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"Los Alamos Plutonium Facility Waste Management System"

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ABSTRACT

This paper describes the new computer-based transuranic (TRU) Waste Management System (WMS) being implemented at the Plutonium Facility at Los Alamos National Laboratory (LANL). The Waste Management System is a distributed computer processing system stored in a Sybase database and accessed by a graphical user interface (GUI) written in Omnis7. It resides on the local area network at the Plutonium Facility and is accessible by authorized TRU waste originators, count room personnel, radiation protection technicians (RPTs), quality assurance personnel, and waste management personnel for data input and verification. Future goals include bringing outside groups like the LANL Waste Management Facility on-line to participate in this streamlined system. The WMS is changing the TRU paper trail into a computer trail, saving time and eliminating errors and inconsistencies in the process.

INTRODUCTION

The Nuclear Materials Technology (NMT) Division as the landlord of the Los Alamos Plutonium Facility has recognized for many years that cradle to grave tracking of transuranic waste could be done most expeditiously by a computer network based real-time data generation and tracking system. Towards this goal, the TA-55 Waste Management System was launched in 1993 with a week long meeting of users and programming personnel to sketch out the system requirements.

Phased implementation of the Waste Management System inside the Plutonium Facility began in August of 1995 with the submittal of waste information by the waste originator to the materials management and the waste management groups. Full implementation at TA-55 is anticipated in early 1997. Advantages realized so far by the use of this system include cutting down the duplicated effort required in transferring information from one group to another and the standardization of waste naming conventions for the entire facility, which makes it much easier to review waste generation data for one or any number of processes. It has eliminated transcription errors, missing certification signatures, and incorrect discard authorizations. It has cut down the time required to originate paperwork and to review the paperwork for accuracy. In addition, we anticipate that when fully implemented the system will relieve the time of a data entry clerk at the plutonium facility by 20 hours per week.

THE PLUTONIUM FACILITY

The Plutonium Facility is the largest producer of newly generated TRU waste at LANL. The waste is destined for disposal at the Waste Isolation Pilot Plant (WIPP). Once the waste is generated, it

is sent to the LANL Waste Management Facility for temporary storage until it is shipped to WIPP. The Waste Management Facility also provides certification activities and loading facilities for all TRU waste and storage and repackaging facilities for legacy TRU waste.

The Plutonium Facility is the largest quantity generator of TRU waste at LANL, producing 500 new containers of TRU waste per year. The facility is anticipating an expanded mission and upgrades which will increase the waste production rate. The TRU waste is generated from plutonium processing in basic special nuclear material (SNM) research to develop, prove, and implement technology for existing and/or future plutonium processing needs, and from the provision of support to national defense and energy programs. The plutonium processing area in the facility has about 100 processes operating in over 300 gloveboxes. It is a two story building of about 150,000 square feet with about 530 waste originators. The facility team dedicated to TRU waste management consists of ten people. An on-site quality assurance (QA) representative provides full-time support to waste management programs.

One of the primary operations performed at the facility is the recovery, purification, and stabilization of SNM from scrap residues. This is done through nitric acid, hydrochloric acid, and pyrochemical processing. Metal technologies such as casting, machining, and assembly maintain the technology base for plutonium in nuclear weapons. Surveillance activities are conducted for the nuclear weapons stockpile. Plutonium related safety and reliability research is done in the facility. Metallurgical and chemical properties studies are performed as well as fundamental and applied research in actinide chemistry, which focuses on new and emerging separation technologies with strong emphasis on waste reduction, environmental protection, and safety improvement. The facility also develops plutonium-238 heat sources for space applications and does fuel fabrication research. Radioactive sources from medical use and university research are disassembled and the SNM recovered for future use.

TRU waste generated at the Plutonium Facility consists of solid waste and immobilized liquid waste. The solid waste is primarily contaminated with plutonium-239 or plutonium-238. The cemented waste form is primarily contaminated with plutonium-239 and is high in americium-241 due to the concentration of the isotope in upstream liquid processing. Other radionuclides may be present as secondary contaminants in the waste. The waste is presently packaged in 55-gallon drums or standard waste boxes (SWBs).

