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Y-12 Integrated Materials Management System

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ABSTRACT

The Integrated Materials Management System, when fully implemented, will provide the Y-12 National Security Complex with advanced inventory information and analysis capabilities and enable effective assessment, forecasting and management of nuclear materials, critical non-nuclear materials, and certified supplies. These capabilities will facilitate future Y-12 stockpile management work, enhance interfaces to existing National Nuclear Security Administration (NNSA) corporate-level information systems, and enable interfaces to planned NNSA systems.

In the current national nuclear defense environment where, for example, weapons testing is not permitted, material managers need better, faster, more complete information about material properties and characteristics. They now must manage non-special nuclear material at the same high-level they have managed SNM, and information capabilities about both must be improved. The full automation and integration of business activities related to nuclear and non-nuclear materials that will be put into effect by the Integrated Materials Management System (IMMS) will significantly improve and streamline the process of providing vital information to Y-12 and NNSA managers. This overview looks at the kinds of information improvements targeted by the IMMS project, related issues, the proposed information architecture, and the progress to date in implementing the system.

INTRODUCTION

The Integrated Materials Management System is, more than a single system, a strategy for managing today's diverse material information needs amid dynamic missions. Activities for collecting and reporting material information are widely dispersed in Y-12, as are the sources for requesting this information from within the Nuclear Weapons Complex, NNSA, and the Department of Energy (DOE). Separate Y-12 organizations interact with various entities, both internal and external, to provide material information that is often similar to and sometimes overlapping other organization-specific information flows. A goal of the IMMS project is to coordinate these efforts within Y-12 and implement an integrated, cost-effective, whole-site solution.

The integration goals of IMMS are administrative as well as systems oriented. Administratively, the goal is to identify various information needs and integrate the efforts dealing with them and, in this way, minimize duplication and produce consistent data. The IMMS information architecture will integrate system functions and data where appropriate and cost effective but will also rely on interfacing data between separate systems.

The first phase of the IMMS project identified where information gaps and issues exist between what information is needed by program and operations managers and what information is currently readily available. The authors conducted a material information gap analysis[i] in 2001 (upon which this paper is based) to examine such gaps and issues. The implementation of systems and interfaces to address these gaps will be based on an information architecture founded on existing traditional material information systems. These traditional systems will be modified and new

systems developed and integrated with them, as appropriate, to expand and improve material information capabilities.

INFORMATION ISSUES

The IMMS addresses a number of issues that impede or restrict fully effective material information flow. For example, important data collection and information reporting activities are being independently performed in various organizations based on personal knowledge, personal networking, manual processing and, often, private spreadsheets and databases. While effective to an extent, significant time and effort are required to compile and manage data in this manner. Also, the ability to perform these functions is based in large part on the knowledge and experience of the few people (and, in some cases, single person) involved. The potential for losing related expertise through job attrition is high, especially at a site such as Y-12 where the average employee age is 47. Knowledge related to these activities should be captured and documented and the process should be automated, as appropriate, and integrated with IMMS.

Generally, the greatest impediment to providing information is the effort required in collecting data. Manual data entry is expensive and often unreliable. Technologies that reduce the amount of effort and time for capturing data, enable easy data capture away from workstations, and reduce the number of data errors provide the greatest potential for improving the amount and quality of information available for managing materials. Examples are direct scale input to workstations for capturing weight data and wireless bar code readers to capture location data. Y-12 contains thousands of containers of accountable material that require regular manual inventory assessments. Rapid and automated inventory technologies can reduce the high costs associated with physical inventories, reduce radiation exposure to personnel, and improve both productivity and security.

Some information gaps could be resolved by data currently captured electronically in an organization-specific database that's not available to legitimate users outside that organization or that may require additional information processing to be useful. Other vital data is captured and recorded in non-electronic formats that are not easily incorporated into reporting and decision-making processes. Improvements in these areas can be achieved through developing system and user interfaces or developing new integrated information systems, as appropriate.

