Title:
Los Alamos National Laboratory
Plutonium Facility's Certification of Newly Generated Transuranic Waste

Author(s):
Kathleen M. Gruetzmacher, NMT-7
Andrew J. Montoya, NMT-7
Barbara J. Sinkule, CST-7
Marshall A. Maez, ESH-14

Submitted to:
Waste Management '97 Conference
Tucson, Arizona
March 2-7, 1997

DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.
DISCLAIMER

Portions of this document may be illegible in electronic image products. Images are produced from the best available original document.
"Los Alamos Plutonium Facility Newly Generated TRU Waste Certification"

by

Kathleen Gruetzmacler and Andrew Montoya
Nuclear Materials Technology Division, LANL

and

Barbara Sinkule
Chemical Sciences and Technology Division, LANL

and

Marshall Maez
Environmental Safety and Health Division, LANL
Los Alamos, New Mexico, 87545

ABSTRACT

This paper presents an overview of the activities being planned and implemented to certify newly generated contact-handled transuranic (TRU) waste produced by Los Alamos National Laboratory's (LANL's) Plutonium Facility. Certifying waste at the point of generation is the most important cost and labor saving step in the WIPP certification process. The pedigree of a waste item is best known by the originator of the waste and frees a site from expensive characterization activities such as those associated with legacy waste. Through a cooperative agreement with LANL's Waste Management Facility and under the umbrella of LANL's WIPP-related certification and quality assurance documents, the Plutonium Facility will be certifying its own newly generated waste.

Some of the challenges faced by the Plutonium Facility in preparing to certify TRU waste include the modification and addition of procedures to meet WIPP requirements, standardizing packaging for TRU waste, collecting processing documentation from operations which produce TRU waste, and developing ways to modify waste streams which are not certifiable in their present form.

INTRODUCTION

The Plutonium Facility is the largest producer of newly generated TRU waste at LANL. The waste is to be sent to the Waste Isolation Pilot Plant (WIPP) and must be certified to Rev. 5 of the Waste Acceptance Criteria for the Waste Isolation Pilot Plant (WIPP WAC). Temporary storage of newly generated TRU waste is provided by the LANL Waste Management Facility until the waste 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.

TRU waste has been certified to Rev. 4 of the WIPP WAC for the past several years. The past 18 months have seen numerous changes in the certification requirements for WIPP, including Rev. 5 of the WAC, new quality assurance documents, transportation requirements, and the commitment of WIPP to open in November 1997. This has presented a challenge to producers of newly generated waste as well as personnel who must prepare legacy waste for shipment to WIPP.
The Plutonium Facility produces 500 new containers of TRU waste per year and is anticipating an expanded mission and upgrades to the facility which will increase the waste production rate. The goal of the waste management group is to certify as much newly generated waste as possible and make it eligible for shipment to WIPP as it is produced. To this end, the Plutonium Facility’s waste management personnel have an implementation plan to meet the new WIPP requirements; TRU waste procedures have been revised; packaging has been standardized to meet the wattage and plutonium equivalent (PE) Curie WAC limits; process documentation has been gathered to support acceptable knowledge (AK); and research and development activities have been planned for waste streams which consistently fail to meet the WAC and transportation requirements.

THE PLUTONIUM FACILITY

The Plutonium Facility is the largest quantity generator of TRU waste at LANL. The Nuclear Materials Technology Division (NMT) is the landlord of the Plutonium Facility and is responsible for the appropriate treatment and handling of facility waste. 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 facility has about 100 processes operating in over 300 gloveboxes.