THE PAPER TRAIL FOR TRU WASTE

The following paragraphs describe the pertinent details of the process for certification and packaging of TRU waste at the Plutonium Facility as the process existed before the implementation of the Waste Management System. This description serves and a "before and after" picture to highlight the quantum leap in data handling represented by the WMS.

The documentation trail for a TRU waste item begins with the generation of the item. The originator completes a form called the Waste Origination and Disposition Form (WODF) giving the item an identification number and identifying the waste item matrix, originating process, date of origin, weight with and without packaging, and regulated materials in the item. The originator signs and dates the form assuring that the waste item was appropriately characterized. A TRU waste

management technician then visually inspects the item and verifies the originator's characterization. The item is bagged out of the glovebox system in a materials management room and sent to the non-destructive assay (NDA) laboratory for nuclear material assay. The assay information, including the assay results, uncertainty in the measurement, and an identification of the instrument used is recorded on the WODF and signed and dated by the person doing the measurement. One use of the NDA measurement is for waste management personnel to determine that the amount of special nuclear material (SNM) in the item is not practically recoverable from the matrix and therefore can be disposed of. The waste management technician performs the calculation and determines whether the item is below the discard level by comparing his calculation to tables of discard values based on over 10 SNM material types and 35 waste matrices. Examples of waste matrices are combustibles, graphite, salt, non-plutonium metal, rubber, plastic, leaded gloves, etc. These waste matrices fit into larger categories of LANL TRUPACT-II (Transuranic Package Transporter-II) Content (TRUCON) codes. The waste management technician then signs and dates the WODF.

When it is determined that a waste item is discardable, the item is added to an empty or partially filled waste container with the appropriate TRUCON code. Once the item has been added, a partially filled container is closed and locked to assure that no items are added or taken out. A full container is closed and a tamper indicating device (TID) is put on it. The physical description (identification number, weight, etc.) of the item is added to a log sheet for the container called the discardable waste log sheet (DWLS). This is simply a matter of copying the information from the WODF to the DWLS and adding the discard information. The technician then signs and dates his/her entry. The DWLS already has information about the container and packaging configuration, such as the waste package serial number and whether it contains lead shielding. As other items are added to the container, a running total of the SNM plus twice the uncertainty in the individual item measurement is kept on the log sheet to assure that the SNM limit for the container is not exceeded.

Once a container is full, the individual package weights are totaled and the tare weight of the container is added to obtain a calculated gross weight. The container is then put on a scale and the scale weight is compared with the calculated weight. If there is a difference of more than two pounds, a nonconformance report is generated and the container must be opened up and the individual items be re-weighed. The SNM and uncertainties are totaled and the weights of any hazardous materials are totaled. The container then goes through a confirmation assay for radionuclide content and the result of the assay is compared with the calculated SNM total. Count room personnel sign and date the assay information. If the confirmation assay is within a certain percentage (depending on the confirmation instrument used) of the SNM total, the container passes confirmation. If the container does not pass confirmation, it has to be re-opened and the individual items remeasured.

When the container has passed the weight and assay checks, the pertinent information on the DWLS is transferred to the transuranic waste storage record (TWSR), the official document for transmitting the container to the LANL Waste Management Facility. The TWSR has already been started for the container, including the waste package serial number and the signed and dated empty container integrity inspection. Additional information besides that transferred from the DWLS includes the container carbon filter identification number, the TRUCON code, the date the container was closed and the waste profile form (WPF) number. There is a WPF for each TRUCON code which describes the waste form, nuclear material content and any special characteristics (such as the identification

of hazardous materials). This form is completed by waste management personnel and reviewed and approved by the LANL Waste Management Facility. The waste management technician completing the TWSR signs and dates it. The container is then surveyed for surface contamination and dose rates at the surface, at 30 centimeters and at one meter. This information is recorded on the TWSR along with the survey instrument identification number and calibration void date. The RPT signs and dates this portion of the TWSR.

The completed data package is copied by the data package coordinator who then sends it for review and approval. The coordinator takes the package to each reviewer sequentially and tracks the progress of the package through the review cycle using a dedicated database. The data package is reviewed, signed and dated by the TRU Operations Team Leader, the on-site quality assurance representative, the nuclear material accountability representative, the LANL Waste Management Facility acceptance personnel (who also prepare the shipping manifests), and the LANL Safeguards and Security personnel. Any problems identified during the review cycle are corrected immediately by the person responsible.