INFORMATION IMPROVEMENTS

The material information systems that are currently in place at Y-12 provide production control, material accountability, laboratory analysis, and remote inventory monitoring. These core systems are essential for accomplishing site missions. However, there are other activities related to handling, processing, analyzing, or evaluating material inventories for which additional information capabilities can produce important results and cost-efficiencies. The areas of such information improvement currently targeted by IMMS are shown in Figure 1 and described below. Some of these improvements can be accomplished by enhancing existing information capabilities while some will require new information systems.

The material information needs of the site change often as it adapts to changing missions, directives, designs, etc. Consequently, the picture in Figure 1 will continually change. The system architecture supporting material management must, therefore, be designed with an appropriate level of adaptability in mind.

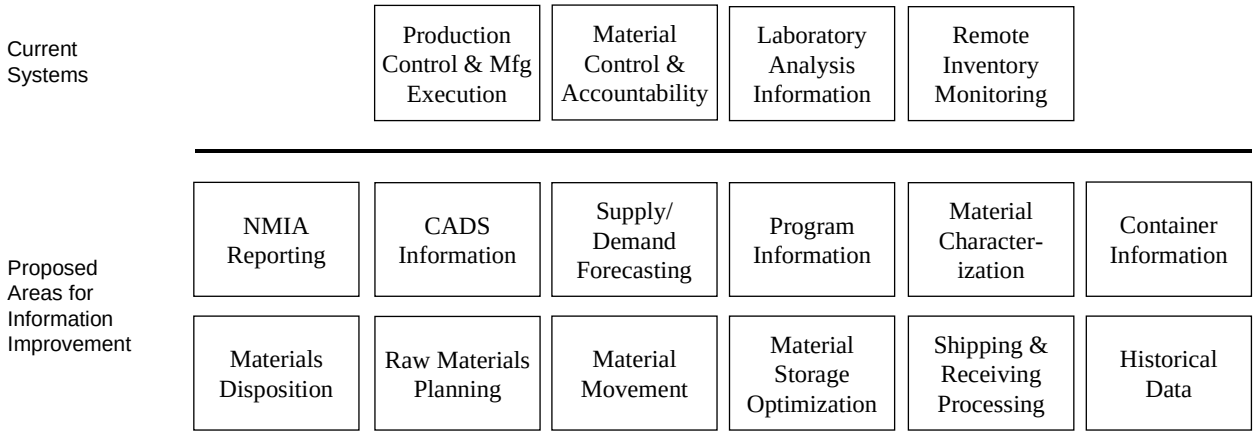

Figure 1. Material Information Improvement Areas

NMIA Reporting – Y-12 conducts an annual assessment of nuclear materials per guidelines provided by the NNSA Office of Defense Programs (DP). NMIA information is used by DP to respond to management queries, is part of DP's strategic plan for life cycle materials management, and is key to the revitalization of materials management in the weapons complex. At present, responding to the NMIA is a mostly manual process. The nature of NMIA reporting changed significantly in 1998, going from reporting summary information to reporting item level information. As a result, the amount of data and effort necessary to compile NMIA reports increased dramatically.

CADS Information - As part of the NMIA process, data is sent via sneaker-net from Y-12 to the NNSA Characterization Analysis Database (CADS). An electronic interface to CADS, if developed, would enable automatic transmission of Y-12 NMIA data to the CADS database as well as enable local material managers, armed with information about material at other sites being shipped to Y-12, to better plan for deliveries.

Supply/Demand Forecasting - The assessment, forecasting, and planning activities for nuclear materials is largely a manual process that requires significant effort and relies on individual knowledge and expertise. Automation of these functions can reduce effort hours and costs, enhance material forecasting capabilities, improve forecasting data, and reduce reliance on individual expertise. To this end, DP is sponsoring the development of a corporate-level advanced inventory information and analysis system that utilizes site forecasting systems and site data to predict and manage the supply/demand of nuclear materials and critical non-nuclear materials.

Nuclear Materials Management - A number of improvements can benefit nuclear material managers in general. Y-12, for example, receives ad hoc requests from NNSA and other entities to provide certain kinds of material information summarized by weapons **program**, information that currently is not always readily available and requires extensive manual effort to compile. The kinds of program information requests vary widely. Material managers need improved information about **material characterization**, i.e. data about the chemical and physical properties of material.