One of the primary operations performed 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 IMPLEMENTATION PLAN

The TA-55 Transuranic Waste Interface Document is the implementation plan for certification of TRU waste at the Plutonium Facility. This plan describes activities and procedures that have been or will be implemented to fulfill the requirements established for LANL in the Los Alamos National Laboratory Transuranic Waste Certification Plan. The Certification Plan directly addresses the
requirements of the WIPP WAC and the TRUPACT-II (Transuranic Package Transporter-II) Authorized Methods for Payload Control (TRAMPAC). It is used in conjunction with the Los Alamos National Laboratory Transuranic Waste Characterization Quality Assurance Project Plan (QAP) and the Los Alamos National Laboratory Transuranic Waste Characterization Sampling Plan (Sampling Plan) to ensure that TRU waste has been properly characterized.

The Interface Document begins by identifying TRU waste duties and responsibilities of Plutonium Facility personnel. It describes the TRU waste streams generated at the facility and then goes on to describe how each of the WIPP WAC criteria are met. Certification activities are performed according to approved LANL procedures. All pertinent data are appropriately recorded. Containers not meeting requirements are reprocessed either by the Plutonium Facility or the LANL Waste Management Facility. Each of these criteria and how they are met are described briefly below.

Container and Physical Properties

Containers and filter vents are purchased, inspected, and used according to LANL procedures. Container weights are determined and controlled by waste management personnel. Payload assembly weights, center of gravity requirements, and dunnage requirements are met by loading personnel. Container surfaces are checked for removable surface contamination by a WIPP-certified radiation protection technician (RPT). Containers are marked with the WIPP WAC bar code identification labels and shipping categories.

Liquids

Waste originators ensure and certify that solid TRU waste items contain no free liquids. Waste management personnel verify this.

Nuclear Properties

At the Plutonium Facility, the amount of each radionuclide in a solid waste container is determined by local radioassay of each item going into a waste container. For liquid waste destined for cementation, radiochemical analysis on a representative sample is performed and used to determine the final radionuclide content in a cemented drum. To meet the WIPP WAC quality assurance (QA) requirements, TRU waste containers will be radioassayed by LANL Radioassay and Nondestructive Testing (RANT) personnel using radioassay equipment qualified under the Performance Demonstration Program (PDP). The radionuclide content determined by RANT is used to calculate the plutonium-239 fissile gram equivalent (FGE), the average thermal power density (decay heat), the TRU alpha activity concentration, and the PE Curies for the waste container. The contact dose rate for the waste container is measured by a WIPP certified RPT.

Chemical Properties

Waste originators ensure that solid TRU waste items contain no pyrophorics. They identify, quantify and certify the presence or absence of hazardous constituents in a waste item. They ensure and certify that solid TRU waste items contain no explosives, corrosives, or compressed gases and that

DRAFT
liquid items to be immobilized contain no explosives or compressed gases. Corrosive liquids are neutralized in the cementation process. Waste management personnel verify the originator's certifications. To ensure chemical compatibility, waste items are segregated by matrix type and waste drums which could contain corrosive materials are lined with a 1/8 inch thick polyethylene liner. Sampling and analysis is required to quantify possible polychlorinated biphenyl contamination of organic liquids or solutions prior to immobilization.

Gas Generation

Decay Heat

As noted above, decay heat is calculated using the radionuclide content as determined by RANT personnel. Containers exceeding the decay heat requirement are reprocessed by NMT or by the Waste Management Facility where practical. Containers which exceed the decay heat limits and cannot be reasonably repackaged are stored at the Waste Management Facility as uncertified waste until an appropriate methodology is available to prepare the waste for shipment to and disposal at WIPP. An example of a waste type which is being generated and stored in this manner at the Waste Management Facility is discussed in the Research and Development section below. Loading personnel ensure that the decay heat of the loaded TRUPACT-II meets the TRUPACT-II Content (TRUCON) limits for the appropriate shipping category.

Volatile Organic Compounds (VOCs) and Flammable VOCs

The Waste Management Facility’s Transuranic Waste Characterization Project (TWCP) personnel sample headspace gases and have them analyzed to determine that they meet the VOC and flammable VOC WIPP WAC requirements. Any containers that do not meet these requirements are reprocessed by NMT or by Waste Management Facility personnel.

