

United States Government

Department of Energy

memorandum

 Albuquerque Operations Office
 Waste Isolation Pilot Plant
 Carlsbad, New Mexico 8822

ENTERED

DATE: JUL 19 1991

REPLY TO: SI:HJD 91-0542

ATTN OF: Waste Characterization Program Plan for WIPP Experimental Waste, DOE-WIPP 89-025, Revision 1

SUBJECT: Those on Attached List

TO:

Attached for your information is Revision 1 of the "Waste Characterization Program for WIPP Experimental Waste", DOE-WIPP 89-025. The purpose of this program plan is to define the activities required to characterize the experimental waste prior to conducting the bin-scale and alcove tests at WIPP. The characterization activities identified will satisfy the project's information needs to support the test program and the various regulatory requirements.

This revision of the program plan incorporates the requirements imposed by the No-Migration Determination. Comments from the New Mexico Environment Department, Environmental Protection Agency Office of Solid Waste and Region VI, the Environmental Evaluation Group and DOE were incorporated as appropriate.

This program plan will be revised and reissued as necessary to reflect changes in DOE Orders, Federal and State regulations and requirements.

Arlen Hunt
 Arlen Hunt
 Project Manager

Attachment

Report in magazine file

10/21/91 ACS

SEP 1991

910704





DOE/WIPP 89-025
Revision 1

Waste Characterization Program Plan for WIPP Experimental Waste

July 1991



SEP

Waste Isolation Pilot Plant

This document is issued by Westinghouse Electric Corporation, Waste Isolation Division, as the Managing and Operating Contractor for the Department of Energy, Waste Isolation Pilot Plant, Carlsbad, New Mexico, 88221 .

DISCLAIMER

This document 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. References 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.

This document has been reproduced directly from the best possible copy. It is available to DOE and DOE contractors at the following address:

Office of Scientific and Technical Information
P.O. Box 62
Oak Ridge, TN 37831

Prices available from (615) 576-8401; FTS 626-8401

**Available to the public from the
National Technical Information Service
U.S. Department of Commerce
5285 Port Royal Road
Springfield, VA 22161**

WASTE CHARACTERIZATION PROGRAM PLAN
FOR
WIPP EXPERIMENTAL WASTE

APPROVAL:

DATE:



Project Manager, DOE-WIPP Project Office

7-19-91

DOE-WIPP 89 - 025
Revision 1.0
July 1991

**Waste Characterization Program Plan
for
WIPP Experimental Waste**

TABLE OF CONTENTS

SECTION	<u>PAGE</u>
TABLE OF CONTENTS	i
LIST OF FIGURES	ii
LIST OF TABLES	ii
LIST OF ACRONYMS	iii
1.0 INTRODUCTION	1-1
2.0 SCOPE AND RESPONSIBILITIES	2-1
2.1 Department of Energy	2-1
2.2 External Agencies and Organizations	2-1
3.0 WASTE CHARACTERIZATION PROGRAM	3-1
3.1 Waste Characterization Requirements for Performance Assessment (PA)	3-4
3.2 RCRA Waste Characterization Requirements	3-9
3.2.1 Conditional No-Migration Determination	3-9
3.2.2 Compliance with Other RCRA Regulations	3-11
4.0 QUALITY ASSURANCE	4-1
5.0 REFERENCES	5-1
6.0 GLOSSARY	6-1

LIST OF FIGURES

<u>FIGURE</u>	<u>PAGE</u>
1 - Documents Governing Waste Characterization	2-2
2 - Waste Characterization Requirements for Bin-Scale Experiments	3-7
3 - Waste Characterization Requirements for Alcove Experiments	3-8

LIST OF TABLES

<u>TABLE</u>	<u>PAGE</u>
1 - General Technical Requirements for Waste Characterization	3-2
2 - Expected Controlling Variables for Gas Generation by CH TRU Wastes	3-3

LIST OF ACRONYMS

ASME	American Society of Mechanical Engineers
CFR	Code of Federal Regulations
CH-TRU	Contact-Handled Transuranic
DOE	U.S. Department of Energy
DOE-EM	U.S. Department of Energy, Office of Environmental Restoration and Waste Management
DOE-WPO	U.S. Department of Energy, WIPP Project Office
EEG	Environmental Evaluation Group
EPA	U.S. Environmental Protection Agency
EPA/ORP	U.S. Environmental Protection Agency, Office of Radiation Programs
EPA/OSW	U.S. Environmental Protection Agency, Office of Solid Waste
HWMR	Hazardous Waste Management Regulations
LEL	Lower Explosion Limit
NMD	Conditional No-Migration Determination
NMED	New Mexico Environment Department
NMVP	No-Migration Variance Petition
NRC	Nuclear Regulatory Commission
PA	Performance Assessment
QAPP	Quality Assurance Program Plan
QAPJP	Quality Assurance Project Plan
RCRA	Resource Conservation and Recovery Act
RTR	Real Time Radiography
SNL	Sandia National Laboratories
SOP	Standard Operating Procedure
TRAMPAC	TRUPACT-II Authorized Methods for Payload Control
TRU	Transuranic
TRUCON	TRUPACT-II Content Codes
TRUPACT-II	Transuranic Package Transporter-II
UEL	Upper Explosion Limit
VOC	Volatile Organic Compound
WAC	Waste Acceptance Criteria
WACCC	Waste Acceptance Criteria Certification Committee
WAP	Waste Analysis Plan
WCP	Waste Characterization Program
WCPP	Waste Characterization Program Plan
WIPP	Waste Isolation Pilot Plant
WPP	Waste Profile Plan

1.0 INTRODUCTION

The U.S. Department of Energy (DOE) has developed a transuranic (TRU) Waste Characterization Program (WCP) to support the test phase activities designed to determine compliance with several regulatory requirements that have been imposed on the Waste Isolation Pilot Plant (WIPP). This document is the Waste Characterization Program Plan (WCPP) that defines the tasks that are necessary to meet the applicable requirements and test phase criteria.

The TRU waste characterization activities will apply to both TRU and TRU mixed waste. These wastes are generated as a result of defense-related activities at several DOE facilities. TRU waste is classified as TRU mixed waste if it contains hazardous wastes as defined in 40 CFR Part 261 (EPA, 1989).

Waste characterization information derived from the implementation of this Waste Characterization Program Plan will be used to support the following regulatory requirements and test phase activities:

- Compliance with the Conditional No-Migration Determination (NMD) for the test phase (EPA, 1990).
- Verification of waste characterization information for 40 CFR Part 265.13 (EPA, 1989).
- Verification that the assumed hazardous constituent concentrations in the hydrologic modeling for the No-Migration Variance Petition (NMVP) (DOE, 1990) do indeed represent conservative (high) values.
- Analysis of headspace gases from waste containers to confirm the assumptions made about the potential releases of volatile organic compounds (VOCs) during the experimental and operational periods (DOE, 1990; EPA, 1990).
- Collection of data as part of waste characterization activities to demonstrate that the WIPP facility will be in long-term compliance with 40 CFR Part 191 (EPA, 1985) and applicable RCRA regulations.
- Demonstration that the waste used in the WIPP test phase is representative (in terms of gas generation controlling variables) of waste to be sent to WIPP for disposal.
- Verification that the experimental waste meets the WIPP Waste Acceptance Criteria (WAC) (DOE, 1989b) and the TRUPACT-II Authorized Methods for Payload Control (TRAMPAC, Appendix 1.3.7 of the TRUPACT-II Safety Analysis Report) (NuPac, 1990) before shipment to WIPP.

