LA-UR- 97-4655

Approved for public release; distribution is unlimited.

Title: Documentation of Acceptable Knowledge for Los Alamos National Laboratory Plutonium Facility TRU Waste Stream

CONF-980307--

Author(s): Andrew J. Montoya
Kathleen M. Gruetzmacher
Charles L. Foxx
Pamela Z. Rogers

Submitted to: Waste Management 98 Conference

Los Alamos
NATIONAL LABORATORY

DISCLAIMER

"Documentation of Acceptable Knowledge for LANL Plutonium Facility TRU Waste Streams"

by
Andrew J. Montoya, Kathleen Gruetzmacher, and Charles Foxx
Nuclear Materials Technology Division
and
Pamela S. Z. Rogers
Chemical Sciences and Technology Division

Los Alamos National Laboratory
Los Alamos, New Mexico, 87545

ABSTRACT

Characterization of transuranic waste from the LANL Plutonium Facility for certification and transportation to WIPP includes the use of acceptable knowledge as specified in the WIPP Quality Assurance Program Plan.

In accordance with a site specific procedure, documentation of acceptable knowledge for retrievably stored and currently generated transuranic waste streams is in progress at LANL. A summary overview of the TRU waste inventory is complete and documented in the Sampling Plan. This document also includes projected waste generation, facility missions, waste generation processes, flow diagrams, times, and material inputs. The second part of acceptable knowledge documentation consists of assembling more detailed acceptable knowledge information into auditable records and is expected to require several years to complete. These records for each waste stream must support final assignment of waste matrix parameters, EPA hazardous waste numbers, and radionuclide characterization. They must also include a determination whether waste streams are defense waste streams for compliance with the WIPP Land Withdrawal Act.

The LANL Plutonium Facility's mission is primarily plutonium processing in basic special nuclear material (SNM) research activities to support national defense and energy programs. It currently has about 100 processes ranging from SNM recovery from residues to development of plutonium 238 heat sources for space applications. Its challenge is to characterize and certify waste streams from such diverse and dynamic operations using acceptable knowledge. This paper reports the progress on the certification of the first of these waste streams to the WIPP WAC.

INTRODUCTION

Acceptable knowledge refers to applying knowledge of the waste based on the materials or processes used to generate the waste. Acceptable knowledge includes information regarding the

physical form of the waste, the base materials composing the waste, the nature of the radioactivity present, and the process generating the waste. To meet the waste acceptance criteria for the Waste Isolation Pilot Plant (WIPP), acceptable knowledge characterizations of TRU waste streams are used to assign matrix parameter categories and EPA hazardous waste numbers and to determine the waste material parameters and radionuclides present.

The Plutonium Facility operated by the Nuclear Materials Technology Division is the largest generator of TRU waste at Los Alamos National Laboratory. Acceptable knowledge is used to complement sampling and analysis to characterize TRU waste at the Plutonium Facility. The challenge in documenting acceptable knowledge characterizations of TRU waste streams generated here arises from the ever changing mission of the facility and the vast diversity in its research and development and materials processing operations. 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 currently has about 100 processes operated in over 300 gloveboxes by about 530 plant workers. In addition their has been a constant evolution in requirements and procedures for managing and characterizing the waste since the facility began operation in 1978 which further complicates the effort to document acceptable knowledge for various waste streams.

ACCEPTABLE KNOWLEDGE DOCUMENTATION REQUIREMENTS

The Transuranic Waste Characterization Quality Assurance Program Plan (QAPP) specifies that generator sites must prepare a written procedure outlining the specific methodology used to assemble acceptable knowledge records. Further, Acceptable knowledge information must be compiled in an auditable record, including a road map for all applicable information. The QAPP and the site specific procedure Acceptable Knowledge Documentation summarize the process of compiling acceptable knowledge using the flow diagram shown in figure 1. With the exception of confirmation and audit of the acceptable knowledge, which can occur only after waste stream approval by WIPP, this represents the process described here.

