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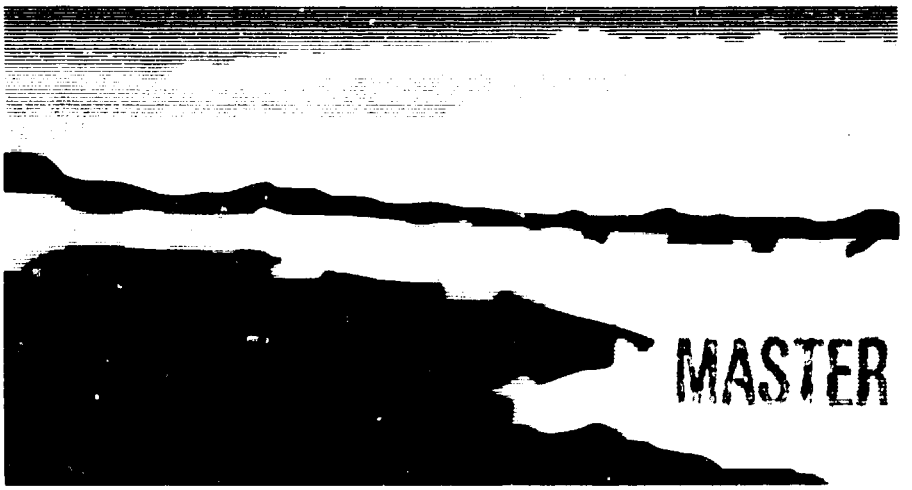

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THE USE OF MODERN DATABASES IN MANAGING NUCLEAR MATERIAL INVENTORIES

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ABSTRACT

The need for a useful nuclear materials database to assist in the management of nuclear materials within the Department of Energy (DOE) Weapons Complex is becoming significantly more important as the mission of the DOE Complex changes and both international safeguards and storage issues become drivers in determining how these materials are managed. A well designed nuclear material inventory database can provide the Nuclear Materials Manager with an essential cost effective tool for timely analysis and reporting of inventories. This paper discusses the use of databases as a management tool to meet increasing requirements for accurate and timely information on nuclear material inventories and related information. From the end user perspective, this paper discusses the rationale, philosophy, and technical requirements for an integrated database to meet the needs for a variety of users such as those working in the areas of Safeguards, Materials Control and Accountability (MC&A), Nuclear Materials Management, Waste Management, materials processing, packaging and inspection, and interim/long term storage.

INTRODUCTION

Over the past fifty years, the United States has either acquired or produced significant quantities of nuclear material, for purposes of research and development, nuclear power generation, and nuclear weapons production. Major quantities of plutonium and enriched uranium, having previously been under control by the Department of Defense as nuclear weapons components, are now being removed from dismantled weapons and will subsequently be stored until disposition plans are put in place for the ultimate use of this material. Furthermore, significant quantities of plutonium and uranium exist in various types of scrap and as waste as a result of the nuclear weapons production activities at the DOE Weapons Complex sites. Much of this material, currently in interim storage at the now idle production facilities, is not well characterized and will remain in storage for an indefinite period of time pending DOE strategic decisions on long term storage and ultimate disposition options.

The extent to which nuclear material was characterized and how much of that information was accumulated and stored for future use was defined in the past by nuclear weapons production schedules, weapon build requirements, material utilization, and production budgets. Since a major requirement for the DOE Weapons Complex sites was to meet nuclear weapon build schedules, little attention was given to characterization of the scrap, residue and waste generated as a result of the production activities. Furthermore, the DOE Weapons Complex sites were considered exempt from meeting Federal regulations concerning the generation, handling, storage, and remediation of wastes, The DOE sites were also considered exempt from meeting Federal environmental regulations. Thus outside of the need for an appropriate Safeguards-related data base there was no incentive (technical, legal, budgetary, or otherwise) for the DOE sites handling and processing

nuclear materials to invest in developing and maintaining a comprehensive database of nuclear material inventories and associated characteristics.

Weapons grade plutonium and uranium metal were constantly generated at Rocky Flats Plant and the Y-12 Plant respectively in order to meet weapon component production schedules. Part of the feed material for producing weapons grade metal was generated from recycled scrap which fed back into the production cycle. Now however, these production activities have ceased and lie idle within the United States. With dismantlement of major numbers of weapons in the nuclear stockpile, the DOE is now responsible for the management of more nuclear material than during any time in its history. Questions concerning the chemical stability and safety of stored scrap and weapons grade plutonium metal and plutonium oxide are now being asked with increasing frequency by both Federal and State Legislators, public activists, environmentalists, and by the DOE itself. Information in a readily usable form is not now available within the DOE to assist managers in providing accurate and timely answers to these questions.