Knowledge of TRU and TRU mixed waste at the DOE generator/storage sites is based on the following information:

- Process knowledge, which is the understanding of waste quantities and composition gained from a knowledge of the waste and the processes that generate them, and

- **Sampling and analysis of the actual waste generated/stored at all DOE sites shipping waste to WIPP.**

Process knowledge provides the central body of information used to characterize the waste which will be emplaced at WIPP. The sampling and analysis of TRU and TRU mixed wastes during the test phase will provide additional analytical data to verify system-wide process knowledge. These data will be obtained through the examination of a statistically selected fraction of the waste intended for shipment to WIPP for disposal. The examination of waste at the sites will be performed using the procedures outlined in this document and detailed in the Quality Assurance Program Plan for the Waste Isolation Pilot Plant Experimental-Waste Characterization Program (QAPP) (DOE, 1991a) and site-specific Quality Assurance Project Plans (QAPjPs). These activities will provide information to demonstrate that the waste used in the test phase experiments is representative (in terms of gas generation controlling variables) of the waste to be emplaced in WIPP for disposal.

This WCPP will be revised as new requirements are identified.

2.0 SCOPE AND RESPONSIBILITIES

The scope of this document is to define the WCP and the relationships among the agencies, regulatory documents, and program requirements associated with the characterization of waste to be emplaced at WIPP. In this section, the agencies and organizations responsible for elements of the WCP are identified, and descriptions of their responsibilities within the program are provided below. The WCP requirements are included in a number of documents based on program and regulatory requirements. Figure 1 indicates the relationship of these documents to the program, and to each other.

2.1 DEPARTMENT OF ENERGY

- DOE - Office of Environmental Restoration and Waste Management (DOE-EM) - The DOE-EM reviews this document and approves the Quality Assurance Program Plan for the Waste Isolation Pilot Plant Experimental-Waste Characterization Program (QAPP) (DOE, 1991a).
- DOE-WIPP Project Office (DOE-WPO) - Overall management of the WIPP WCP is the responsibility of DOE-WPO. DOE-WPO approves this document, the QAPP, and the Sandia National Laboratories (SNL) test plans (and addenda). In addition, DOE-WPO has administrative responsibility for the analytical laboratory Performance Demonstration Plan (PDP) (DOE, 1991d).
- Waste Acceptance Criteria Certification Committee (WACCC) - The WACCC will review and approve generator/storage site-specific QAPjPs and perform program surveillance and audit functions. The WACCC is designated as the organization responsible for observing and overseeing waste characterization activities with cooperative participation by other organizations including the U.S. Environmental Protection Agency (EPA), EPA Region VI, the New Mexico Environment Department (NMED), and the Environmental Evaluation Group (EEG).
- DOE Contractors at Generator/Storage Sites - Waste characterization and sampling activities will be performed by site operators and will be subject to review and/or oversight by site contractors, DOE Site Operations Offices, and the WACCC. Generator/storage site waste characterization requirements described in this document are based upon program requirements found in the NMD, Bin-Scale and Alcove Test Plans (Molecke, 1990a; Molecke, 1990b), the Bin-Scale Addendum (Molecke and Lappin, 1990), and additional test plans (e.g., leaching/solubility requirements document) which will be addressed in the future. As these additional test plans or requirements are issued, they will be incorporated into future revisions of this document.

2.2 EXTERNAL AGENCIES AND ORGANIZATIONS

- EPA Office of Radiation Programs (EPA/ORP) - The EPA/ORP is the regulatory agency responsible for issuing 40 CFR Part 191, "Environmental Radiation Protection Standards for Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Wastes."