The Chemical Science and Technology (CST) Division at LANL coordinates the site's compliance program to ensure that transuranic waste meets the WIPP Waste Acceptance Criteria (WIPP WAC) and TRUPACT II Authorized Methods for Payload Control (TRAMPAC). LANL's transuranic waste generating facilities document their compliance with the site certification program in an interface document that describes the facility's operational and quality procedures for managing transuranic waste as prescribed in the Quality Assurance Project Plan (QAPjP). The TA-55 Transuranic Waste Interface Document (TWID) is used by the Plutonium Facility's waste management personnel to ensure compliance with the LANL Transuranic Waste Certification Program (TWCP). The Plutonium Facility TWID along with the is the LANL Acceptable Knowledge Documentation procedure and the LANL TRU Waste Characterization Sampling Plan ensure that the Plutonium Facility TRU Waste has been properly characterized and that waste stream designations and numbers and TRUPACT II content (TRUCON) codes are consistent.

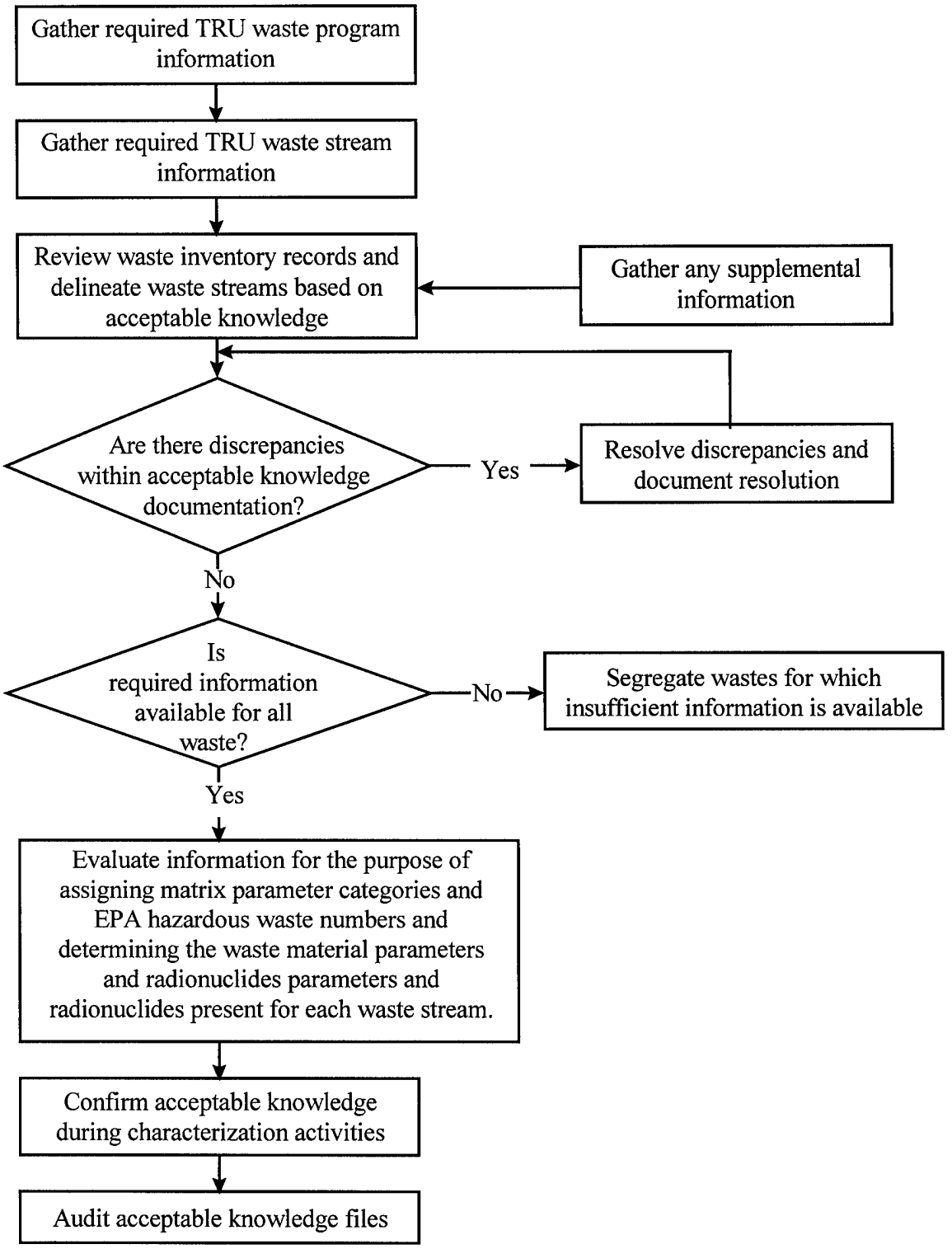

Figure 1
Compilation of Acceptable Knowledge Documentation

PLUTOMIUM FACILITY TRANSURANIC WASTE GENERATING PROCESSES

Plutonium operations have been conducted at building PF-4 of the Plutonium Facility since January 1978. The variety of plutonium handling operations includes:

