Contract No:

This document was prepared in conjunction with work accomplished under Contract No. 89303321CEM000080 with the U.S. Department of Energy (DOE) Office of Environmental Management (EM).

Disclaimer:

Recommendations for Best Practices in Inventory Management for DOE Facilities

Catherine Ramsey[1], Ashley Naughton[2], Cristy Abeyta[2], Calen Raulerson[1]

[1]Savannah River National Laboratory, [2]Los Alamos National Laboratory

Abstract:

The United States Department of Energy (DOE) sites are required to comply with DOE Order 410.2 which lays out requirements for the life-cycle management of DOE-owned and/or managed accountable nuclear materials. Individual sites are given the flexibility to determine how to integrate these requirements with their other site systems. In 2021 both Savannah River National Laboratory (SRNL) and Los Alamos National Laboratory (LANL) began independent evaluations to improve their local site programs for implementation. Site cooperation has led to documentation to fulfilling the role leading to successful knowledge transfer and increased efficiency.

Introduction:

Department of Energy (DOE) Order 410.2 [1] is the directive that establishes the requirements for lifecycle management of accountable nuclear materials owned or managed by DOE. It includes requirements in 5 main categories: Materials Forecast and Allotment Reporting (NMFAR), Nuclear Materials Management Plans (NMMP), Inventory Assessments, Inventory Management, and the National Strategic Plan for Management of DOE Nuclear Materials. It includes the responsibilities of Headquarters organizations, field offices, and contractors. The Contractor Requirements Document (CRD) attached to the order specifically defines the responsibilities of contractors awarded contracts involving the management of nuclear materials and they must fulfill those requirements as directed by the contracting officer including flowing the requirements down to subcontractors as required. This paper will focus on best practices identified for these contractors for implementing these requirements at the operating facility level that may be transferrable to other nuclear material processing facilities.

Requirements and Organizational Implementation:

The contractor requirements document articulates 18 different requirements for contractors to follow as directed by their contracting officer and field element. The most transferrable requirements to non-DOE facilities could be summarized as: submitting inventory reports as required including an annual Nuclear Material Inventory Assessment (NMIA), assigning project codes to nuclear materials to reflect ownership by programs, and completing a Nuclear Material Balance Spreadsheet (MBS), Nuclear Materials Forecast and Allotment Report (NMFAR) and Nuclear Materials Management Plan (NMMP). Many of these are performed on an annual cycle as shown in *Figure 1* and are directly dependent on each other to show a full picture of activities. In addition to the large required reports, the contractor also must designate a primary point of contact for nuclear materials management responsibilities, conduct and/or contribute to analytical

studies and plans, manage restricted use materials, and document and maintain characterization data. These responsibilities are diverse and require the primary point of contact to have extensive integration with multiple functions within the operating facility.

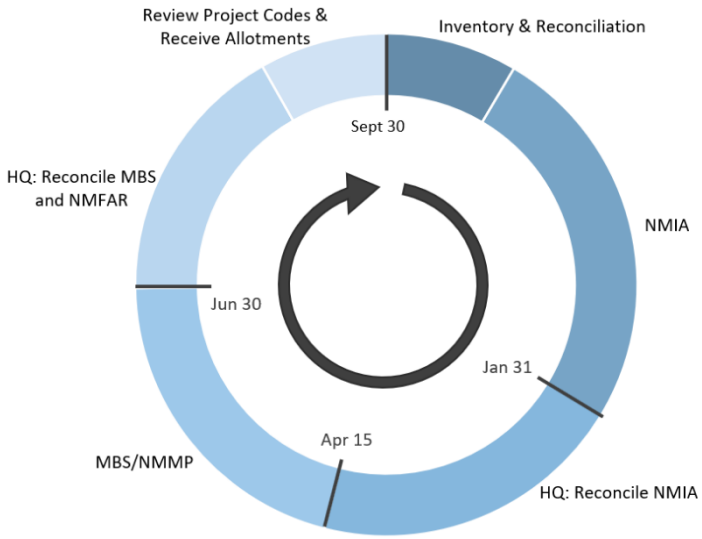

Figure 1:Nuclear Materials Management Annual Schedule

The extensive strategic integration aspect of these requirements mean that the most critical part of implementation is to establish a structure for roles and responsibilities related to the diverse tasks required as well as a system for providing those roles with the authority to execute those responsibilities. Reporting on the lifecycle of accountable nuclear materials requires broad coordination between all programs processing nuclear material as well as site services like material control and accountancy. The key to enabling this is to ensure that there is a clear procedure for formally naming the nuclear materials management point of contact, as well as ensuring that role has a unique title to provide clarity in other procedures where review, concurrence, or formal approval is required.

