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## **MANAGEMENT OF NUCLEAR MATERIALS IN A R&D ENVIRONMENT AT THE LOS ALAMOS NATIONAL LABORATORY**

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### **ABSTRACT**

Los Alamos National Laboratory is a multidisciplinary R&D organization and, as such, its nuclear materials inventory is diverse. Accordingly, major inventories of isotopes such as Pu-238, Pu-239, Pu-242, U-235, Th, tritium, and deuterium, and lesser amounts of isotopes of Am, Cm, Np and exotic isotopes such as berkelium must be managed in accordance with Department of Energy Orders and Laboratory policies. Los Alamos also acts as a national resource for many one-of-a-kind materials which are supplied to universities, industry, and other government agencies within the U.S. and throughout the world. Management of these materials requires effective interaction and communication with many nuclear materials custodians residing in over forty technical groups as well as effective interaction with numerous outside organizations. This paper discusses the role, philosophy, and organizational structure of Nuclear Materials Management at Los Alamos and also briefly presents results of two special nuclear materials management projects: 1- Revision of Item Description Codes for use in the Los Alamos nuclear material data base and 2- The recommendation of new economic discard limits for Pu-239.

### **INTRODUCTION AND OVERVIEW OF NUCLEAR MATERIALS MANAGEMENT AT LOS ALAMOS NATIONAL LABORATORY**

The major objective of Nuclear Materials Management (NMM) at Los Alamos is to maintain sufficient material to meet programmatic requirements while attempting to prevent oversupply or shortages that would build up inventories of no defined use material. Laboratory policy states that minimization of material holdings is a major goal when minimum inventories can be readily defined. Because Los Alamos is an R&D facility, material demands are highly variable and diverse. Effective planning is thus required to ensure that materials are readily obtainable for researchers while maintaining as small an on-site inventory as possible.

The manner in which nuclear materials are presently managed at Los Alamos is a function of 1) the genesis of nuclear materials management activities from materials accountability organizations; 2) the Laboratory's programs in nuclear materials; 3) the diversity of the Laboratory's nuclear facilities, users, and nuclear materials used in support of programs; 4) the wide range of DOE projects at Los Alamos; and 5) the Laboratory's complex organizational structure.

## **NUCLEAR MATERIAL PROGRAMS AND FACILITIES**

The nuclear material programs at Los Alamos comprise a broad range of activities including:

- Nuclear weapons research, development, and testing,
- Stockpile evaluation,
- Technology development and demonstration,
- Material processing and recovery,
- Technical support for DOE and its contractors,
- Weapons complex reconfiguration studies,
- Nuclear technology for energy systems,
- Actinide research,
- Facilities research, and
- Collateral functions.

This broad range of activities in turn requires Nuclear Materials Management interaction with most major DOE facilities: Rocky Flats Plant, Y-12 Plant, Pantex, INEL, Hanford, Savannah River Site, Lawrence Livermore National Laboratory, Oak Ridge National Laboratory, and Sandia National Laboratory. Interactions with non-DOE (NRC licensed) users such as universities; other U. S. Government agencies such as the U.S. Geological Survey, National Institute of Standards and Technology, Department of Defense (Air Force, Navy), and the National Institute of Health; state agencies (such as the Colorado Dept. of Health); and private corporations (such as Teledyne, Nuclear Metals) are also required of a multifaceted research organization such as the Los Alamos National Laboratory.

A number of nuclear facilities, including several Category I facilities, are available at Los Alamos to support the Laboratory's programs in nuclear materials. Some of these facilities are:

- Plutonium Processing Facility (TA-55),
- Tritium Systems Test Assembly (TA-21),
- CMR Building (TA-3),
- Tritium Handling Facility (TA-33),
- Weapons Engineering Tritium Facility (TA-16),
- Uranium Storage Facility (TA-3, Bldg 164),
- Main Storage Vault (TA-41),

- Waste Disposal Site (TA-54),
- Waste Treatment Plant (TA-50),
- Technical Shops (TA-3),
- Tritium Salt Facility (TA-21),
- Icehouse (TA-41),
- Size Reduction Facility (TA-50),
- Omega West Reactor (TA-2),
- Critical Experiment Facility (TA-18).