- Preparing ultra-pure plutonium metals, alloys, and compounds
- Large scale preparation of specific alloys, including casting and machining these materials into specific shapes
- Determining high-temperature thermodynamic and physical properties of plutonium
- Disassembling components for inspection and analysis
- Reclaiming plutonium from scrap and residues produced by numerous feed sources (generated at various LANL facilities and other DOE sites)
- Manufacturing parts on a limited basis
- Processing plutonium-238 and the associated production of heat sources
- Processing of mixtures of plutonium and uranium oxides for reactor fuels

The manufacturing and research operations performed at the facility in the production of plutonium results in the production of plutonium contaminated scrap and residues. These are processed to recover as much plutonium as is practical. The Plutonium Facility has extensive capabilities for the extraction and recovery of plutonium from residues and scraps generated from operations at various LANL facilities, other DOE sites, and radioactive sources from commercial industry. These recovery processes (including nitrate-based, chloride-based, mechanical, and pyrochemical operations), as well as associated maintenance operations, and plutonium research are the sources of transuranic waste generated at the facility.

Because of the variety and complexity of the Plutonium Facility's operations, they are best described using process flow diagrams focused on identifying the points at which transuranic wastes are generated. Figure 2 is an example of such a flow diagram for the nitrate operation, one of the aqueous processes for recovery of plutonium from scrap or contaminated residues. As with other operations, it has been used at the facility since it opened in 1978. Each stage of this operation is actually a collection of sequential or alternative processes. For example, purification may consist of solvent extraction, precipitation, or ion exchange and more than one specific type of ion exchange process may be available. All of the many processes used in the Plutonium Facility are identified with unique process status codes and are tracked by the special nuclear material accountability system as required by DOE. Since about 1987 with the implementation of the Waste Originator's Disposal Form (WODF) a waste item can be tracked back to the process where it was generated. The correlation of waste items to process status codes is an important factor in characterization of waste streams generated since that time.

WASTE STREAM CHARACTERIZATION

As part of delineating waste streams by generating processes, acceptable knowledge

documentation must include all available information about potential contamination of the waste caused by:

- Process specific reagent chemical inputs
- Potential chemical contaminants from maintenance or monitoring activities
- Feed materials composition (including chemical and radiological contaminants)

The most important application of this information is for identification of chemical constituents or contaminants that result in the characterization of the waste stream as hazardous in accordance with the Resource Conservation and Recovery Act (RCRA). Since 1989, use of materials that would render waste streams hazardous have been discontinued wherever feasible. In addition,