A recent example of the compelling need for an informational database on nuclear material inventories, properties and characteristics associated with plutonium processing and storage, is the recent Vulnerability Assessment of all DOE sites and facilities which either use or store plutonium as requested by the Secretary of Energy. If a comprehensive database were currently available which contained a broad set of information on nuclear material inventories, the effort, cost, and time associated with this activity would have been decreased significantly, and the response time to the Secretary's request for information would have been shortened significantly.

Another example of how a comprehensive nuclear material database could be a cost effective tool to DOE managers involves the Defense Nuclear Facilities Safety Board[1] concern over the speed at which remediation of extant fissile material and other radioisotopes in spent fuel storage pools, reactor basins, reprocessing canyons, processing lines, and various buildings around the DOE Weapons Complex which were once used for processing and weapons fabrication. Detailed data on the characteristics of much of this material may either be lacking or inaccessible. This could cause costly delays in remediation activities as workers approach each situation with extreme caution in order to minimize the risk of accidents associated with handling of material which is not well characterized.

To briefly summarize the points of this section, I have attempted to illustrate that detailed information often is not readily available concerning the chemical characteristics and storage configurations of much of the nuclear material managed by the DOE. The root cause of this problem is due to the fact that "over the years, emphasis has been placed on ensuring that sufficient quantities of nuclear materials were produced and acquired to meet cold war requirements. Also, DOE has emphasized safeguarding nuclear materials inventories. Commensurate concern, however, was not given to ensuring that materials status was properly assessed and accurately reported."[2] Thus the availability of a complete and comprehensive nuclear material database, which could be readily accessed by the entire DOE Complex, would be of significant value in assisting DOE managers and cognizant site managers in making complex decisions concerning the effective management of the nuclear materials under their jurisdiction.

CURRENT NUCLEAR MATERIAL DATABASES

There is no single uniform database tool available today within the DOE Complex which provides sufficient detailed information on DOE's nuclear material inventories and which can be of timely assistance to the Nuclear Materials Manager in decision making situations.

The Nuclear Material Management Safeguards System (NMMSS), maintained under DOE/NRC auspices, is the only major centralized data base available to the DOE Complex which contains sufficient information to be utilized as a nuclear materials management tool.

The NMMSS database was designed for and has been used as a materials accounting data base for Safeguards and Security applications. Its intent was never to be used as a tool for providing detailed information on nuclear material inventory characteristics which are now being required by various organizations within the DOE. Since the NMMSS provides the only formal record of nuclear material quantities for the entire DOE Complex, Nuclear Materials Managers within DOE are compelled to rely on it to provide them with inventory information nation-wide. However, while information on inventory quantities and general types of material at a particular DOE site may be obtained from the NMMSS data base, details concerning the inventories are lacking and the DOE manager must then rely on an individual site for any ancillary information. Often requests from the DOE are made to the site Nuclear Materials Manager for an "analytical study". These requests are generally made with out any consideration of the cost incurred by the site in performing the study as compared to any benefit derived by performing the "study." Thus if a comprehensive nuclear material database were available to cognizant DOE managers, relevant data and information could be supplied to the DOE managers almost instantaneously for their timely evaluation and use in the decision making process.

In many respects, the NMMSS database is outmoded. One example of the dated nature of the NMMSS database is its reliance on Composition of Ending Inventory (COEI) codes to describe inventory items. The COEI codes are "production" focused codes and thus are outdated (with the possible exception of uranium COEIs). While apparently still of some use to DOE Nuclear Materials Managers, the COEIs appear to have limited utility to DOE site Nuclear Materials Manager. As such, each DOE site has derived its own internal item description codes as a replacement for the ineffectual COEIs.[3,4]

At present, this author also sees a limited application of the Local Area Network Material Accountability System (LANMAS) for use as a broad materials management tool. The LANMAS is a material accountability system based on advanced microcomputer hardware, software and network technology. The LANMAS will be used as the facility system for "tracking nuclear material inventories, documenting nuclear material transactions, issuing periodic reports, and assisting with the detection of unauthorized system access, data falsification, and material gains or losses and will satisfy NMMSS reporting and data submission requirements."[5] Based on the general LANMAS user requirements outlined in Reference 5, LANMAS is being designed to replace outdated accountability systems at DOE sites and "will duplicate the current functions of any existing automated accountability system as specified in DOE Order 5633.3A and Order 5633.5." Thus while it appears that LANMAS is being designed to be extendible, it is clear that Nuclear Materials Management interests for the DOE Complex are not being currently represented during the design and development of this system. Apparently reporting requirements of DOE Order 5660.1B, "Management of

Nuclear Materials," are not being considered in the initial LANMAS design.