These facilities are used to handle a wide variety of isotopes including tritium, deuterium, lithium-6, americium-241 and -243, uranium (depleted, normal U-233, and highly enriched), plutonium (Pu-238, Pu-239, and Pu-242), berkelium, curium, neptunium-237, and thorium.

To demonstrate the complexity of the organizational structure and diversity of programs which utilize the above facilities and isotopes within Los Alamos National Laboratory, let's consider the Laboratory's uranium inventory. Management of the Laboratory's uranium inventory involves interaction with 40 nuclear materials custodians residing in 36 (line) technical groups. These groups cut across 16 different (line) technical divisions and 6 separate Laboratory Directorates. In addition, the uranium inventory is located at 19 different sites over a 40 square mile Laboratory site area. Similar number of interactions are required for managing the Laboratory's plutonium inventory as well as other actinide materials.

## **NUCLEAR MATERIALS MANAGEMENT STRUCTURE**

Figure 1 shows the present Nuclear Materials Management Structure at Los Alamos. The Nuclear Materials Program Director has the authority and responsibility for insuring that the Laboratory manages nuclear materials in accordance with the regulations, requirements and practices described in DOE Order 5660.1 (Ref 1). As such, a Program Manager for Nuclear Materials Management is appointed to the Program Office to accomplish this task. The reader should note that Nuclear Materials Management activities are distinctly separate from Materials Control and Accountability (MC&A) activities at the Laboratory. MC&A responsibilities and authorities reside with the Program Director for Safeguards Assurance and the Operational Security and Safeguards Division. The Program Director for Safeguards Assurance and the Leader of the Operational Security and Safeguards Division report to the Associate Director for Operations while the Program Director for Nuclear Materials Programs reports to the Associate Director for Chemistry and Materials. While these are two clearly distinct reporting lines of authority, both MC&A and NMM personnel must work closely with one another to ensure that all aspects of material management (from acquisition to

disposal) are properly and correctly provided for at the Laboratory.

At present, three Nuclear Materials Management Specialists are assigned to work for the Nuclear Materials Management Program Manager to help him with day-to-day materials management activities, data collection, management of no defined use material, inventory reduction activities, interfacing with Nuclear Materials Managers at DOE/AL and with the production plants, and to help him with reporting activities required by DOE Order 5660.1.

The Nuclear Materials Management Specialists also interface directly with the Nuclear Material Custodians and Users in the Nuclear Materials Technology Division (NMT), the Materials Science and Technology Division (MST), and in the Weapons Engineering Division (WX). These organizations comprise the largest set of nuclear materials users in the Laboratory. The NMT Division activities involve development of plutonium recovery and manufacturing technologies along with fabrication of parts in support of the nuclear weapons test program. The MST Division activities similarly involve technology development and parts fabrication for uranium in support of the weapons test program. Also, MST Division uses tritium and deuterium to support work in the fusion energy program. Similarly, WX Division work supports the weapons test program and is involved with handling plutonium, uranium, and tritium.

The Material Accountability Safeguards System data base (MASS) is used to manage the nuclear materials inventory. This data base is managed for the Laboratory by group OS-8 (Security and Safeguards Support). Assistance in answering questions concerning MC&A policy and the direct interface between NMM and MC&A personnel exist through group OS-2.

## **NUCLEAR MATERIALS MANAGEMENT POLICY**

The fundamental Laboratory policy with respect to Nuclear Materials Management is to minimize nuclear material holdings. Material demands for R&D projects are highly variable and require a wide variety of material types and specifications. If the fundamental policy cited above is to be implemented, reliable feedback from line organizations is required to identify realistic material needs and appropriate inventories. Researchers must have the confidence that material for research needs is available to meet changing R&D needs. Nuclear Material Managers must therefore work in close cooperation with the research line organizations and with DOE to ensure the availability of material as required by the R&D projects. Clearly

nuclear materials management involves human relations aspects of managing in order to ensure effective communication at all levels within the Laboratory, to communicate a commitment to excellence and leadership in materials management, to implement a "new culture" in accord with current materials management philosophy and goals, to ensure proper training and education of nuclear materials custodians, and to provide performance incentives in recognition of outstanding effort in managing inventories on a day-to-day basis.