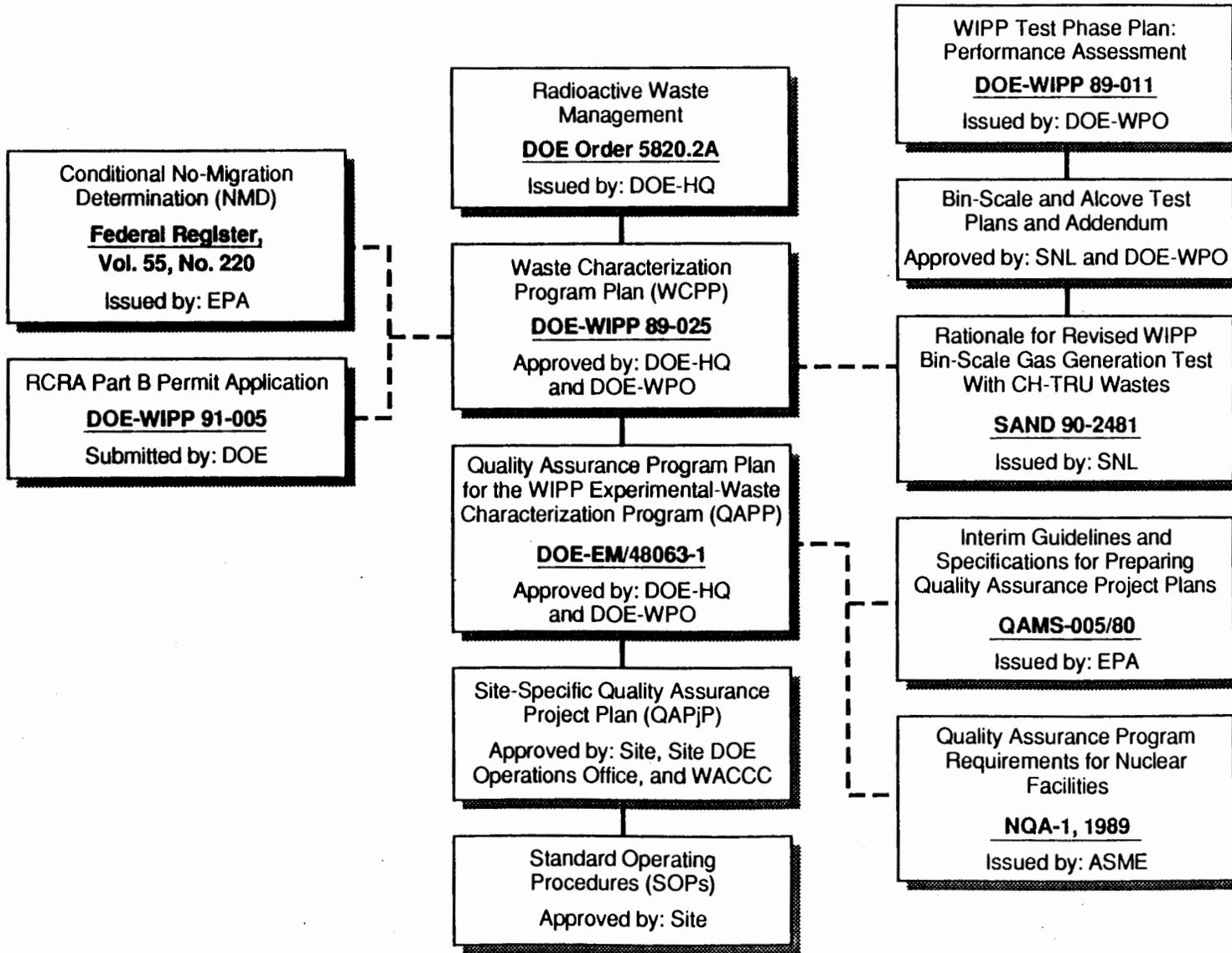


FIGURE 1. DOCUMENTS GOVERNING WASTE CHARACTERIZATION

- EPA Office of Solid Waste (EPA/OSW) - EPA/OSW issued the Conditional No-Migration Determination (NMD) (EPA, 1990) for WIPP. EPA/OSW is providing technical review for issues relating to compliance with the NMD.

EPA/OSW will be involved in the WCP throughout the development and implementation of sampling and analysis protocols. In addition to reviewing WIPP program plans, EPA/OSW will be asked to review and comment on DOE's proposed sampling and analysis methods documented in the QAPP.

- EPA Region VI - The EPA Region VI is responsible for implementing the NMD including any possible enforcement.
- New Mexico Environment Department (NMED) - The NMED is the state agency in New Mexico authorized by the EPA to regulate mixed waste under the authority of RCRA.
- Environmental Evaluation Group (EEG) - The EEG is an organization created to provide independent technical review of all WIPP activities. The EEG is funded by DOE and is administered by the New Mexico Institute of Mining and Technology.

In addition to the agencies listed above, agencies of states other than New Mexico in which DOE facilities are located, and which are participating in WIPP programs, may have requirements that are not precluded by the WCPP.

3.0 WASTE CHARACTERIZATION PROGRAM

The DOE has developed the current WCP to obtain data to verify process knowledge in support of the regulatory requirements and test phase activities listed in Section 1.0. This information will be added to the existing waste characterization databases. This section describes the objectives of the current program.

Technical Requirements for Waste Characterization

Parameters and procedures considered in this document, how they relate to 40 CFR Part 191 (EPA, 1985) and 40 CFR Part 268 (EPA, 1989), and how they relate to verification of process knowledge, are presented in Table 1 and are described below.

- **Isotopic Distribution and Assay:** These results provide information necessary to determine both the total radionuclide quantity and the specific isotopes present in the waste. This information is used to assess 40 CFR Part 191 and long-term 40 CFR Part 268 compliance. Total alpha activity is an SNL test plan (Molecke 1990a, 1990b; Molecke and Lappin, 1990) criteria that will be used to determine potential radiolytic gas generation rates.
- **Headspace Gas Analysis:** Headspace gas composition data can be used to determine:
 - The presence of nonflammable VOCs, as specified by the QAPP (DOE, 1991a), in the headspace of a drum. This information will be used to address the comparability requirement from the NMD (EPA, 1990).
 - Measurement of H₂, CH₄, and potentially flammable VOCs, as specified by the QAPP (DOE, 1991a), to address the flammability requirements in the NMD (EPA, 1990).
 - Identification of the dominant gas generation/consumption process occurring in a drum (e.g., production of CO₂ and depletion of O₂ due to radiolysis of paper/cloth).
- **Real-Time Radiography (RTR):** This video-based, x-ray examination provides general information about the waste components (e.g., combustibles, metals, or inorganic sludges). RTR is used by the sites to determine compliance with the WAC (DOE, 1989) and TRAMPAC criteria (NuPac, 1990). Examples of items that can be detected or determined by RTR are the presence of free liquids, the physical form of the waste, and the presence of prohibited items such as sealed containers greater than 1 gallon in size.
- **Visual Inspection and Weighing of Solid Waste:** Visual inspection and weighing will provide data on the types and amounts of waste materials present in a waste container (e.g., corroding metals/steels, cellulose). The weight of all waste materials in a waste container will be reported for the first ten variables listed in Table 2. The quantities (by weight) of materials listed in Table 2 which are present in each container will be determined in support of DOE experimental programs (Molecke, 1990a, 1990b; Molecke and Lappin, 1990) and performance assessment (PA) calculations.

TABLE 1. GENERAL TECHNICAL REQUIREMENTS FOR WASTE CHARACTERIZATION

PARAMETER	PROCEDURE	40 CFR PART 191	40 CFR PART 268		VERIFICATION OF PROCESS KNOWLEDGE
			SHORT-TERM (NMD)	LONG-TERM	
Isotopic Distribution and Assay	Radioassay	Yes	--	Yes	Yes
Headspace Gas Composition	Sampling and Analysis	--	Yes	Yes	Yes
Waste Component Materials/Waste Categories	RTR and/or Visual Inspection and Weighing	Yes	--	Yes	Yes
VOCs and Toxic Metals (Sludges)	To Be Determined	--	Yes	Yes	Yes
Major Cations and Anions, pH (Sludges)	To Be Determined	Yes	--	Yes	Yes

TABLE 2

EXPECTED CONTROLLING VARIABLES FOR
GAS GENERATION BY CH TRU WASTES*

	<u>CONTROLLING VARIABLE</u>	<u>DESCRIPTION</u>
1.	Cellulosic Materials	paper, cloth, wood, filter media
2.	Plastics	bags, liners, wastes, Plexiglas, benelex
3.	Rubber Materials	gloves, aprons, wastes, general
4.	Corroding Metal/Steels	drums, wastes, including stainless (high gas generation, high pH concerns)
5.	Corroding Metal/Aluminum	wastes
6.	"Non-Corroding" Metals	lead, copper, tantalum, etc. (significantly less hydrogen production)
7.	Solid Inorganic Materials	glasses, ceramics, graphite, etc.
8.	Inorganic Sludges	including sorbed water estimate
9.	Cements	including additives
10.	Other Organic Materials	resins, oils, organic sludges, solvents
11.	Total alpha curie content	(individual radionuclides also needed for PA)

*Lappin, et al., 1991.

- **Sludge Analysis for Volatile Organic Compounds and Toxic Metals:** Sludges will be analyzed for VOCs and toxic metals as specified in the QAPP (DOE, 1991a) to verify RCRA waste characterization information provided by the DOE generator/storage sites. In addition, analyses for these constituents will be used in support of a long-term NMVP that will be submitted by DOE.
- **Major Cations and Anions and pH of Sludges:** These properties will be quantified because of their influence on radionuclide solubilities, which are input into PA calculations. In addition, these properties may influence the solubilities of VOCs and toxic metals.