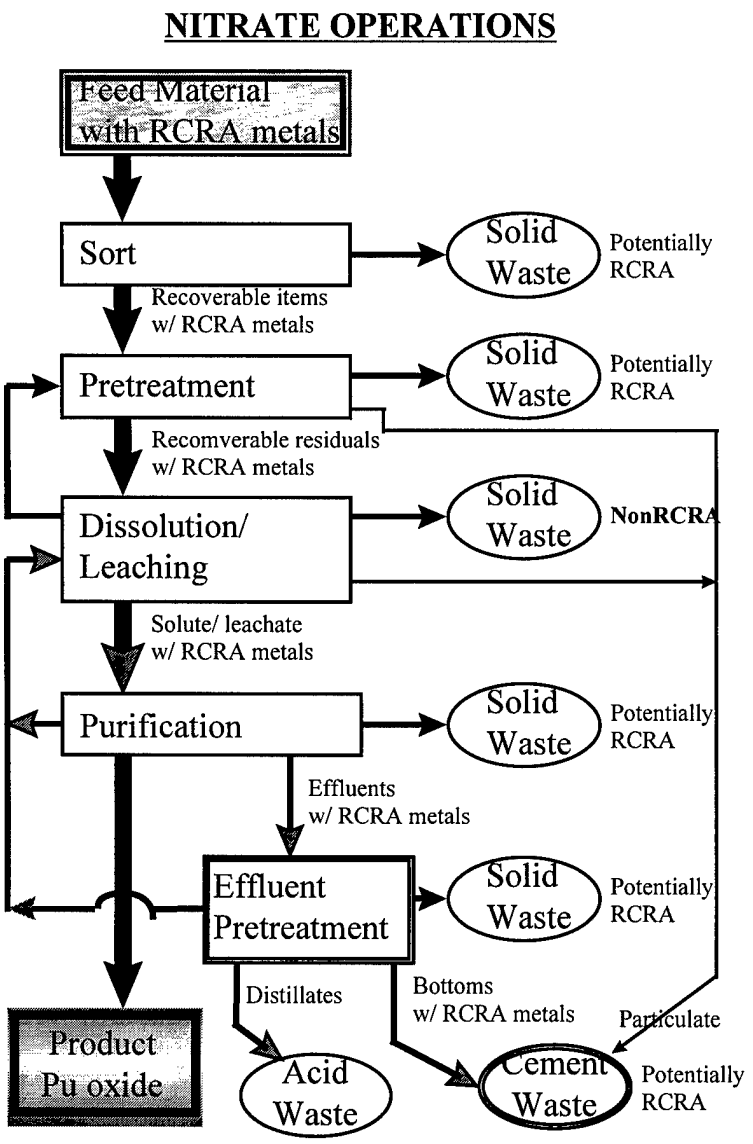

Figure 2
Flow Diagram for an Aqueous Recovery Operation

since 1991, waste stream characterizations as determined in part by waste originators and recorded on WODFs have been documented on LANL Waste Profile Forms (WPF) in accordance with ist RCRA operating permit Waste Analysis Plan. For the Plutonium Facility many process specific waste contaminants have been identified by reviewing WPFs and WODFs, reviewing operational procedures, analyzing of chemical and radiological assay data where available, reviewing reports and memos, and interviewing facility personnel responsible for current as well as discontinued processes.

For operations involving well characterized materials, such as metal casting, where only dry processes are used, LANL has characterized waste by-products for WIPP waste acceptance as nonhazardous using acceptable knowledge. Radioisotope distributions in the waste are characterized for assay as the same as in weapons grade plutonium with contaminants well known (including decay products).

Characterizing waste streams derived from aqueous recovery of residues is more challenging. Reagent inputs and process maintenance and monitoring materials can be well characterized by the process described above. Various processes over time have introduced materials that render waste streams potentially hazardous. Facility personnel have identified these processes and constituents (See Table 1) and will use this information to characterize corresponding waste items as hazardous in accordance with the QAPP.[1]

In addition, it has been determined that some chemical processes, such as acid dissolution, tend to leach process equipment (specifically lead shielding and steel) which contaminate process liquids with metals including lead, chromium, and cadmium. Waste streams generated from these processes are characterized as hazardous. Exceptions to this may include metal and plastic items discarded directly from dissolution or leaching processes or which have been decontaminated prior to discard.

Currently, lead shielding used in aqueous process areas and steel equipment in the chloride recovery operation are coated with corrosion resistant materials. Corrosion of stainless steel reaction vessels continues to contaminate some process liquids. Organic compounds (including solvents) are used in only two end of line processes and their hazardous waste by-products are well documented.

What remains to be determined for recovery processes is what contaminants are contributed by feed materials, specifically by residues from other DOE sites. Plutonium Facility personnel are gathering all available data on what off-site residues have been processed, what processes were used on them, and whatever chemical assays are on-hand. Table 2 shows the typical categories of scrap and residue fed into plutonium recovery operations at the Plutonium Facility.

[1] QAPP requires that when a toxicity characteristic hazardous constituent is identified as reasonably expected to be in the waste stream, no judgement, using acceptable knowledge, will be made regarding the concentration of the constituent. Analytical data must be used to demonstrate that concentration is below regulatory level for disposal.