The Plutonium Facility waste shipment coordinator then receives the data packages, including the shipping manifests, and prepares a shipment. This entails setting up a shipping date and vehicle, setting up a road closure (the containers travel on a public road) reviewing and signing the shipping manifests, marking and labeling the containers, setting up the final formal container inspection prior to shipment, and working with the waste management technicians to load the containers on the date of shipping. The original data package and the waste manifests accompany the containers to the LANL Waste Management Facility where the containers and official paperwork are stored.

After the containers leave the facility, the copy of the data package is given to a data clerk at the Plutonium Facility to input the information from the DWLS and TWSR into a dedicated TRU waste database. This data serves only as local information and is not extensively QA'd. The copy of the data package is stored on site. Copies of the signed waste manifests are also kept on site.

When the containers are received at the LANL Waste Management Facility, the information on the data packages is entered onto the official LANL waste database. This data entry is extensively QA'd and is done under a system called double data entry to assure accuracy.

THE COMPUTER TRAIL FOR TRU WASTE

The Waste Management System was designed to mirror the paper TRU waste data package system described above. During beta testing and implementation, use of the system required the buy-in and extensive testing and input from all of the different organizations involved in providing information for the certification of the waste. Through the programmer's daily interactions with these personnel, many improvements were made and are still being made in the way the process is handled to take advantage of capabilities of the computer. The product of the WMS now looks better than the previous paper product and only contains relevant information. One programmer has worked on the WMS since its inception and continues to control the system. Therefore the programmer has an intimate knowledge both of the computer program and of the process. During the phased implementation of the system, the programmer has been able to recognize inconsistencies between the program and the process and to make changes as appropriate for a smooth running operation.

The WMS data is stored in a Sybase database which resides on a Sun Workstation. It is accessed throughout the facility using a GUI interface which was written in Omnis7, a client/server development tool. Client/server computing breaks programs into two parts: one part on the local workstation - the client - that requests data and the rest on one or more server machines that supply the data. This program can be run using Windows 3.1, Windows 95, Windows NT and Macintosh operating systems. The following paragraphs describe the pertinent details of the process for certification and packaging using the WMS.

The first phase of the Waste Management System was introduced in the Plutonium Facility in August of 1995 with the requirement that originators input the same information on the computer that they were submitting to waste management personnel on a paper WODF. The waste originator logs on to the system and characterizes the waste. The item is assigned a unique identifier which contains an abbreviation of the process originating the waste and of the waste matrix and a sequential waste item number for that process and matrix. At first this caused some difficulty for the waste originators who had always assigned their own identification numbers and had a numbering scheme in place specific for their process and were reluctant to change (the identification numbers are used for other purposes besides the WMS). This item identification aspect of the WMS will be discussed further below.

Most information is selected from dropdown lists, check boxes or radio buttons. A dropdown list is a field on the window which may be expanded to a list of choices by using the mouse. A check box is a field that indicates a yes or no selection. A radio button allows the selection of options which are mutually exclusive. One primary requirement of the system was that it be easy to learn and use.

Network connections and computers were not immediately available in many rooms of the Plutonium Facility, so the originators had to go to the solid waste management operations room to input the information. Waste management technicians were available to assist the originators in logging onto the network, and filling in the form on the computer.

The implementation of the WMS required that upgrades to networking capabilities be made throughout the Plutonium Facility so that originators would have the ability to log on to the system in their own processing room and input the waste item information. This included the addition of new network lines and ports in the rooms and the purchase of new hardware and software. Waste management personnel purchased portable laptop computers which are used to travel to the originators location, plug into a network port, and input waste item data.

The new item is visually inspected and approved on line by Waste Management personnel. At the time of approval more rigorous checks are in place to ensure that all information is complete. After approval, the item may no longer be modified by the generator. Modifications require re-approval.