3.1 WASTE CHARACTERIZATION REQUIREMENTS FOR PERFORMANCE ASSESSMENT (PA)

In addition to laboratory experiments (Brush, 1990), DOE has developed tests to estimate the gas generation rates of wastes to be emplaced at WIPP under simulated repository conditions. These tests are detailed in the Bin-Scale Test Plan and Addendum (Molecke, 1990a; Molecke and Lappin, 1990) and the Alcove Test Plan (Molecke, 1990b). These tests simulate both long-term repository conditions (Bin-Scale Test) and post-closure, short-term repository conditions on a room scale (Alcove Test). A fraction of the total DOE waste inventory will be tested in the Bin-Scale and Alcove experiments to provide data in support of performance assessment studies being conducted by DOE. The composition of the test waste was chosen in an effort to study waste which is representative (in terms of gas generation controlling variables) of TRU waste throughout the DOE system.

The variables listed in Table 2 are used to analyze gas generation properties. These variables are grouped by waste material characteristics that affect gas production from processes such as bacterial, corrosive, and radiolytic mechanisms which may exist in the WIPP repository after closure. The first ten parameters represent potential sources for gas production. The eleventh parameter (alpha curies) is not in itself a gas production source. However, it is an energy source for radiolysis, which may produce gas. Alpha radiation from all TRU elements has approximately the same energy associated with alpha decay. Therefore, equivalent alpha curies from different transuranic elements should produce the same potential amount of gas.

Representativeness of the waste with respect to the variables in Table 2 refers only to overall properties (e.g., the gas generation potential per unit weight of variable) and not to the amount of constituents present in the waste. For example, if the maximum amount of cellulosics (variable 1 in Table 2) present in a WIPP experimental drum is 50 kg, a drum of waste sampled at a site with 100 kg of cellulosics can still be included within the test waste acceptability envelope described below. The drum sampled at the site must contain only waste materials which are listed in Table 2.

The occurrence of VOCs and/or toxic metals in the wastes is not expected to affect the gas generation rate or gas generation potential of the nonhazardous waste components. Therefore, the wastes characterized for the Bin-Scale and Alcove Tests are not selected to be representative of the DOE inventory with respect to hazardous constituents.

In the event that waste exists in the system that is not statistically represented by the test waste (i.e., if the potential gas generation properties of a waste cannot be classified by the variables in

Table 2), the following three options are available to qualify this "non-representative waste" for disposal at WIPP:

- **OPTION 1**

- Process the non-representative waste to alter its properties such that it is represented by the waste tested in the experimental program. This option modifies the non-conforming waste such that it would be included under the existing acceptability envelope for gas generation potential.

- **OPTION 2**

- Test the nonrepresentative waste under the conditions of the experimental waste for the same test parameters, and include these results in the PA evaluations. This option allows expansion of the existing acceptability envelope to include the nonrepresentative waste from the DOE inventory into the WIPP disposal system, based upon acceptable results in the PA calculations.

- **OPTION 3**

- Based upon bounding analyses and knowledge of the waste (without actual gas generation testing), demonstrate that the waste can be included in the PA. This option allows expansion of the acceptability envelope (as in Option 2) but relies on conservative analysis and assumptions instead of actual gas generation testing of the waste. This option requires that sufficient information be available regarding the properties of this waste to enable conservative analyses to be performed.

The test plans specify waste characterization requirements in Section 8.3 of the Bin-Scale Test Plan (Molecke, 1990a), in Sections 4.2 and 5.11 of the Bin-Scale Test Plan Addendum (Molecke and Lappin, 1990), and in Section 10.4 of the Alcove Test Plan (Molecke, 1990b). The test plans will be revised and updated as necessary to reflect changes in waste characterization requirements and/or developments in experimental design. This document addresses the present waste characterization requirements of the test plans and may supersede some analytical requirements in those test plans with respect to determining gas generation properties.

DOE is currently preparing a drum-scale leaching/solubility requirements document. These experiments will be performed in lieu of liquid sampling experiments detailed in the Bin Scale Test Plan (Molecke 1990a). Additional waste characterization requirements are expected to be identified in the leaching/solubility requirements document. When additional requirements are identified in the drum-scale leaching/solubility requirements document, these requirements will be incorporated into a revision of the WCPP.

Waste Characterization Requirements to Demonstrate Representativeness of Waste

An objective of the WCP is to characterize waste used in experiments to demonstrate that the gas generation properties of experimental waste are comparable to those of TRU waste in the DOE system. This requires that all sites generate waste characterization data for comparison with the test waste.

The basis for comparison of TRU waste in the DOE system is process knowledge as supported by waste sampling and analysis, which consists of the following:

- Process flow diagrams presented in the NMVP
- Information in the TRUPACT-II Content Codes (TRUCON) (DOE, 1991c) document and chemical lists published in the NMVP (DOE, 1990)
- Records and documentation (including any waste analyses data) from generator/storage sites.

Each DOE TRU waste generator/storage site must characterize a statistically selected (Lappin et al., 1991) portion of their waste to verify their process knowledge. TRU waste data collected during the WCP will be compared with existing process knowledge information, as outlined above. These data will be used to verify that assessments of the physical and chemical composition of the waste are accurate (e.g., the percentages of materials listed in Table 2), or that conservative assumptions have been made in cases where no analytical data exists.

A summary of the waste characterization requirements for the Bin-Scale Test waste is presented in Figure 2. Each of the drums that will be repackaged into bins for the Bin-Scale Test must meet all applicable waste characterization requirements. During the repackaging process, data will be collected for comparison with the waste content codes, and any previous applicable waste characterization data, to determine the accuracy of assessments of the physical and chemical composition of the waste.

Selection of Drums for Bin Tests

The number of drums from each WIPP waste test type, and from each content code within a WIPP waste test type, which are required for the bin tests is specified in the "rationale document" (Lappin et al., 1991). All waste drums for the bin-scale tests shall be randomly selected as specified in the rationale document. Drums used in the bin tests will be selected from that population of waste which is known or reasonably expected to comply with WIPP-WAC (DOE, 1989b) and TRAMPAC (NuPac, 1990) criteria. The bin must meet the WIPP-WAC (DOE, 1989b) and the TRAMPAC (NuPac, 1990) requirements. These requirements and criteria have been published and made available to the waste generator/storage sites.

Selection of Drums for Alcove Tests

Waste characterization requirements for the Alcove Test are shown in Figure 3. The waste drum equivalent volumes needed per alcove are listed in Table 10.4 of the Alcove Test Plan (Molecke, 1990b). Selection of drums or boxes will be done in accordance with a statistical sampling plan, as in the Bin-Scale Test. The same restrictions that apply to Bin-Scale Test drums (meeting both the WIPP-WAC criteria and the TRAMPAC requirements) apply to the drums/boxes to be used in the alcove tests.