Aspiration

All new containers are vented prior to first use. Aspiration criteria are not applicable.

Shipping Category

Waste management personnel at the Plutonium Facility assign a TRUCON code and the corresponding shipping category to newly generated waste containers.

Confinement Layers

Solid TRU waste drums for newly generated waste contain only one layer of confinement. Items are usually bagged out individually from a glovebox and that inner confinement layer is sealed. The drum liner bag for a 55-gallon drum is folded over and not sealed when the drum is full. A standard waste box (SWB) does not contain a liner bag. Cemented TRU waste drums for newly generated waste also contain only one layer of confinement. A drum liner bag which is attached to a glovebox is twisted, tied, and taped when the drum is removed from the glovebox. The outer liner bag, which
Data Package Requirements

Auditable data generated by NMT is transferred to the TWCP for compilation into WIPP data packages. (A description of the new computerized method for collecting processing data of newly generated TRU waste can be found in a companion paper at this conference.) NMT personnel prepare a waste profile form (WPF) to characterize each newly generated waste stream for RCRA purposes. Environmental Protection Agency (EPA) codes are assigned by the Waste Management Data Package does not see radioactive contamination, is folded over when the drum is sealed.

Facility based loading personnel.

REVISED PLUTONIUM FACILITY WASTE PROCEDURES AND LANL TRU CON CODES

Work at the Plutonium Facility is governed by safe operating procedures (SOPs). Full conformance with the WIPP WAC requirements, transportation requirements, and the recently issued WIPP QA requirements, has required several modifications in existing procedures. For example, records management of the Transuranic Waste Storage Records at the Plutonium Facility has always been appropriate, but not formalized in a procedure. This omission has been corrected. Another example is that the addition of particulates to the allowable waste forms for WIPP has allowed the transfer of this waste form from the immobilization operation to the solid waste operation and the applicable procedures have been revised to reflect this. TRU CON codes have also undergone revision, partly to broaden the range of authorized package contents, but mainly to take advantage of standardized packaging. The chemical lists associated with the TRU CON codes have been extensively reviewed to assure that they are up to date and accurately represent the actual contents of the waste containers.

STANDARDIZED PACKAGING

Analytical shipping category wattage limits are dependent on the waste type and on the number of closed waste packaging layers in the container. For example, for solid organics and solid inorganics in 55-gallon drums, the wattage limit for one closed packaging layer is 121% higher than the wattage limit for two layers. For solidified aqueous waste, the limit for one layer is 133% higher than the limit for two layers. The wattage requirements are usually the most limiting factor in TRU waste packaging and can be easily exceeded for solid organic waste forms and for waste containing high wattage radionuclides such as plutonium-238 (0.573 W/g) and americium-241 (0.116 W/g).

Historically, TRU waste at the Plutonium Facility has generally been packaged in a maximum of two layers of closed packaging. For Rev. 4 of the WIPP WAC, a standard of one closed packaging layer was implemented in order to assure that waste would meet the wattage limits where possible. However, this standard was not rigorously followed, so there were occasions when more than one closed packaging layer was used in a waste container. This information was not always included with the data package generated by NMT, consequently, the worst case of two layers of closed packaging has been assumed for many waste types in the legacy category. (Still older legacy waste had fewer controls and could contain as many as four layers of closed packaging.) NMT now requires that waste be packaged in a maximum of one closed packaging layer, with the exception of

DRAFT
plutonium-238 waste. Plutonium-238 waste is packaged in high efficient particulate air (HEPA) filtered bags, so is essentially not in a closed packaging layer.

PROCESS DOCUMENTATION

Acceptable knowledge for the characterization of TRU waste has to be well documented. Waste Management personnel at the Plutonium Facility initiated an effort last year which tracks all facility procedures which may result in the production of TRU waste. This requires that copies of all current SOPs and all revisions be kept in a central location to prevent their inadvertent loss in the future. This store of knowledge provides a cornerstone for acceptable knowledge of TRU waste streams at the facility.