Such information will, for example, support decisions based on the availability of materials suited for specific programs. Much of this data is captured, but not necessarily in an electronic format or in an electronic format that's readily usable. More information about **containers** used for nuclear materials can facilitate handling and storage of material. This might include information about types of containers and kinds of packaging. Information at the item level about the **disposition path** of materials can show commitments made on the inventory and provide vital information about short and long-term material availability.

Raw Materials Planning – Certain supply materials that are not nuclear or critical are nonetheless essential for manufacturing operations. Manufacturing activities would stop without them. Some of these materials require vendor certification and/or have long order-delivery lead times, so they must be well managed. The inventory of certified supplies is currently being administered through a largely manual process that relies on personal knowledge and personal networking. An automated system that would track inventory levels, project consumption rates, maintain a qualified vendors list, track vendor compliance, maintain material specifications, trigger new orders, etc. would significantly improve this process and help assure uninterrupted service.

Material Movement - Considerable effort is currently expended to manually plan, verify, and track material movement and assure that these moves comply with procedural and safety regulations. Automation can reduce this effort and reduce human error associated with these processes. An automated system can monitor, compare, and confirm the authorized type and quantity of materials that may reside in a facility or location, as well as produce the documentation that must accompany these moves. The use of technologies such as wireless barcode terminals offer an interface to operators which can streamline data input, reduce human error, and provide real-time feedback regarding the appropriateness of a move.

Material Storage Optimization - The need to make efficient use of storage space at Y-12 is magnified by an increase in the amount of material being stored there coupled with the implementation of a cost-saving strategy to decrease the footprint of the site. Software tools are needed to optimize storage density while planning for facility consolidation.

Shipping and Receiving Processing - As materials are received into or shipped from the site, manual inspection and shipment/receipt transaction data are entered into the Shop Floor Control (SFC) system and other pertinent facility information systems. These inspections involve visual comparisons of the shipping records with the receiving records and a decision as to whether or not the paperwork is in order. Advances in bar code technology, voice recognition, and optical character recognition enable attractive alternatives to the kind of manual data processing currently being performed.

Historical Data - Y-12 does not have a single electronic source of historical information about weapons materials. Much of this information is maintained in separate site system databases such as SFC and DYMCAS (the Y-12 material accountability system), some information is kept in organizational-specific databases, and some is contained only in hardcopy files. As historical weapons information is needed, multiple databases must be electronically searched and in many cases hardcopy files must be manually searched. A modern data warehouse containing data about all facets of Y-12 weapons processing can expedite and improve historical retrieval.

IMMS IMPLEMENTATION

Various organizations are involved in implementing parts of the information improvement areas described above on what is now a limited budget. Much of the progress is in preliminary stages of development, although one area is at a fairly advanced stage. The NMIA data gathering function will be automated this year. A majority of NMIA data reported by Y-12 is extracted from DYMCAS (Dynamic Special Nuclear Materials Control and Accountability System). In the past, this was for the most part a manual process. This year, an NMIA interface was implemented that enables nuclear material managers to automatically pull data from DYMCAS into separate NMIA database tables. A second phase is nearing completion that will automate the annotation of non-DYMCAS derived data. Business rules once contained in the heads of NMIA experts are now, for the most part, captured and documented in the system. Additional NMIA data that is not now reported by Y-12 may be added as other information capabilities are developed.

Y-12 is working in cooperation with Sandia National Laboratory (SNL) personnel to develop a Supply-Demand Forecasting system. SNL is developing models, based on information sessions with Y-12, for forecasting supply-demand trends of highly enriched uranium, lithium, and depleted uranium. SNL is also working with other sites, developing similar models for other kinds of materials that will eventually be incorporated into a corporate-level comprehensive forecasting system, the Integrated Inventory Information Management System (IIIMS). This year, Y-12 is developing an interface to DYMCAS to extract data to test the HEU forecasting model and is designing a user interface to the site-level forecasting system. Plans are to eventually develop a fully functional site-level forecasting system that will support Y-12 material projections as well as feed the IIIMS.

In other areas, initial program reporting capability has been developed using data out of SFC and DYMCAS; a study is underway to identify the most beneficial improvement opportunities related to material characterization information; another study is conducting a knowledge download from an expert responsible for managing certified supply materials in preparation for automating that important function; and improvements are being made to SFC and DYMCAS to provide better container information.