Statistical Sampling Requirements

All of the drum equivalent waste to be used in the Bin-Scale Test will be characterized according to the requirements described in this document and the QAPP. RTR and assay measurements

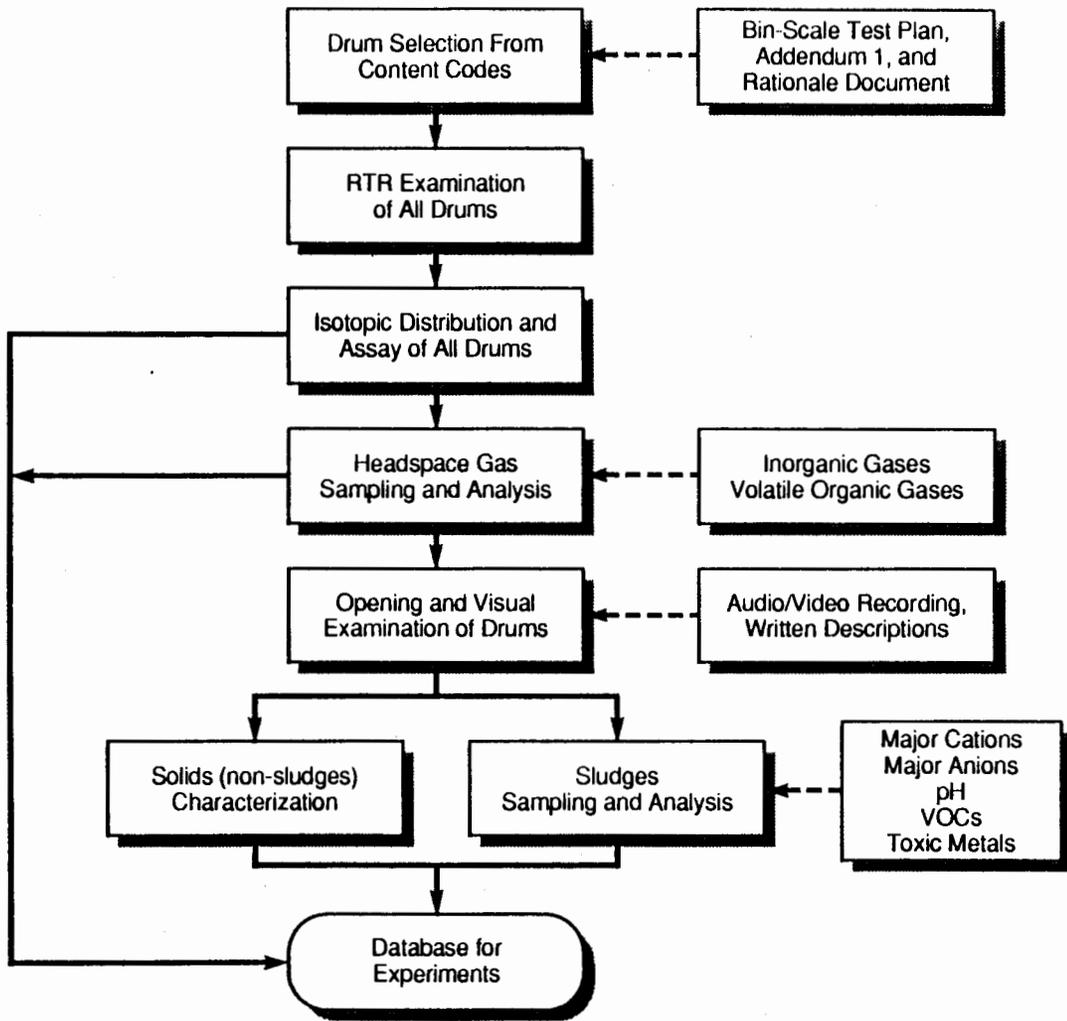


FIGURE 2. WASTE CHARACTERIZATION REQUIREMENTS FOR BIN-SCALE EXPERIMENTS

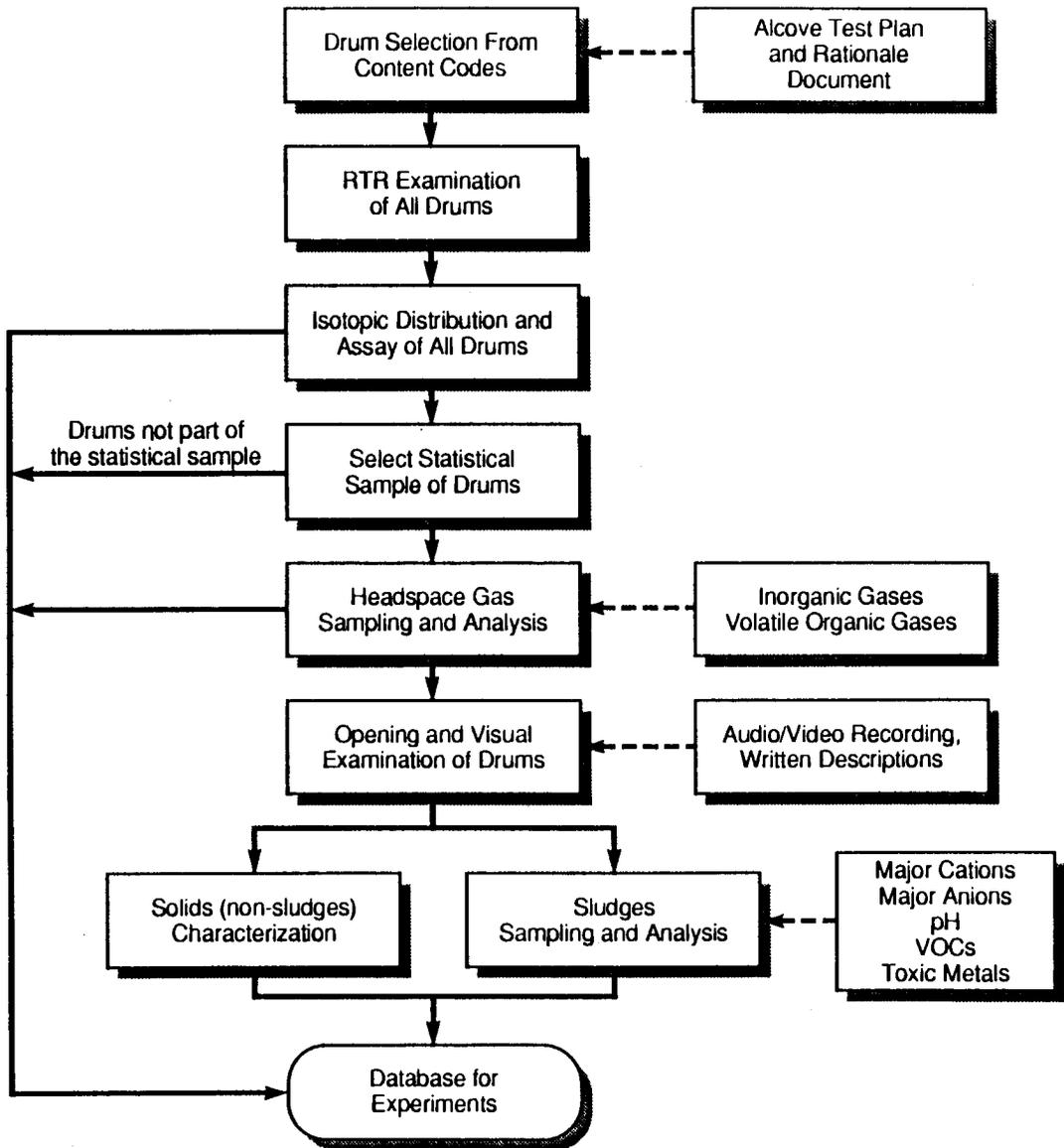


FIGURE 3. WASTE CHARACTERIZATION REQUIREMENTS FOR ALCOVE EXPERIMENTS

will be used to provide data on all experimental waste (both bin-scale and alcove). A statistical sample of the drum equivalent waste to be used in the Alcove Test will be characterized in accordance with the requirements described in this document and the QAPP.

3.2 RCRA WASTE CHARACTERIZATION REQUIREMENTS

A portion of the waste destined for WIPP is TRU mixed waste. TRU mixed waste is solid waste with transuranic elements and RCRA-regulated hazardous wastes. Waste is regulated as hazardous waste if it meets the following criteria:

- It is a listed waste as defined by New Mexico Hazardous Waste Management Regulations (HWMR-6), Part II, Subpart D; or is mixed with or derived from a listed waste;
- It exhibits a characteristic as defined by HWMR-6 Part II, Subpart C.

Waste which exhibits characteristics of ignitability, corrosivity, or reactivity (as defined by HWMR-6, Part II, sections 261.21, 261.22, or 261.23, respectively) will not be emplaced in the WIPP (DOE, 1991b).

Waste subject to the land disposal restrictions of HWMR-6, Pt. VIII, section 268 is proposed to be emplaced in the WIPP.

3.2.1 Conditional No-Migration Determination

The WIPP submitted a No-Migration Variance Petition (NMVP) (DOE, 1990) to the EPA Office of Solid Waste (EPA/OSW) to receive a variance from the EPA's Land Disposal Restrictions (40 CFR Part 268) (EPA, 1989). Conservative (i.e., high) estimates for the potential concentration of VOCs and/or toxic metals were made for the source term for long-term modeling of repository performance under undisturbed conditions. Estimates of VOCs in the headspace of waste drums were used to demonstrate short-term compliance with releases of VOCs during the experimental and operations periods. These VOC estimates were calculated from the sampling and analysis of approximately 200 drums of Rocky Flats Plant waste in storage at the Idaho National Engineering Laboratory (DOE, 1990).

In response to the NMVP for the WIPP, the EPA issued a Conditional No-Migration Determination (NMD) (EPA, 1990). The NMD waste characterization requirements for the test phase are summarized as follows:

- **Flammability**
 - Any waste container may not exceed 50 percent of the lower explosion limit (LEL) for H₂ and CH₄ in any layer of confinement (see glossary), when potentially flammable VOCs as a class are less than 500 ppm by volume prior to emplacement in WIPP. This requirement can be satisfied by measurement of the H₂ and CH₄ concentrations in the headspace and calculation of 50 percent LEL using the Le Chatelier Law (see glossary).

If the sampling and analysis of headspace gases to comply with the 50 percent of the LEL requirement is not performed immediately prior to emplacement, this condition can be satisfied by calculations using bounding gas generation rates, as presented in the QAPP (DOE, 1991a).

- If the potentially flammable VOCs occur in the headspace in concentrations greater than 500 ppm as a class, then a flame test must be performed, and the concentration of headspace gases must be below 50% of the LEL, prior to acceptance of that waste container for emplacement underground at WIPP.

- **Comparability (Nonflammable VOCs)**