Two of the major hurdles to overcome in the implementation of this system were the QA requirements for signatures of the various individuals who input information to the system and for an auditable trail of changes made to the data. This required setting up a table of authorities identifying who could change data once it was entered into the system. It also required setting up records tables to track changes. An example of the way the table of authorities works is that the

TRU team leader reviewing the data package can only review the package and request the waste management team member who entered to data to make changes or corrections if needed. If a change is made in a data item at the level of the waste management team member, for example, all subsequent approvals on the data package are revoked and the package has to be reviewed a second time with the corrected data.

During this phase and all subsequent phases, the paper forms were filled out and used to conduct parallel testing of the WMS. The purpose of the parallel testing was to confirm the correctness and usability of all aspects of the system by allowing all levels of users to compare the information, calculations and process handling to the actual paper system. All final documents were reviewed to determine accuracy at the conclusion each phase of the implementation and a log was maintained to document and address errors when located. The paper form remained the official form until the parallel testing of this phase was complete. Errors identified during the parallel testing phase were tracked and used to correct the computer program and to re-design the process to include only essential information. When the tracking statistics proved that the confidence level in the data was very high, the paper WODF was deleted as a confirmatory step and the data in the WMS became the official waste record. The DWLS and the TWSR were still completed in their paper form using the waste item information from the WMS.

The approved item is eligible for assay which was the next phase implemented for the WMS. The waste originator requests an assay on line. The item then appears on the list of items ready for assay to personnel in the NDA Laboratory. The items appear in the order assays are requested. NDA Laboratory personnel may prioritize the items on line as desired. When NDA is ready to receive the item, they notify the waste originator and the item is bagged out of the glovebox line and brought to the NDA Laboratory to be measured. After measuring the item, NDA personnel enter the results of the assay into the system. The system compares the results of the assay to the discard limits for the item being measured and displays the two values. If the item exceeds the discard limit, NDA personnel are asked to confirm the information. If the information is confirmed, the approval is removed from that item. This then allows the item to be re-inspected to determine if there are errors or converted to a non-discardable item. If the item does not exceed the discard limit, it then becomes available for packaging into a waste container.

Waste management personnel notify the waste originator(s) when they are ready to package items into containers. As each item arrives, waste management personnel use the system to locate the appropriate container, either a partially filled container with the same matrix (the system keeps a rough account of how full a container is) or an empty container, and electronically place the item in the container. The system calculates the resultant weight and SNM of the container. The item is then placed next to the container into which it will be packaged. To minimize exposure (ALARA), this is done for all items which will be packaged at that time. When personnel confirm that none of the containers will exceed the SNM limits and that all containers are ready to be packaged, they don respirators for the actual packing. One person sits at the computer terminal while the others do the packing. The containers are opened and each new item is weighed and the final packaged weight of the item is relayed to the individual at the terminal. The waste is then physically placed into the container. This final measurement allows the completion of all calculations required for the individual waste items. When packing is complete, the final gross weight of the container is entered (the tare weight of the container has been previously entered). The calculated weight of the container

has been created by the computer and is displayed for comparison. The packed container is then closed electronically, entering and verifying calculations required on the documentation.

The closed and sealed container undergoes a confirmation assay by the NDA Laboratory. The computer does all calculations previously done by NDA Laboratory personnel to determine if the container confirms based on any difference between the container assay and the sum of the assays of all items in the container. These calculations are quite extensive for containers which contain multiple material types (material types are combinations of several isotopes in different percentages). Different levels of approval may be required based on this difference, and the container may have to be re-opened and individual item re-assayed.

The closed and sealed container must be swiped and surveyed by WIPP-certified RPTs. The RPTs enter their swipe and survey data and identify the instruments they used with pull-down menus. In order to help the RPTs and to eliminate potential transcription errors, the calibration information from the instruments and the instrument identification numbers were added to the database tables and are kept up to date. The WMS then presents the RPTs with allowable instrument numbers and automatically alerts them when they an instrument is out of calibration. The system verifies measurement limits and prevents containers from being released which exceed those limits. From a usability perspective, it is no longer necessary for measurements to be entered in scientific notation--the computer makes that translation for them.