The information architecture designed to implement IMMS is founded on existing traditional material information systems. Y-12 has several systems that, for the most part, have been in place for decades supporting traditional cold-war missions. These are depicted in Figure 2. Shop Floor Control (SFC) is the Y-12 production control and manufacturing execution system. It provides manufacturing plans that define specific operations and routes for material products, schedules and tracks parts through manufacturing steps, and captures data as parts are processed.
SFC supports all major manufacturing and storage areas and is capable of tracking nuclear materials, critical non-nuclear materials, and certified supplies. Operators enter transactions into SFC to support manufacturing execution as well as material accountability.

The Dynamic Special Nuclear Material Control and Accountability System (DYMCAS) is Y-12's official material control and accountability system. DYMCAS is used to assist in preventing or detecting loss of nuclear material through theft, diversion, or error; to assure rapid reconciliation of nuclear material inventories; and to facilitate timely notification and reporting of nuclear material

shipments and receipts to and from Y-12. It is integrated with the SFC system in that accountability transactions processed by DYMCAS are collected through the SFC system from operators and material handlers located throughout nuclear material processing and storage areas.

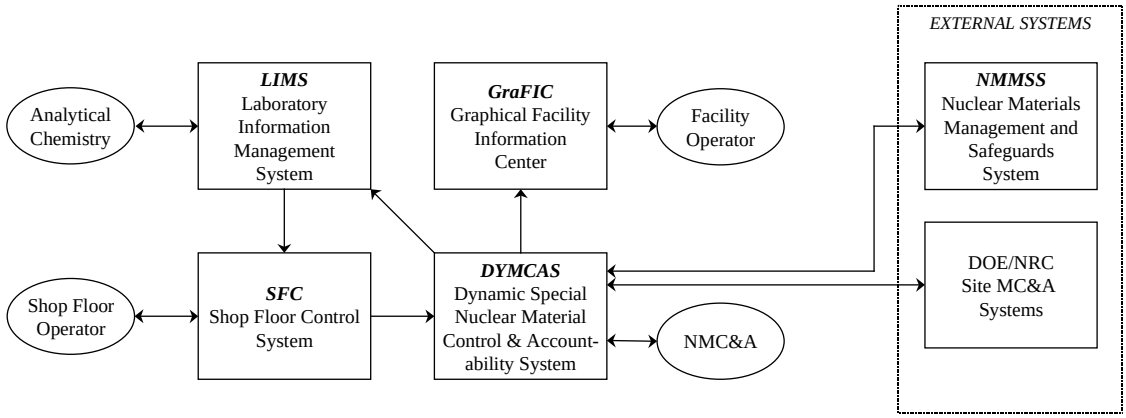

Figure 2. Current Systems

The Laboratory Information System provides support for Y-12's Analytical Chemistry organization in performing physical and chemical measurements of samples submitted to the laboratory for weapons parts certification, SNM inventories, production process control, development, and environmental compliance. The Graphical Facility Information Center (GraFIC) system provides an inexpensive and flexible method of remotely verifying a complete "up-to-the-minute" inventory status of stored items and facility assets. GraFIC also provides several features that assist in facility management, such as space planning and the association of documents, pictures, and other information to assets or geographical locations. GraFIC, unlike the three above, is a relatively new system.

These traditional systems contain a vast amount of material data, however access to them is restricted and data views are sometimes insufficient for users outside the primary business focus areas. Figure 3 depicts a functional perspective of the proposed, fully implemented IMMS information architecture. This architecture will open up access to information stored in traditional systems to new users in different business areas and add capabilities to adapt or augment traditional data to serve different information needs.

In this model, consumption information about certified supplies, collected in SFC, is processed by the Raw Materials Planning system to activate respective material orders, enabling procurement engineers to effectively manage this function. Supply and Demand information from SFC and DYMCAS feed the Y-12 Supply/Demand Forecasting function, which in turn feeds the corporate level Integrated Inventory Information Management System (IIIMS). Forecasting is thereby performed consistently at the site and corporate level.