Contaminant	Waste Code
Arsenic	D004
Barium	D005
Cadmium	D006
Chromium	D007
Lead	D008
Mercury	D009
Selenium	D010
Chloroform	D022
Carbon Tetrachloride	D019, F001
Chlorobenzene	D021, F002
Acetone	F003
n-Butyl alcohol	F003
Methanol	F003
Methyl ethyl ketone	D035, F005
Methylene Chloride	F001, F002
Toluene	F003
Tetrachloroethylene	D039,F001, F002
1,1,1-Trichloroethane	F001, F002
1,1,2-Trichloroethane	F002
Trichloroethylene	F001, F002
1,1,2-Trichloro-1,2,2-trifluoroethane	F002
Xylene	F003

Isotopes
Cerium 144
Thorium 230
Thorium 232
Protactinium 231
Uranium 233
Uranium 238
Americium 241
Americium 243
Curium 244

Table 1
Hazardous Chemical and Radioisotopic Contaminants

The nuclear materials (i.e. plutonium) in recovery scrap and residue also have contaminants that occur naturally or are products of nuclear decay. The major radioisotope contaminants have been identified (See Table 1) and correlated to processes where their concentrations relative to the plutonium in the waste stream can be increased or decreased. Knowledge of the presence of these contaminants and their relative concentrations are important in determining what nondestructive assay techniques are needed to fully characterize the waste for radiological constituents in accordance with the QAPP.[2]

[2] QAPP requires that for waste streams contaminated with radioactive materials of variable or unknown isotopic composition, a method independent of acceptable knowledge be used to determine isotopic ratios.

Scrap or Residue Category	Purity[3]	Comments
Graphite	Pure	Molds from casting
Combustibles		With lead tape prior to 1991/ includes HEPAs
Incinerator ash		Some is from off-site
Oxide heels	Pure	From casting/ well characterized
Reduction slags	Pure	Sand, slag, and crucibles
Insulation		Asbestos, ceramics, firebrick
Scrap metal		Can generate chromium
Glass		With lead tape prior to 1991
Rubber		Includes leaded gloves
Sludge		
Chloride salts	Pure	From extractive metallurgy
Chloride salt electrolyte	Pure	
Chloride salt solvent	Pure	
Pu/U mixtures	Pure	
Pu/Th mixtures	Pure	
Pu/Be mixtures	Pure	
Pu/Np mixtures	Pure	
Pu/Zr mixtures	Pure	
Pu/Al mixtures	Pure	
Nonspecification metal	Pure	High level scrap
Anode heels		High level scrap/ contains RCRA metals
Rich Plutonium oxide	Pure	High level scrap
Lean Plutonium oxide	Pure	High level scrap

Table 2
Materials Commonly Processed for Plutonium Recovery

TIME LINE FOR WASTE STREAM DELINEATION

A critical consideration in the delineation and characterization of waste streams is when the waste was generated in relation to the implementation at the Plutonium Facility of waste segregation practices, hazardous waste regulation compliance, WIPP WAC compliance, etc. Clearly, since the opening of the facility in January, 1978 waste management and compliance practices have evolved to a high level of sophistication, just as the regulations, quality criteria, and public expectation have.

To account for the progression in the amount and quality of information available for characterization of waste major waste streams must be divided into substreams delineated by the

[3] Purity here implies that the scrap or residue used as feed in recovery operations contains no toxicity characteristic hazardous chemical constituents as determined by knowledge of the process that generated it and/or assay.

time span in which the waste was generated and characterized using the knowledge of the waste available at the time. Table 3 shows the major milestones in management of transuranic waste at the Plutonium Facility that influence delineation of waste streams.

Date	Milestone
January, 1978	Opening of LANL Plutonium Facility.
November, 1978	Implementation of the Radioactive Solid Waste Disposal (RSWD) form for transfer of waste to interim storage.
January, 1979	Implementation of Plutonium Facility database for compiling transuranic waste package data. Tracks RSWD data.
July, 1987	Implementation of Transuranic Waste Storage Record (TWSR) to replace RSWD. Complies with WIPP WAC, Revision 3.
July, 1987	Implementation of facility specific certification program to comply with WIPP WAC, Revision 3.
July, 1987	Implementation of Waste Originator Disposition Form (WODF) for waste characterization and Drum Waste Log Sheet (DWLS) for collating package data.
July, 1987	Implementation of Plutonium Facility database for compiling data from WODFs and DWLSs.
April, 1991	Implementation of LANL Waste Profile Form for documentation of waste stream characterization.
May, 1992	DOE Mixed Waste Moratorium - facility operations cease - processes are meticulously evaluated and redesigned to prevent or minimize mixed waste generation.
August, 1995	Implementation of process controlling waste management database. Ensures compliance with WIPP WAC, Revision 5.
August, 1997	Implementation of facility specific certification program to comply with WIPP WAC, Revision 5.