- Any waste container that is sent directly to WIPP or any waste container that is loaded into a bin for emplacement at WIPP must meet the criteria that the headspace concentration within a waste container does not exceed two times (2X) the maximum concentration for the five nonflammable VOCs specified in the NMD (Table 2 of EPA, 1990), as specified in the QAPP (DOE, 1991a).
- Any bin or other waste container that is sent to WIPP must meet the requirement that the headspace concentration within a package does not exceed ten times (10X) the average concentration of the three nonflammable VOCs specified in the NMD (Table 3 of EPA, 1990), as specified in the QAPP (DOE, 1991a).
- Headspace gases must be analyzed for the VOCs listed in the NMD, as specified in the QAPP (DOE, 1991a). If additional VOCs are detected, these must be added to the NMD list and quantified.

- **Representativeness**

- For the initial experimental waste, sampling will be performed in the container headspace and the headspace of inner layers of confinement, as specified in the QAPP (DOE, 1991a). This is to ensure that representative data on the headspace gas concentrations in the container are obtained. For most non-flammable VOCs, the concentrations in the container headspace and in the inner confinement layers are expected to be similar. For gases like hydrogen, algorithms can be developed to conservatively predict the concentration gradients in a waste container. It is expected that once the representativeness of the container headspace sample is established, sampling of inner confinement layers will not be necessary.
- EPA/OSW will require demonstration of comparability and representativeness for headspace gases throughout the DOE system to allow the results of this WCP to be extrapolated to the remainder of the TRU waste inventory. DOE will also be required to demonstrate that the content of waste sampled in the test phase is similar to the waste described in the NMVP.

Other Waste Characterization Requirements

In addition to headspace sampling and analyses, other waste characterization requirements stipulated by the EPA in the NMD include the following:

- Analyses should be performed on sludges used in the test phase for toxic metals and VOCs listed in the NMD (EPA, 1990). This information will be used to verify RCRA waste characterization information provided by the DOE generator/storage site. In addition, analysis of the sludges for major cations and anions and pH will be performed since these variables can influence the mobility of toxic metals in the sludges.
- Solid wastes must be characterized for the 11 gas generation controlling variables identified in Table 2, Section 3.0 of this document. Quantification of these gas generation variables is important because EPA considers production and release of excess gas to be a viable mechanism by which hazardous constituents could migrate from the repository.

3.2.2 Compliance With Other RCRA Regulations

As a miscellaneous unit (HWMR-6, Part V, Subpart X), WIPP must comply with HWMR-6, Part VI, sec. 265, while under interim status, and HWMR-6, Part V, sec. 264, after the final RCRA permit is issued. WIPP submitted Part A of the RCRA permit application to the New Mexico Environment Department in January of 1991, and Part B of the RCRA permit application in February of 1991.

Certain activities undertaken through this program will provide the opportunity for verification of process knowledge. The majority of information available on TRU mixed waste is based on process knowledge. Process knowledge, in addition to the sampling and analytical criteria described in this document, will serve as the basis for compliance with the RCRA waste analysis requirements for WIPP under HWMR-6, Pt. VI, sec. 265.13.