At the Los Alamos National Laboratory, the Material Accountability and Safeguards System (MASS) was also designed as an operational nuclear material accounting system, not a materials management system. While Los Alamos Nuclear Materials Management is attempting to incorporate more detailed information on the MASS data base in an attempt to better describe the Laboratory's rather intricate nuclear material inventory, this system is still narrowly focused in its application as it provides a database for MC&A applications such as tracking inventories, documenting material transfers, and storing measurement control information.[6]

An example of a database which appears to provide sufficient useful data for broad materials management use and applications is that developed for radioactive wastes requiring long-term isolation.[7] This database is focused on light-water reactor (LWR) spent fuel and immobilized high-level waste as well as non-LWR spent fuel and miscellaneous wastes generated as a result of LWR operations and activities. For LWR spent fuel, the characteristic data is quite comprehensive with details concerning the fuel assembly, requirements for disassembly, detailed descriptions of the fuel rods, assembly hardware, inventory information, and fuel performance.

For high level waste (HLW), physical descriptions of canisters of immobilized HLW at West Valley, Savannah River, Hanford, and Idaho are provided. Chemical compositions for both immobilized forms and predecessor forms (i.e. interim forms) are provided by individual generator sites. A summary of canister properties and projected quantities expected to be produced are also provided. Curie content and thermal output of canisters are also provided in the data base.

FUTURE NUCLEAR MATERIAL DATABASE INFORMATION

Most of the DOE Defense Programs (DP) facilities involved with plutonium production and manufacturing now have a broad mission to act as interim plutonium storage facilities. Recent preliminary guidance from the DOE will require each site to have "a database to serve as a master list of relevant information for the stored plutonium materials."[8,9] Reference (8) specifies that the database should contain the following information:

- Identification of the material and form in the primary container, date and condition of the packaging, radiation field, and other pertinent information to the contents.
- Type of inspection test performed, including equipment used an individuals performing inspections, and the dates of inspection.
- Inspection results.
- Material characteristics including complete and precise information about the amount of plutonium material and form stored in the individual containers and relevant processing information to characterize the material stored. (This latter set of data should include information on impurities as well as information as to its solid and hazardous waste characteristics.)[10]
- Container information including ID codes, and container history.(date of packaging, packaging configuration, leak test results, periodic tests for integrity, storage history, etc.)

SUMMARY

There is one major problem associated with the current nuclear materials information available within the DOE: available information is limited. Where data does exist, it is considered in the narrow context of a specific application and manipulated to meet the application requirements (e.g. MC&A accounting). I believe that at the present time nuclear material data is not considered a resource to help the entire DOE meet its goals and responsibilities in managing its nuclear materials. The major consequence of this data philosophy is that data is not available to the decision making process around the entire DOE Complex.

Secondary problems associated with the current data management philosophy include the presence of both redundant and erroneous data. It must be understood that nuclear materials data is a resource to the entire Department and that it should be managed accordingly. This will then lead to better data integrity and availability and will allow the various organization within DOE to address changing needs within the Department and allow for better decision making. It should be recognized that the primary goal of data resource management is "to get the right data, to the right people, in the right place, at the right time, in the right form, at the right cost, so they can make the right decisions and take the right actions."(11)

With the decision to implement the LANMAS at DOE sites, an opportunity now exists to implement a correct nuclear materials data management philosophy within the DOE and at the DOE sites. This philosophy should change from the present one of managing data for specific applications (i.e. Safeguards) to a philosophy of managing a broad, DOE Complex-wide data base for use in a wide variety of applications. Thus all elements having responsibility for managing nuclear materials within the DOE should be directly involved in defining data base needs and requirements so that a truly universal data base system will be developed and implemented within the DOE for the twenty first century.

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