### **LOS ALAMOS INTERACTIONS WITH THE DOE/ALBUQUERQUE OPERATIONS OFFICE**

The DOE Albuquerque Operations Office (DOE/AL) is attempting to develop and implement a plan to more efficiently manage nuclear material inventories for which they are responsible. This includes the Los Alamos nuclear material inventory. The DOE/AL Operations Office is attempting to make reporting consistent and timely with an easy to use and easy to understand format. The DOE/AL Operations Office approach involves providing contractors with detailed guidance based on DOE Order 5660.1. This guidance comes in the form of direct communication with the contractors and through the publication of a Materials Management Handbook. In addition, software is being developed to generate the yearly inventory assessment report. A PARADOX Forecast program was implemented this past year which Los Alamos found to be of major help in the Laboratory's attempt to prepare a timely and accurate materials forecast. The Laboratory strongly supports this effort by DOE/AL to assist its contractors in preparing consistent and accurate data bases of their nuclear material inventories. The goals of the DOE/AL nuclear materials managers are consistent and complimentary to those of Los Alamos managers; that is to modernize and streamline materials management functions so that material inventories can be more effectively managed.

### **SPECIAL PROJECTS**

Los Alamos Nuclear Material Managers are constantly striving to improve all operations associated with managing the Laboratory's nuclear inventories. Two projects associated with this goal were initiated during the past year and are worthy of note. The first involves a restructuring of the Laboratory's item description codes. The second involves studying Pu-239 discard limits in order to provide recommendations to DOE for new residue discard guidance.

## ITEM DESCRIPTION CODE

Item Description Code (IDES) are designed to describe items residing in the Laboratory's nuclear material inventory. Effective management of this inventory requires an IDES code on the MASS data base which is easy to use and understand by personnel doing the coding. The IDES code must also adequately describe the inventory item(s) so Nuclear Materials Managers can use the information to understand and evaluate the inventory in an accurate manner.

During the past year a team of Nuclear Materials Specialists from both MC&A and NMM was chartered to restructure the Laboratory's IDES code for the following reasons: 1- The codes as they existed allowed for too many coding inconsistencies and errors, 2- Too many choices (many not applicable) were available to the user, 3- There was no association of the IDESs with COEIs, and 4- Attractiveness levels needed to be incorporated in the IDES codes for each item in the nuclear material inventory.

The restructured IDES code consists of a four character alphanumeric field. The first character (called the Major Category Identifier) identifies the major category under which an item in the inventory belongs. There are eight separate categories plus two Special Designator categories from which to choose:

<u>Character</u>	<u>Category</u>
A	Assembly
C	Compound
G	Gas
K	Combustible
L	Liquid/Solution
M	Metal
N	Noncombustible
R	Process Residue
S	Shipper/Receiver Special Designator
Z	CLS Special Designator.

The category "Compound" refers to a material which is primarily an actinide element which is in the form of a chemical compound (e.g. PuO<sub>2</sub>, PuF<sub>4</sub>) while the Category "Process Residue" refers to a non-actinide chemical compound (e.g. Al<sub>2</sub>O<sub>3</sub>, ZrO<sub>2</sub>, MgO) which is contaminated with an actinide metal or an actinide chemical compound.

The second and third characters of the IDES code (called the Modifier) are in the form of a two digit integer. These integers provide further detail of the Major Category represented by the first character of the IDES code. For

example, the Modifier will provide information about the specific type of actinide compound (e.g. plutonium dioxide, americium oxide, uranium tetrafluoride, etc.) being referred to if the Major Category Identifier "C" is chosen. Another example using the Modifier involves the double zero (00) value called "Non-Specific/No Further Modifier Needed". This particular Modifier is only allowed for the Major Categories "A-Assembly", "K-Combustibles", "N-Noncombustible", and the two Special Designator Categories S and Z. Items in these particular Categories do not require further detail to adequately describe them so selection of the "00" Modifier is appropriate.