For older, legacy waste, an additional effort was successfully completed which captured copies of all available procedures since the facility opened in 1978 and those available from the previous plutonium facility. These projects represent an extensive effort, but one which we expect will produce dividends in providing characterization documentation for those who have to deal with waste in the future.

Process documentation is also provided by the waste originator at the time that at TRU waste item is generated. Waste Management SOPs at the Plutonium Facility require that the originator of a TRU waste item describe the waste item and identify any hazardous or otherwise regulated materials associated with the waste item. The waste originator's name, group, waste originating location and process is attached to the paperwork for the waste item. The originator signs a statement assuring that the waste has been accurately characterized and facility waste management personnel visually inspect the waste to verify the originator's statement. In addition to the visual verification, facility waste management personnel are an invaluable resource since they are familiar with the actinide processing which is done in the Plutonium Facility and have had appropriate training in regulated materials and the WIPP WAC.

RESEARCH AND DEVELOPMENT ACTIVITIES

The two most pressing research and development activities are associated with the high wattage isotopes (Am-241 and Pu-238) in TRU waste generated at the Plutonium Facility. The simplest approach to dealing with high wattage isotopes is to spread them out into many containers and therefore significantly increase the number of drums of waste, but allow the drums to be certified for transport to WIPP. Since pollution prevention and waste minimization are primary goals of waste management organizations and DOE, this is not an appropriate solution for these waste streams.

Americium-241

Americium-241 surfaces as a limiting isotope in cemented 55-gallon drum monoliths of aqueous liquid. These drums have been generated at the Plutonium Facility since 1987 and may contain (with uncertainty) as much as 10 grams of americium-241 and 50 grams of mixed isotopes of plutonium including 238, 239, 240, 241, and 242. The calculated decay heat for a drum of this isotopic
composition is 1.3 watts. The shipping category is I.1A1. The decay heat limit (analytical) for this shipping category is 0.1797 watts, a factor of 7 difference from the actual decay heat. At present, only about 5% of the cemented drums produced at the facility meet the wattage limits. Older legacy waste normally had even higher gram loadings of Am-241 in cement drums and consisted of stacked one-gallon cans of cement.

Several routes are being explored to make this waste stream consistently certifiable for newly generated waste. The most obvious solution is to remove the americium-241 from the aqueous waste stream before it is cemented. This aqueous waste stream consists of bottoms from an evaporator which is the last step in the nitric acid actinide processing line at the facility (the distillate has low concentrations of actinides and is sent to the Radioactive Liquid Waste Processing Facility). The evaporator cuts down the volume of TRU nitric acid waste, but obviously concentrates the actinides in the bottoms. These bottoms are the feed for the cementation process. The chemical processing required to remove most of the americium-241 from the evaporator bottoms is well known, so a minimal amount of research and development would be required to design a recovery process. However, there is no current market for this isotope and it would still have to be disposed of somehow or stored indefinitely. An added complication is that americium-241 is a high exposure radionuclide. People working on the process and otherwise handling the material could receive an unacceptable dose of radiation even though engineering controls would minimize this risk.

A second avenue being researched is the possibility of revising the wattage limits for cemented aqueous waste through the matrix depletion studies. Preliminary results from these studies indicate that the wattage limits could conceivably be raised by a factor of 2 or 3 for this waste matrix. If this is the case, a greater percentage of these cemented drums could be certified for shipment to WIPP. However, even with this kind of relief, many of the drums would still not qualify unless additional measures are undertaken to reduce the amount of americium-241 in a drum. These drums could also conceivably fit into the test category wattage limit per drum of 10 watts. *(Barbara - is anything being done here???)*

The third route being pursued involves placing the evaporator bottoms in a non-aqueous, inorganic, solid form and place the waste in a metal can so that the wattage limit is raised to 40 watts. This is more than 200 times the limit for the aqueous cemented waste matrix. This would even allow a much higher actinide loading (30 times) in a drum than the currently experienced maximum loading. One way to accomplish this is to vitrify the evaporator bottoms, drying the bottoms and encapsulating them in one operation. Research is underway to explore the practicality of this approach, both in the actual vitrification operation, and in the acceptability of the final waste form.