Another critical factor to consider is who the nuclear materials management point of contact should be and where they will be placed organizationally. The contractor requirements state that the primary point of contact must be a senior representative, but it should be a staff member directly overseeing the work performed rather than a figurehead in senior management. The position should be a single representative per site to meet the integration intent of the order rather than each contractor on a site providing separate unintegrated inputs for their programs that share a footprint and infrastructure with other contractors. The point of contact would then have access to key managers and program managers across sites and contractors as needed to solicit input to support the deliverables. Depending on the size and scale of the site and organization required to perform the functions this may be a member of management, or they may be a lower level like a program manager or technical team lead.

Many organizational structures were available for analysis due to the extensive history of reorganizations within DOE facilities over time. There is no single optimal organizational location due to the differences in facility missions and their resulting structures, but there are specific criteria that can be applied to identify an optimal location within an existing organizational structure. The optimal location within an organization should be neutral with respect to programs in multi-program sites and positioned to optimize the ability to contribute to analytical studies and plans. These two criteria ensure that the products produced are unbiased to any one program and

enable a greater ability to technically review integrated plans and provide recommendations beyond what would be typical in a compliance-based reporting organization.

Communication Strategies:

Facilitating integration between the various programs requires a targeted communication strategy to ensure that the needs and requirements are clear to involved parties. Creating a procedure is a good first step, but additional activities are needed to ensure that the procedure is properly communicated and utilized. There are multiple parts to a communication strategy of this scale, and it will be broken down into 3 parts: general communication, targeted communication, and requirement tracking.

General communication is the category of communication that is put out to communicate with everyone within the site/facility regardless of their job role. This type of communication should typically be indirect communication where possible to avoid wasting time and resources as opposed to direct communication that forces an interaction due to the diversity of the audience. A good best practice for all site services and functions that implement site-wide requirements is to have a website available from the broader facility intranet. This is a convenient and accessible location to act as a repository where everyone can access information they may need on-demand in the course of their duties. Some good examples would be information including the latest list of contacts, procedures, training, forms, and other reference materials. This acts as a consolidated place for directing everyone to as a first step that is easily accessible. The website can also be augmented by a team email that ensures that inquiries and requests don't get missed or dropped due to individual personnel changes or availability.

Targeted communication is the category of communication that is tailored to a specific audience that has a demonstrated need for specific pieces of information. This type of communication should include more direct communication strategies such as email or assigned training with the goal of actively providing information to a specific group of people instead of expecting them to find it on their own. A best practice for this kind of communication is integrating this information into other programs existing programs within the facility where possible. Examples would be things like adding a module to a required training for a specific kind of worker or providing notifications to material owners about upcoming reporting requirements. All these targeted communications should also be included on the previously recommended website so they are available on demand and are easy to find.

Requirement tracking is a subset of the targeted communication category that is specific to how to communicate and track requirements. Tracking requirements can be complicated when integrating input from multiple facilities and programs with short deadlines. It's critical to ensure that requirements and the current status are clearly communicated to prevent impacts to facility functions. Missing requirements in an operating facility could lead to lost operation time, fines, and other detrimental events. A best practice is to ensure that there are defined processes and timelines for each process that a nuclear material manager performs to ensure that it can be easily added and adequately managed in a facility schedule. Unanticipated requirements that require multiple approvals can have large facility impacts and lead to shipment or processing delays. One

way to do this is to have standard forms for things like discard requests along with standard schedule logic so facilities know what to expect and can easily integrate it into their standard tracking. It's also important to ensure that any reporting requirements for annual deliverables are integrated into facility schedules for tracking to maintain visibility and ensure accountability.

Inventory Organization Strategies:

The requirements for inventory reports including the annual NMIA for September 30th, fiscal year-end, inventories are crucially important for establishing the baseline for any analysis or program planning [2]. Many program plans use notional rounded values and do not utilize detailed modeling to account for measurement differences and process upsets that may occur throughout the year. Having a good mapping of programs and projects to the true inventory on an annual basis is critical to re-baseline programs to adjust for these perturbations that would otherwise accumulate over time. Common examples of perturbations that may occur in processing facilities may include decay, measurement differences, and processing losses due to process upsets or holdup. DOE Order 410.2 requires that materials be mapped to programs and owners to enable this function, but to truly add value to the analysis, additional detail is required to understand where materials are throughout the process to anticipate shortfalls and quantify liabilities.