Generator/storage sites must develop waste-category-specific waste profile plans (WPPs) to provide waste characterization information on a specific waste stream, content code or identification code (DOE, 1991b). The WPPs must include a description of the procedures used to verify the hazardous constituents in the waste to the satisfaction of the NMED. The Waste Analysis Plan (WAP) of the WIPP Part B permit application (DOE, 1991b) contains a general methodology for developing WPPs. DOE-WPO will provide the generator/ storage sites with prototype WPPs and specific guidance on how to document the required information.

4.0 QUALITY ASSURANCE

The WCP will be conducted in accordance with the following:

- NQA-1 [American Society of Mechanical Engineers (ASME), 1989]
- DOE Order 5820.2A, Radioactive Waste Management (DOE, 1988a)
- DOE Order 5700.6B, Quality Assurance (DOE, 1986)
- DOE-AL 5700.6B, Revision 1, Non-Weapons Quality Assurance (DOE-AL, 1988b)
- The quality assurance/quality control guidelines from SW-846 (EPA, 1986) which have been included in the QAPP (DOE, 1991a).

In addition, the WACCC will serve in a review, approval and audit capacity for the QAPjPs.

Specifications set forth in this document do not relieve any program participant from the responsibility of complying with applicable Federal, State, and local regulations; DOE Orders; existing permits and Interagency Agreements; or any site-specific controls on operations.

As a specific requirement of the WCP, dosimetry data will be collected for all radiation-exposed personnel at all sites participating in the program. These records will be collected on the basis of specific activities. The records will be used to evaluate relative risks and benefits of waste treatment and handling options. Dosimetry information will be made available to DOE-WPO without identification of any personnel participating in the WCP. Evaluations resulting from these records will be provided to the EPA.

Analytical methods and procedures to be used in the WCP are documented in the QAPP (DOE, 1991a), which is the governing document for all analyses performed in support of the WCP. The QAPP is based upon analytical requirements identified in this document. The QAPP addresses regulatory and programmatic requirements relative to sample size, preservation techniques, chain of custody, type of containers, holding times, and any other pertinent requirements.

Each site supplying waste for the test phase is required to prepare a site-specific QAPjP detailing how the requirements outlined in this program plan, and the system-wide QAPP, are met by the site. The QAPjPs will provide a detailed description of the sampling and analytical functions, as well as additional site-specific quality related objectives, in accordance with:

- EPA Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans (EPA, 1983)
- Criteria listed in Table 1 of this WCPP
- The list of analytes in the system-wide QAPP (DOE, 1991a).

All site waste characterization activities will be performed in conformance with requirements specified in an approved QAPJP. If off-site laboratories are used to perform analyses associated with this WCP, those laboratories must prepare and submit a QAPJP for their scope of work. Off-site laboratory QAPJPs must be approved by the WACCC. All laboratories performing analyses for the WCP will participate in the PDP which is detailed in the Performance Demonstration Program Plan (DOE, 1991d).

Participating DOE sites will be responsible for identifying and performing the quality assurance/quality control tasks associated with characterization activities, and must include those activities in the site-specific QAPJP submitted to the WACCC for approval. WACCC personnel will conduct audit and/or surveillance functions to ensure that sites are in compliance with their approved site-specific QAPJPs. Affected state and federal organizations and agencies will be invited to participate as observers during the audit and surveillance activities.

5.0 REFERENCES

American Society of Mechanical Engineers (ASME), 1989, "Quality Assurance Program Requirements for Nuclear Facilities," NQA-1, American Society of Mechanical Engineers, New York, New York.

Brush, L. H., 1990, "Test Plan for Laboratory and Modeling Studies of Repository and Radionuclide Chemistry for the Waste Isolation Pilot Plant," SAND 90-0266, Sandia National Laboratories.

DOE - See U.S. Department of Energy.

EPA - See U.S. Environmental Protection Agency.

Lappin, A. R., C. A. Gotway, M. A. Molecke, R. L. Hunter, and E. N. Lorusso, 1991, "Rationale for Revised WIPP Bin-Scale Gas-Generation Test with Contact Handled Transuranic Wastes at the Waste Isolation Pilot Plant," SAND90-2481, Sandia National Laboratories, Albuquerque, New Mexico.

Molecke, M. A., 1990a, "Test Plan: WIPP Bin-Scale CH-TRU Waste Tests," Sandia National Laboratories, Albuquerque, New Mexico.

Molecke, M. A., 1990b, "Test Plan: WIPP In Situ Alcove CH-TRU Waste Tests," Sandia National Laboratories, Albuquerque, New Mexico.

Molecke, M. A., and A. R. Lappin, 1990, "Test Plan Addendum #1: WIPP Bin-Scale CH TRU Waste Tests," SAND90-2082, Sandia National Laboratories, Albuquerque, New Mexico.

New Mexico Hazardous Waste Management Regulations (HWMR-6), 1991, Santa Fe, New Mexico.

NuPac, 1990, "Safety Analysis Report for the TRUPACT-II Shipping Package," Appendix 1.3.7, "TRUPACT-II Authorized Methods for Payload Control," Rev. 9, Nuclear Packaging, Inc., Federal Way, Washington.

U.S. Department of Energy, 1991a, "Quality Assurance Program Plan for the Waste Isolation Pilot Plant Experimental-Waste Characterization Program," DOE-EM/48063-1, Rev. 0, U.S. Department of Energy, Washington, D.C., April 1991.

U.S. Department of Energy, 1991b, "Resource Conservation and Recovery Act Part B Permit Application," DOE-WIPP 91-005, U.S. Department of Energy, Carlsbad, New Mexico, February 1991.

U.S. Department of Energy, 1991c, "TRUPACT-II Content Codes (TRUCON)," WIPP/DOE 89-004, Rev. 5, U.S. Department of Energy, WIPP Project Office, Carlsbad, New Mexico.

U.S. Department of Energy, 1991d, "Performance Demonstration Program Plan for the WIPP Experimental-Waste Characterization Program," DOE-WIPP 91-016, Waste Isolation Pilot Plant, Carlsbad, New Mexico.

U.S. Department of Energy, 1990, "Waste Isolation Pilot Plant No-Migration Variance Petition," DOE-WIPP 89-003, Rev. 1, U.S. Department of Energy, WIPP Project Office, Carlsbad, New Mexico.

U.S. Department of Energy, 1989a, "Draft Final Plan for the Waste Isolation Pilot Plant Test Phase: Performance Assessment," DOE-WIPP 89-011, U.S. Department of Energy, WIPP Project Office, Carlsbad, New Mexico.

U.S. Department of Energy, 1989b, "TRU Waste Acceptance Criteria for the Waste Isolation Pilot Plant," WIPP/DOE-069, Revision 3, Westinghouse Electric Corporation, Waste Isolation Division, Carlsbad, New Mexico.

U.S. Department of Energy, 1988a, "Radioactive Waste Management," DOE Order 5820.2A, September 28, 1988.