Various nuclear material management capabilities are fed by DYMCAS to facilitate that work. These provide characterization data, program reporting, materials disposition data, and others as new needs arise. Finally, DYMCAS feeds the Nuclear Materials Inventory Assessment function,

which provides annual item-level inventory reports to the NNSA NMIA system and characterization data to the NNSA CADS system. Nuclear material managers access the corporate CADS database to plan Y-12 shipment returns.

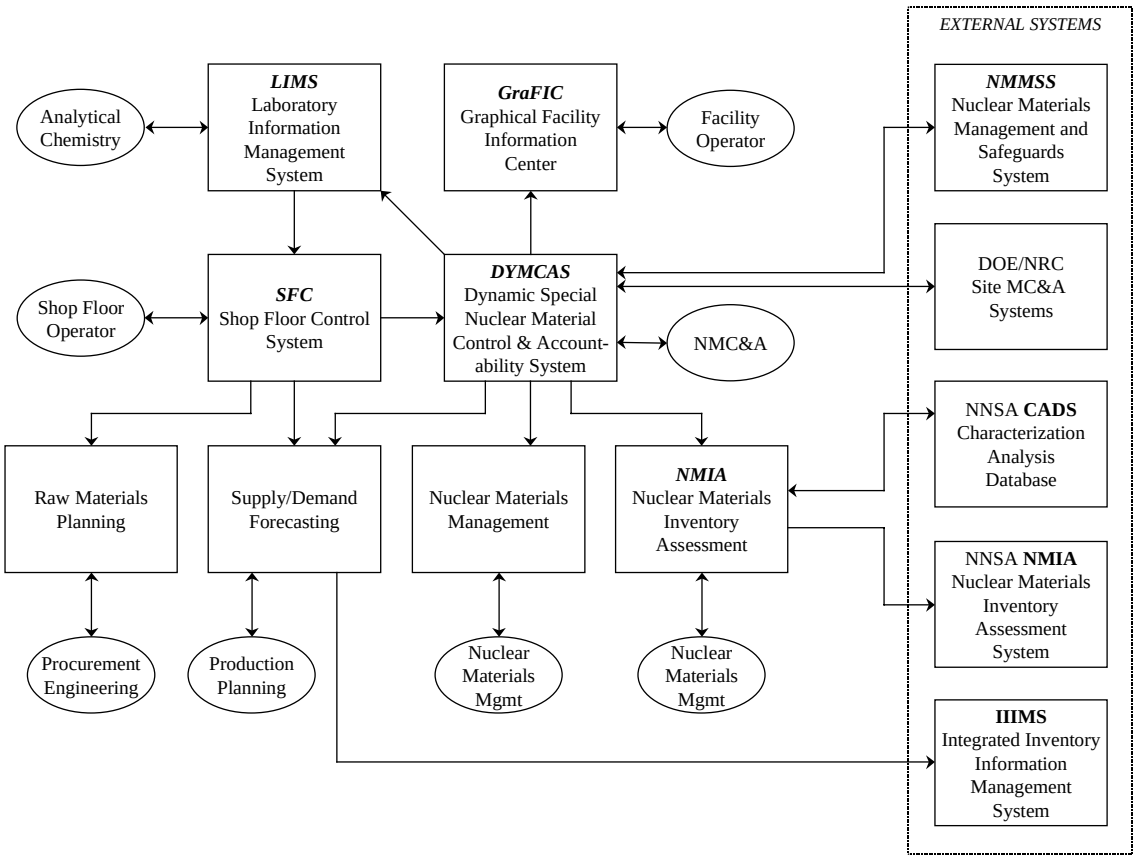

Figure 3. Proposed Y-12 Integrated Material Management System

CONCLUSION

Initial progress has been made toward developing the Integrated Material Management System and improving material information at Y-12. As more attention is focused on this area from NNSA and DOE and as future funding is forthcoming, important capabilities can be added that will provide the site and headquarters with vital material information and related analysis tools to enable managers to effectively assess, forecast and manage material inventories. By this process, the material information systems and functions will be managed and developed to the extent practical by an integrated, whole-site approach that will produce consistent information in a cost-effective manner.

[i] David Alspaugh, Tim Hickerson, "Proposed Architecture for Y-12 Integrated Materials Management System", September 2001, BWXT Y-12 National Security Complex, Y/DW-1861