If all material for a nuclear material processing program is in one grouping associated with that program, it meets the minimum requirements of the order and additional planning could be left to the program. The best practice would be to map the program's plan onto the inventory to show the current processing status by not just identifying items with program ownership, but breaking it into different groupings based on what part of the process it is in as shown in *Figure 2*. This allows for analyzing and validating the program plan to ensure that there is adequate feed

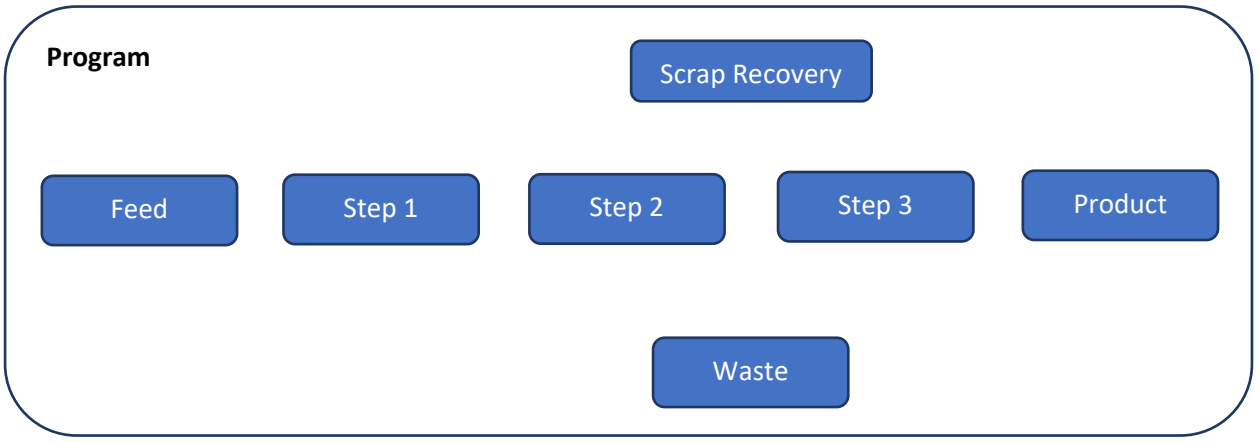

Figure 2: Inventory Grouping Example

material for the process, knowledge of how much material is in various process steps, and adequate product material produced in time to accommodate the estimated shipments. If the material is all in one category there is a risk that there would be inadequate notice of a production shortfall or capacity restriction because a full facility process validation is not being performed. The results of this analysis can then be fed back to the program or project to enable them to update their planning documents to match the latest inventory data as a rudimentary process model.

The additional granularity can also be useful to identify potential overlaps or gaps in programs. This is a big risk due to scope changes over time due to changes in resources, as well as to communicate about orphaned legacy materials that are outside of any current planning basis. The guidance only requires that items with no current disposition path be identified as such but organizing them into multiple groupings of similar materials allows for greater ease of communication with projects and programs for potential reuse or disposition of the materials in the future. By formalizing these groups and including the additional level of detail in these reporting documents, it better enables the products to communicate the needs to effectively utilize or disposition the materials.

Nuclear Materials Forecasting:

The organization of the inventory should be designed to set the stage for the annual Material Balance Spreadsheet (MBS) and Nuclear Materials Management Plan (NMMP) requirements [3]. These two documents work together to show changes to the nuclear material inventory over the next 15 years with the NMIA as the starting inventory baseline for all future activities. The MBS shows the exact quantities associated with each activity over time and is used to produce the Nuclear Materials Forecasting and Allotment Report (NMFAR) and a master shipping and receiving schedule.

This is where the operational plans get combined with the assessed inventory to show anticipated activities. The nuclear materials management organization should not be planning any of the activities for these materials, but should be directly referencing the existing plans that the program and project planning organizations are producing for their activities. The activities that are required to be included under the guidance are consumption, discard, loss, procurement, production, receipt, shipment, and changes in programmatic ownership [4].

