   In certain circumstances, Fermilab conducts non-routine physical inventories. Conditions requiring this kind of physical inventory may include a change in custodial responsibilities, apparent missing items, inventory differences, abnormal occurrence, or a breach or failure in Radiation Physics Calibration Facility (RPCF) security system. Additionally, non-routine physical inventories may be conducted at the request of authorized facility personnel or DOE office personnel.

G. Nuclear Materials Control and Accountability Work Processes

Procedures, forms, and types of reports for the work processes involved in Fermilab's nuclear materials program are described in Fermilab Nuclear Materials Control and Accountability Program document which can be found in the ES&H Section DocDB web page. The Nuclear Materials Representative maintains and updates this document

whenever new processes that reflect more efficient operation are put into effect. All of these processes have ES&H impact in that they provide for proper accountability, storage, and safe use of nuclear materials at Fermilab. This document is updated on an as needed basis to reflect program/policy changes.

H. Nuclear Materials Procurement

Fermilab's NMR coordinates procurement of nuclear materials. Nuclear materials receipt procedures are outlined in Fermilab's NMC&A Program (Ref. 1).

I. Nuclear Materials Access Controls, Transfer Checks, and Acceptance Criteria

Fermilab has implemented material access controls to ensure that only authorized personnel gain access to nuclear materials. Locked fences, doors, and padlocks control material access to depleted uranium and deuterium in storage. Depleted uranium contained in the D Zero calorimeter is sealed within stainless steel plates and is not accessible to personnel.

Sealed neutron sources are stored in a concrete vault located inside Cave 1 of the Radiation Physics Calibration Facility. Access to the neutron source storage vault is controlled by use of a combination lock. Only authorized persons are granted the combination to this lock. The NMR grants these authorizations. An intrusion alarm system is installed on the doors of the RPCF, which upon unauthorized entry, set off an alarm at the Communications Center. ES&H Section personnel perform a monthly security check of the security system that controls nuclear materials at the Radiation Physics Calibration Facility.

Data access control is used to prevent unauthorized access to nuclear materials control and accountability data. A log-on password is required to access nuclear materials inventory data. The NMR or NMR Alternate establishes and controls the log-on password. The radioactive source and depleted uranium databases are contained on the Fermilab network, which is backed up every evening during the workweek. This data can be obtained from the network system back up if necessary.

A transfer check is completed upon receipt of nuclear materials. A transfer check is a confirmation of shipping container or an item count. This item count is compared with shipping documentation to ensure that the shipment was received intact. If there is a discrepancy in the item count, a representative of the division/section/center receiving the material notifies the NMR or NMR Alternate to resolve the problem. If a discrepancy cannot be resolved, the NMR or NMR Alternate notifies DOE Fermi Site Office and DOE CH SSS to report a possible diversion of nuclear materials. Transfer checks, receipts, and shipments of nuclear and radioactive materials are documented on Record of Radioactive Material Receipts and Shipments, R.P. Form # 20 (Ref. 11).

Acceptance/Rejection criteria for resolution of nuclear materials receipts are based on verification of the inventory upon receipt of the material. If there is a discrepancy in the container or item count, the NMR or NMR Alternate notifies the shipper to resolve the problem. If a significant discrepancy cannot be resolved, Fermilab notifies DOE Fermi Site Office and DOE CH SSS to report the discrepancy.

J. Self-Assessments and External Reviews

Self-assessments of Fermilab's nuclear materials program are conducted biennially. Self-assessments include review of previous self-assessments, accounting procedures, nuclear material transaction reports, material balance reports, internal transfer records, and nuclear materials logs. The assessments are conducted by knowledgeable Fermilab representatives.

The DOE CH SSS conducts independent assessments of Fermilab's nuclear materials program when deemed necessary. Such appraisals assess compliance with DOE orders and policies.

K. List of References

1. Fermilab Nuclear Materials Control and Accountability Program (6/09 or current revision).

2. Fermilab Site Security Plan (11/08 or current revision).

3. DOE M 470.4-6, Nuclear Material Control and Accountability (Chg. 1, 8/14/06).

4. Fermilab Hazard Assessment (current revision).

5. Fermilab Security Department Vulnerability Assessment (current revision).

6. Fermilab Nuclear Materials Control and Accountability Program Task Analysis and Training Needs Assessment (6/09 or current revision).

7. Fermilab NMC&A Program On the Job Training Form, R.P. Form # 100 (4/08 or current revision).

8. Fermilab Radioactive Sealed Source Control and Accountability Program (6/09 or current revision).

9. DOE O 5660.1B, Management of Nuclear Materials (5/26/94).

10. Sealed Neutron Source Physical Inventory Log, R.P. Form # 47 (2/07 or current revision).

11. Record of Radioactive Material Receipts and Shipments, R.P. Form # 20 (11/07 or current revision).