The fourth character in the IDES Code is called "The Detail". This character is used to identify some specific characteristic of an item such as a major contaminant, a major alloy, or some other detail the user wants to call attention to in describing the item. For example, one of the "Detail" options which is available for selection is zero, "0", "Nonspecific/No Further Detail Available". This detail is allowed only for the Major Categories "A", "K", "L", "N", "R", and the two Special Designator Categories. The remaining Major Detail Categories "C", "G", and "M" cannot use the "0" Detail but are limited to Details such as "High Purity", "Multiple Contaminants/See Remarks", or "Impure/No Major Contaminant".

When the full four digit alphanumeric IDES code is selected for an item, three additional pieces of information will automatically be provided for that item.

1. the appropriate COEL/ANSI code,
2. the appropriate Attractiveness Level, and
3. the item will be flagged if it contains hydrogenous material.

These features will insure consistency in assigning COEL/ANSI codes to items and will provide a mechanism for nuclear material custodians to be made aware of any potential criticality concerns involving hydrogenous items.

## **PLUTONIUM DISCARD LIMIT STUDY**

The Plutonium Discard Limit (PDL) study is a joint DOE/NM and DOE/MA effort between DOE and those DOE Laboratory and Production sites which have a specific mission involving the management of plutonium residues. The overall objective of this study is to revise guidance for plutonium residue discard and recovery decisions. The study team has recommended policy guidelines for use by the DOE Office of Defense Programs (DP) by establishing 1- A plutonium residue policy, and 2- A comprehensive plutonium residue management system.



Implementation of the plutonium residue management system will be broken into two phases. The first phase, which is currently in progress, will provide guidance for PDL decisions on plutonium for FY92. Activities during Phase II will be aimed at implementing the fullblown plutonium residue management system.

During the past few weeks Los Alamos National Laboratory (as well as other appropriate DOE facilities) has been actively evaluating the parameters associated with calculations of discard limits.(Ref 2.) In particular, the value of plutonium and the cost of waste management have been used as parameters to provide recommendations for discard of plutonium residues at Los Alamos. The results of this study are quite simple: The cost for waste handling and other associated costs (such as costs for handling RCRA or mixed hazardous wastes, and costs for both handling and transportation of waste to WIPP) are the dominant costs affecting whether a material is stored or recovered. The associated costs to recover the material are small compared to these waste handling costs. A comparison of the concentration of plutonium in the current (unprocessed) residues at Los Alamos with the calculated discard limits (using "educated guesses" as to the amount of waste generated after processing the original bulk residues) shows that most if not all of the Los Alamos residues are not economical to recover. Accordingly, the determining factor which will dictate disposition of these residues becomes either the WIPP waste acceptance criteria or discard/store guidance provided by DOE.

In conclusion, it should be pointed out that the results of these discard calculations are considered to be estimates and are preliminary in nature. They are intended to invoke further discussion of the issues surrounding the future of plutonium residues existing within the DP complex. Much more information concerning the relative costs of residue processing/recovery costs, costs to discard the residues as waste, and residue storage costs; waste generation during recovery; and the value of plutonium to the nation, must be obtained before any justifiable and defensible decision concerning discard policy can be established.

## **SUMMARY**

Los Alamos National Laboratory considers itself to be in the forefront of Nuclear Materials Management within the U. S. DOE complex. The Laboratory is fully supportive of the DOE/AL Operations Office program to streamline Nuclear Materials Management reporting requirements. It in turn is attempting to change long standing cultural attitudes concerning nuclear materials management, and is attempting to modernize Nuclear Materials Management

within its own organizational structure so that materials of national importance may be managed in accordance with the spirit and intent of DOE Order 5660.1 and DOE guidance.

#### **REFERENCES**

1. Management of Nuclear Materials. U.S. DOE Order 5660.1 (November 11, 1988).
2. L. E. Kusler, "Proposed Method for Calculating Economic Discard Limits for Weapons-Grade Plutonium". Report by the Economic Discard Limit Task Group for the Department of Energy Materials Management Executive Committee, U. S. Department of Energy, Office of Nuclear Materials Production document NMP-86-1 (January 1986).

#### **KEY WORDS**

**Nuclear Materials, Management, Materials Management**

# Nuclear Materials Management Structure Los Alamos National Laboratory