U.S. Department of Energy, Albuquerque Operations Office, 1988b, "Non-Weapons Quality Assurance," DOE-AL 5700.6B, Rev. 1, U.S. Department of Energy, Albuquerque Operations Office, Albuquerque, New Mexico.

U.S. Department of Energy, 1986, "Quality Assurance," DOE Order 5700.6B, U.S. Department of Energy, Washington, D.C.

U.S. Environmental Protection Agency, 1990, "Conditional No-Migration Determination for the Department of Energy Waste Isolation Pilot Plant (WIPP)," Federal Register, Vol. 55, No. 220, November 1990, 47700-47721.

U.S. Environmental Protection Agency, 1989, Title 40, Code of Federal Regulations, U.S. Environmental Protection Agency, Washington D.C.

U.S. Environmental Protection Agency, 1986, "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," SW-846, Third Edition, Office of Solid Waste and Emergency Response, Washington, D.C.

U.S. Environmental Protection Agency, 1985 "Environmental Radiation Protection Standards for Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Wastes," Title 40, Code of Federal Regulations, Part 191, (40 CFR 191), U.S. Environmental Protection Agency, Washington D.C.

U.S. Environmental Protection Agency, 1983, "Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans," QAMS-005/80, Office of Monitoring Systems and Quality Assurance, Office of Research and Development, U.S. Environmental Protection Agency, Washington, D.C., February 1983.

6.0 GLOSSARY

CH-TRU Waste - Contact-Handled TRansUranic waste, packaged TRU waste for which the external dose rate does not exceed 200 mrem per hour.

Code of Federal Regulations (CFR) - A documentation of the regulations implemented by the executive departments of the federal government. The code is divided into 50 titles that represent broad areas subject to federal regulation. Each title is divided into chapters that contain the regulations of a specific federal agency. Each chapter is further subdivided into parts covering specific regulatory areas.

Content Code - A uniform system of categorizing waste forms to group those with similar characteristics for purposes of shipment in TRUPACT-II containers.

Drum Equivalent - The volume of waste that is equivalent to that of a 55-gallon drum.

Hazardous Waste - Solid waste is regulated as hazardous waste if it is a listed waste as defined by New Mexico Hazardous Waste Management Regulations (HWMR-6), Part II, Subpart D; or is mixed with or derived from a listed waste; or it exhibits a characteristic as defined by HWMR-6 Part II, Subpart C.

Land Disposal Restrictions - Regulatory prohibition by the EPA of the placement of untreated hazardous waste in or on the land, as defined by 40 CFR Part 268.

Layer of Confinement - Any closed plastic bag containing waste. Punctured bags or liners, bags open at the end, or pieces of plastic sheet wrapped around the waste for handling are not considered as layers of confinement.

Le Chateller's Law - The explosion (flammable) limits of a mixture of several flammable gases and vapors may be estimated if the explosion limits of the components are known. If P_i is the volume fraction of component "i" in the mixture, the lower explosion (flammable) limit (LEL) for the mixture is:

$$\text{LEL (mixture)} = \Sigma P_i / \Sigma (P_i / \text{LEL}_i)$$

and the upper explosion (flammable) limit (UEL) for the mixture is:

$$\text{UEL (mixture)} = \Sigma P_i / \Sigma (P_i / \text{UEL}_i)$$

Mixed Waste - Mixed waste is radioactive waste containing RCRA-regulated hazardous waste.

Performance Assessment - The process of assessing the compliance of a deep, geologic waste repository with the Containment Requirements of 40 CFR Part 191 Subpart B. Performance assessment is defined by Subpart B as an analysis that (1) identifies the processes and events that might affect the disposal system, (2) examines the effects of these processes and events on the performance of the disposal system, and (3) estimates the cumulative releases of radionuclides, considering the associated uncertainties, caused by all significant processes and events. These estimates are incorporated into an overall probability distribution of cumulative release to the extent practicable (40 CFR Part 191.12(q)).

Process Knowledge - The information about waste quantities and composition gained from knowledge of waste generation processes.

Quality Assurance (QA) - All those planned and systematic actions necessary to provide adequate confidence that a facility, structure, system, or component will perform satisfactorily and safely in service. The goal of quality assurance is to ensure that: research, development, demonstration, scientific investigation, and production activities are performed in a controlled manner; that components, systems, and processes are designed, developed, constructed, tested, operated, and maintained according to engineering standards, quality practices, and Technical Specifications/Operational Safety Requirements; and that resulting technology data are valid and retrievable. Quality assurance includes quality control, which comprises all those actions necessary to control and verify the features and characteristics of material, process, product, or service to specified requirements.

Quality Assurance Plan - A document that contains or references the quality assurance elements established for an activity, group of activities, a scientific investigation or a project and describes how conformance with such requirements is to be ensured for structures, systems, computer software, components, and their operation commensurate with (1) the scope, complexity, duration, and importance to satisfactory performance; (2) the potential impact on environment, safety and health; and (3) requirements for reliability and continuity of operation.

Quality Control (QC) - A routine application of procedures for controlling the monitoring process. Quality Control is the responsibility of all those performing the hands-on operations in the field, in the office, and in the laboratory.

Radioactive Waste - Solid, liquid, or gaseous material of negligible economic value that contains radionuclides in excess of threshold quantities.

Real-Time Radiography (RTR) - A non-destructive, semiquantitative technique that involves X-ray scanning of waste containers to identify and verify their contents.

Solid Waste - Discarded material as defined in 40 CFR 261.2 is solid waste. Solid waste includes garbage, refuse, sludge from a waste treatment plant, water supply treatment plant, or air pollution control facility and other discarded materials, including solid, liquid, semi-solid, or contained gaseous materials resulting from industrial, commercial or other processes. (Hall, et al., 1989)

Transuranic Radioactive Waste (TRU Waste) - Radioactive waste that, without regard to source or form, is contaminated with more than 100 nCi per gram of waste of alpha-emitting transuranic isotopes with atomic numbers greater than 92 and half-lives greater than 20 yr, except for: (1) High Level Waste (HLW); (2) wastes that the DOE has determined, with the concurrence of the EPA Administrator, do not need the degree of isolation required by 40 CFR Part 191; or (3) wastes that the Nuclear Regulatory Commission (NRC) has approved for disposal on a case-by-case basis in accordance with 10 CFR Part 61. Heads of DOE field organizations can determine that other alpha-contaminated wastes, peculiar to a specific site, must be managed as TRU waste.

TRU Mixed Waste - Radioactive transuranic waste that contains hazardous constituents (as defined by 40 CFR Part 261).

Volatile Organic Compounds - Any organic compound which participates in atmospheric photochemical reactions or that is measured by Method 18, 24, 25, or 25A or an equivalent or alternative method as defined by 40 CFR Part 60.2.

Waste Form - The physical form of the waste (e.g., solid, liquid, solidified). Provides information on the waste contents, how the waste is processed, and on the chemistry of the components.