**Plutonium-238**

Plutonium-238 waste is a limiting isotope in TRU wastes for two reasons. For combustible matrices, the reason is the decay heat limit. The decay heat limit for 55-gallon drums with one scaled bag is 0.0962 watts. This translates into 0.20 grams of the Plutonium Facility's normal isotopic composition (plutonium-238, -239, -240, -241, and -242) of predominately plutonium-238 contaminated waste. Even with no confinement layers, the limit only increases to 0.1126 watts (0.23 grams). For non-combustible matrices, the wattage limit for one confinement layer is 0.1924 watts.
(0.40 grams). For non-combustibles which are first packaged in a vented can, this limit increases dramatically to 40 watts (83 grams); however, in this case, the newly instituted "plutonium equivalent Curie" limit of 80 plutonium equivalent Curies is rapidly reached at 6 grams of this plutonium mix.

A six-month study of newly generated plutonium-238 TRU waste drums at the Plutonium Facility revealed that 41% of the drums did not meet the wattage or the PE-Ci limits. Of these, the combustible drums generated outside of gloveboxes (75% of the combustible drums) met the limits most frequently, with an average of 0.05 grams (including uncertainty) of plutonium per drum. The combustible drums which failed to meet the limits all failed because of the wattage restriction and had an average of 5 grams of plutonium (including uncertainty). 28% of the non-combustible drums met the limits, with an average gram loading of 3.71 grams (including uncertainty). 56% failed to meet the 80 PE Ci limit and 16% failed because of wattage limits.

As with the americium-241 problem, several routes are being explored which will alleviate this problem. One of these routes is recovery of the plutonium-238. Fortunately for waste operations, plutonium-238 has a high value and therefore, recovery could be economically advantageous. Non-fibrous waste items are surface contaminated and should be relatively easy to run through a recovery operation. No full-scale recovery operations for plutonium-238 are now available at the Plutonium Facility. Small experimental recovery operations are undergoing testing to determine whether they could be effectively be employed at the facility. Implementation of full-scale operations may require a set of operations similar in type (but not scale) with the plutonium-239 nitric acid recovery operations, which encompass nearly one full wing of the Plutonium Facility.

Matrix depletion studies are underway for plutonium-238 waste matrices. No preliminary results are available. Barbara - is this true?? However, it is obvious that relief of the wattage limits by a factor of two or three would not help this situation substantially. Relief from WIPP on the 80-PE Ci limit for non-combustible plutonium-238 waste would, however, make the majority of the drums in this matrix certifiable.

Waste management personnel at the Plutonium Facility require that filtered bags are used whenever possible in order to raise the wattage limit somewhat, and that filtered cans and bagout bags are used for non-combustible matrices where practical (a large metal item will not fit in a can).

Other

Waste management personnel at the Plutonium Facility have been trained in the limiting factors for waste transportation to WIPP. They have been tasked with following a chart based on matrices and packaging configurations which shows them the maximum amounts of different plutonium mixtures and americium which can go into one drum or SWB. The goal is to certify 100% of non-plutonium-238 and non-americium-241 waste at the Plutonium Facility.

CONCLUSION

Seventy-five per cent of the TRU waste generated by the Plutonium Facility from 5/1/96 to the
present meets the WAC and transportation requirements pending approval of the implementation plan and appropriate verification of the drum contents by the LANL Waste Management Facility. The vast majority of the remaining 25% fail due to wattage or PE Curie restrictions on americium-241 and plutonium-238 contaminated waste streams.

REFERENCES