Table 3
Timeline of Plutonium Facility Waste Management Milestones

STATUS OF ACCEPTABLE KNOWLEDGE DOCUMENTATION PROJECT

Application of the site specific procedure, Acceptable Knowledge Documentation, was evaluated as part of the July, 1997 audit of the LANL transuranic waste certification Program by the DOE Carlsbad Area Office (CAO). The waste stream summary for the nonhazardous combustible waste stream (TA-55-20) was reviewed as part of the evaluation. CAO determined that the procedure satisfied the requirements of the QAPP and that the waste stream summary was assembled in accordance with the procedure. There were no findings related to the acceptable knowledge characterization process. Discrepancies in the sample waste stream summary were cited and require resolution. Additional information on the composition of process feed materials and potential hazardous constituents is required as discussed above.

Once the discrepancies in the characterization of waste stream TA-55-20 are resolved waste payload containers that meet the characterization profile will be assigned to that waste stream. A waste stream profile will be submitted via the WIPP Waste Information System (WWIS) to the WIPP waste acceptance official for approval. When waste stream approval is received certification data packages for individual payload containers from the waste stream can be submitted via the WWIS for acceptance. Shipments to WIPP using the TRUPACT II can then be arranged by site certification officials. In the meantime, additional waste stream summaries and waste stream profiles will be generated in accordance with the Acceptable Knowledge Documentation procedure. LANL expects that by the opening of WIPP in May, 1998 it will have a sufficient number of containers from several approved wastes stream to support regular shipments. Initially, all approved LANL waste streams will consist of Plutonium Facility waste as it is the only facility with an interface document approved by the site certification program.

REFERENCES

DOE Consolidated TRUPACT-II Content Codes (TRUCON) and List of Chemicals and Materials in TRUCON (Chemical List). DOE/WIPP 89-004, Carlsbad, New Mexico, U.S. Department of Energy, Carlsbad Area Office (1996a)

Quality Assurance Program Document. CAO-94-1012, Current Revision, Carlsbad, New Mexico, U.S. Department of Energy, Carlsbad Area Office (1996b)

Transuranic Waste Characterization Quality Assurance Program Plan. CAO-94-1010, Current Revision, Carlsbad, New Mexico, U.S. Department of Energy, Carlsbad Area Office (1995a)

Waste Acceptance Criteria for the Waste Isolation Pilot Plant, Revision 5. DOE/WIPP-069, Carlsbad, New Mexico, U.S. Department of Energy, Carlsbad Area Office (1996c)

Waste Isolation Pilot Plant Transuranic Baseline Inventory Report. CAO-95-1005, Current Revision, Carlsbad, New Mexico, U.S. Department of Energy, Carlsbad Area Office (1995b)

NRC Safety Analysis Report for the TRUPACT-II Shipping Package. Docket 9218, Washington, D.C., U.S. Nuclear Regulatory Commission (1994)

LANL AR 10-9, Waste Profile Form

Los Alamos National Laboratory Transuranic Waste Certification Plan, PLAN-CSTDO-004 (1996b)

Los Alamos National Laboratory Transuranic Waste Characterization Quality Assurance Project Plan, CSTDO-PLAN-002 (1997b)

Los Alamos National Laboratory Transuranic Waste Characterization Sampling Plan, TWCP-PLAN-0.2.7-001

Acceptable Knowledge Documentation, TWCP-QP-1.1-021

TA-55 Transuranic Waste Interface Document, WM-TA55-TWID

M98003312

Report Number (14) LA-UR--97-4655
CONF-980307--

Publ. Date (11) 199803
Sponsor Code (18) DOE/DP, XF
UC Category (19) UC-721, DOE/ER

DOE