The TRU-Waste data package can be viewed on line at any time during the processing. All approvals are listed so that viewers may determine the stage in processing for a given container. Using the paper system, about half of the paperwork would be completed at this time. Using the computer system, all paperwork in the data package except the review and approval traveler is finished now. The data package forms are being created by the system only and no paper will be transferred outside of the radiation controlled area. Each approver logs on to the system and issues the approval both electronically and on paper (the traveller). The final stage of this implementation will include electronic notification to approvers when the data package is ready for each level of review and approval and electronic approval only.

When all approvals have been given, a designated individual prints the data package from the computer and this package then accompanies the container when it leaves the facility.

The final TWSR includes the SNM measurement information and the uncertainty. The WMS includes this information on each waste item in the form of a measurement of material type amounts. The waste item information has to manipulated by the program in order to come up with the isotopic information required on the TWSR. On the paper system, this was accomplished by a spreadsheet program run for each container, which incidentally also calculated the Curie values. The calculation results from the spreadsheet were then transferred to the paper TWSR. This spreadsheet step has been eliminated with the WMS since the calculations are now done by the program. Isotopic values are available on the WMS in either gram amounts or Curie amounts.

BENEFITS OF THE WMS REALIZED TO DATE

Numerous benefits have already been realized using the WMS. The most obvious benefits are that transcription errors and calculational errors have been eliminated, mistaken entries on paperwork have decreased, and there are no longer mistakes where decisions need to be made based on numerical comparisons. The need for a data clerk to enter the final data into a separate database has been eliminated. There is no longer a need to transfer hard copies of the data packages from a radiological controlled area to an uncontrolled area. Documents are not misplaced. Reviewers do not have to check calculations or check for transcription errors. One reviewer has been taken out of the cycle.

Personnel who participated in the phased testing of the system and provided feedback to the programmer became partners in the development and improvement of the WMS. This resulted in a vastly improved product that enhanced the WMS and in many cases caused personnel to re-think the way they had been performing work. Personnel who use the WMS frequently say that this part of their job has become a lot easier and less time consuming and has freed them up to do other things. For example, in the past, at the end of a full facility cleanup for the annual SNM inventory, waste management technicians have been left with a two-foot stack of paper to process. Now, when the cleanup is done, 99% of the "paperwork" for TRU waste items is also done.

Waste management personnel are frequently asked to provide information to upper management on waste production. With the previous archival database system, the retrieval of information, such as the monthly production of a certain waste matrix in the facility for a number of years, was difficult. The reason for this is that the item identification numbers were assigned by the waste originator with little consistency across processes. A secondary reason was that data entry into the archival database was not fully QA'd so an identification number may have been entered incorrectly or a weight may have been entered in grams instead of kilograms, for example. With the WMS requirement that waste item identification be consistent across the facility, and standardized data entry, this difficulty has disappeared.

FUTURE PLANS TO EXPAND THIS SYSTEM

Enhancements to the WMS which are being considered for implementation at a future date include the following.

- Bar coding of waste items which will eliminate errors resulting from similar item identifiers.
- Tracking of the physical location of waste containers through the use of barked readers and/or proximity devices attached to individual containers. This first (barcode readers) is anticipated as the first implementation with the use of proximity devices a costly, but more reliable, implementation to come later.
- Electronic interface between NDA laboratory measurement instruments. This would allow the NDA Laboratory to upload assay results stored in the measurement instruments directly to the computer system and, when multiple results are obtained, select the measurement determined to be correct. This selection would then be logged as the official assay for the item. This, of course, eliminates the transposition of numbers and other errors which can occur during manual data entry.

- Capability for all reviewers to approve data on-line.

- Electronic transfer of data to the LANL Waste Management Facility eliminating the need for double data entry currently being used to populate their database. This move is particularly desirable because it would eliminate the additional steps of transporting the paperwork to and from and Waste Management Facility and their double data entry into the official LANL waste management database.

CONCLUSION

To date, implementation of this system has resulted in a 25% time reduction in working the paperwork trail of transuranic waste at the Plutonium Facility. We expect this time reduction to increase to 50% at full implementation. Transcription errors and calculational errors have been eliminated. Mistaken entries on paperwork have decreased. The need for a data clerk to enter the final data into a separate database has been eliminated.