When the transactions are mapped onto the previous inventory example, the added process steps are visible as shown in *Figure 3*. The black arrows leaving the box represent transactions required to be included in the guidance. The orange arrows show additional internal program movements that are integral to the process. Showing only the required transactions acting upon the total quantity of material in the program results in easily missed potential issues like a feed shortfall due to delays in scrap recovery, or a limiting issue in the production rate that causes product not to be available to meet the customer schedule. Adding the additional level of granularity of internal activities allows production rates and lag times to be adequately accounted for, as well as good documentation of the amount of feed material in lead storage to provide input into full facility models.

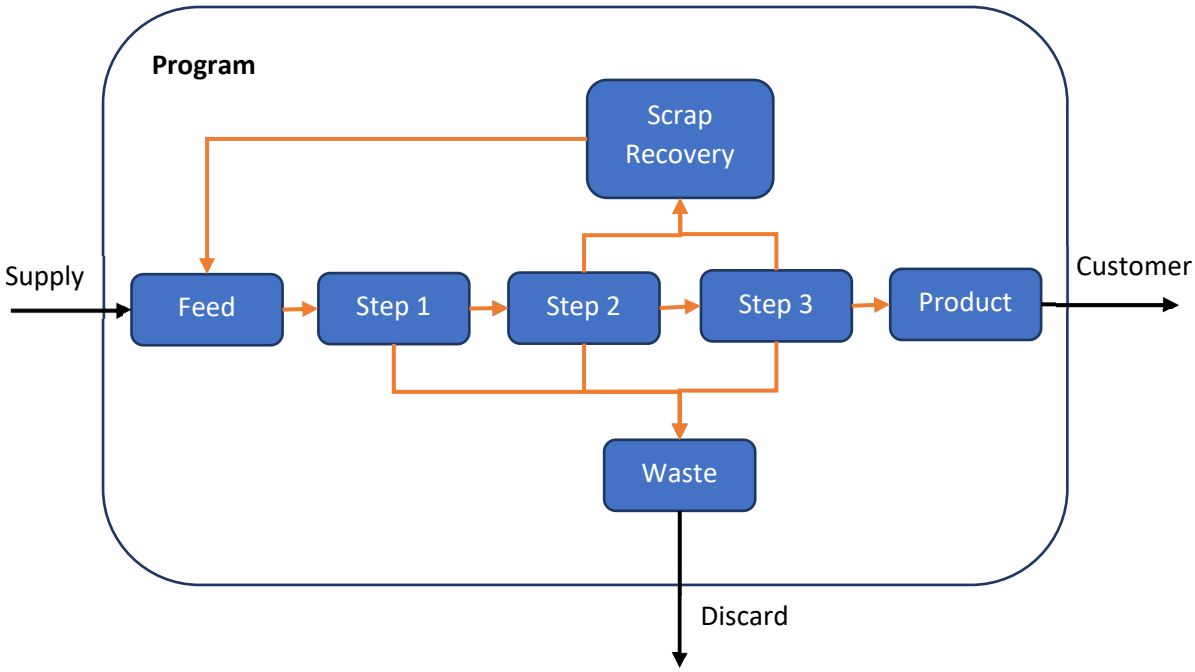

Figure 3: Nuclear Materials Forecasting Diagram

Conclusion:

Implementation of DOE order requirements for managing accountable nuclear materials inventories require a high level of coordination and integration. Establishing a single point of contact for coordination that has the authority to be able to request the necessary information and positioned to produce a quality product is critical to managing accountable nuclear material. Once authority is established, it's important to set up a robust system to communicate with all the programs and stakeholders to produce a quality product. The communication will include more general communication like a website as well as more direct contact with staff, programs, and facilities. With the bounds of communication established, the representative should organize the inventory to understand not just what material belongs to a program, but what part of the process the material is in to enable better planning for those programs. This allows for the materials forecasting process to better assist programs in understanding and projecting production rates and shortfalls. These actions combined enables sites to better communicate their activities with the local programs as well as headquarters officials to work toward more effective and efficient operations.

References:

[1] U.S. Department of Energy, National Nuclear Security Administration, *Management of Nuclear Materials,* 2014.

[2] U.S. Department of Energy, National Nuclear Security Administration, *Nuclear Materials Inventory Assessment (NMIA) Guidance for End-of-Fiscal-Year (EFY) 2022,* 2022.

[3] U.S. Department of Energy, National Nuclear Security Administration, *Site Nuclear Materials Management Plan (NMMP) Guidance for Fiscal Years 2023–2037.*

[4] U.S. Department of Energy, National Nuclear Security Administration, *Site Materials Balance Spreadsheet (MBS) Instructions for Fiscal Years 2023–2037,* 2023.