

PRETEST CHARACTERIZATION OF WIPP EXPERIMENTAL WASTE*

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ABSTRACT

The Waste Isolation Pilot Plant (WIPP) near Carlsbad, New Mexico, is an underground repository designed for the storage and disposal of transuranic (TRU) wastes from U.S. Department of Energy (DOE) facilities across the country. The Performance Assessment (PA) studies for WIPP address compliance of the repository with applicable regulations, and include full-scale experiments to be performed at the WIPP site. These experiments are the bin-scale and alcove tests to be conducted by Sandia National Laboratories (SNL). Prior to conducting these experiments, the waste to be used in these tests needs to be characterized to provide data on the initial conditions for these experiments. This characterization is referred to as the Pretest Characterization of WIPP Experimental Waste, and is also expected to provide input to other programmatic efforts related to waste characterization. The purpose of this paper is to describe the pretest waste characterization activities currently in progress for the WIPP bin-scale waste, and to discuss the program plan and specific analytical protocols being developed for this characterization. The relationship between different programs and documents related to waste characterization efforts is also highlighted in this paper.

INTRODUCTION

TRU waste is generated at the DOE facilities across the country from weapons production, and other defense related activities. The WIPP near Carlsbad, New Mexico, is an underground repository designed for the storage and disposal of TRU wastes. The WIPP facility is located approximately 2150 feet below the surface in a salt bed. The geological and hydrological characteristics of the WIPP site have been described in a number of documents (1,2). The regulation governing the performance of nuclear repositories is 40 CFR Part 191 (3). The present version of this regulation requires that the predicted cumulative release of radionuclides from the repository (under both undisturbed and disturbed conditions, which account for any future human intrusion events) for a 10,000-year period be less than a specified amount (3). The study done to address compliance with this regulation is called Performance Assessment (PA). A major fraction of the TRU waste destined for the WIPP site also contains hazardous constituents (heavy met-

als and solvents, for example) regulated under the Resource Conservation and Recovery Act (RCRA) (40 CFR Parts 260 through 272) (4), and hence is classified as "mixed waste" (i.e., both radioactive and hazardous constituents). The disposal of the hazardous constituents mixed waste is regulated by 40 CFR Part 268 (4). WIPP waste, therefore, is subject to the requirements of 40 CFR Part 191, as well as the RCRA requirements.

PA for the WIPP repository is being conducted by Sandia National Laboratories (SNL). These PA studies consist of laboratory experiments (5), as well as full-scale experiments to be performed at WIPP using a fraction of the total WIPP waste inventory. The full-scale experiments include bin-scale and alcove experiments described in two test plans by SNL (6,7). These experiments are summarized in the next section. The primary purpose of these experiments is to provide data regarding the short-term and long-term performance of the repository. An important parameter that is being investigated in these studies is the gas generation potential of the waste (arising from

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mechanisms like radiolysis, corrosion, and microbial degradation, and synergistic interactions thereof) in the WIPP repository environment. The waste for these experiments is expected to be the first waste to be shipped to the WIPP site, and these experiments comprise the "test phase" of the WIPP repository. PA for the WIPP repository is expected to be completed at the end of this test phase, with input from both laboratory and full-scale experiments.

The bin-scale and alcove experiments have certain waste characterization requirements that need to be satisfied in order to establish the initial conditions for these experiments. This waste characterization is called the "Pretest Characterization of WIPP Experimental Waste." In addition to meeting the requirements for the bin-scale and alcove experiments, these waste characterization efforts are expected to support other related programs, and serve as a template for future waste characterization efforts at the DOE facilities. The pretest waste characterization program is described in the following sections.

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WIPP Full-Scale Experiments

The WIPP full-scale experiments in support of PA can be classified into two groups:

- Bin-Scale Experiments
- Alcove Experiments

The bin-scale experiments are intended to simulate and provide data on the long-term characteristics of the waste in the WIPP repository (6). Current estimates for these tests involve about 800 drum volumes of wastes to be repackaged into approximately 146 bins (8). The bins are rectangular carbon steel containers with a volume of about 1.08 cubic meters. The wastes to be tested in these bin-scale experiments can be divided into four waste test types (6):

- High Organic Newly Generated Wastes
- High Organic Old Wastes
- Low-Organic Newly Generated Wastes
- Inorganic Processed Sludge

The basis for these classifications have been defined in documents elsewhere (6,7). Gas generation rates from these different waste test types are expected to be different, and are being analyzed separately.

The alcove experiments are intended to simulate post operational and the short term characteristics of the waste in the repository (7). These experiments will be conducted in sealed rooms with the waste in either drums or standard waste boxes. The alcove test include approximately 3850

drum equivalents of waste. Further details of these experiments are described in the Alcove Test Plan (7).

Governing Documents

Several documents have been developed that pertain to the pretest waste characterization efforts. Fig. 1 shows the relationship between these different documents. The test plans for the bin-scale and alcove test (6,7) describe the full-scale experiments planned at the WIPP site, along with the waste requirements (quantity and composition) for these tests. An independent document (9) described the rationale behind these test in terms of their required numbers and composition. Together, these documents also identify the pretest waste characterization needs and the justification for this characterization. A program plan (10) has been developed to describe the pretest waste characterization needs, and the protocols to be followed during this characterization. This program plan also defines the overall scope of this characterization and the different regulatory organizations involved in this characterization. A companion document to the program plan describes the analytical procedures and Standard Operating Procedures being developed specifically for the pretest waste characterization efforts. This document is the system-wide Quality Assurance Project Plan (QAPP) (11) for pretest waste characterization. As shown in Fig. 1, this QAPP is being developed to conform with the guidelines and specifications developed by the Environmental protection Agency (EPA) (12). Each DOE site, performing the waste characterization, is required to develop a site-specific QAPP, showing conformance with the system-wide QAPP.

Related Objectives of Pretest Waste Characterization

As stated earlier, the primary purpose of the pretest waste characterization is to characterize the experimental waste prior to conducting the bin-scale and alcove experiments. As described in the program plan (10), this waste characterization effort has several other objectives, that are listed below:

1. As stated in the introduction, the test waste represents a fraction (approximately 0.5 percent) of the total waste inventory destined for the WIPP site. This waste has been chosen such that, based on process knowledge, it represents the waste inventory across the entire system. Information available as process knowledge is comprehensive at all of the DOE sites, and is the subject of a companion paper (13). Data from the pretest waste characterization will be compared to this process knowledge to ensure representativeness of the waste. The program plan (10) described in greater detail this issue of waste representativeness and comparability.
2. Data from the pretest waste characterization will also be used to verify that all of the transportation requirements

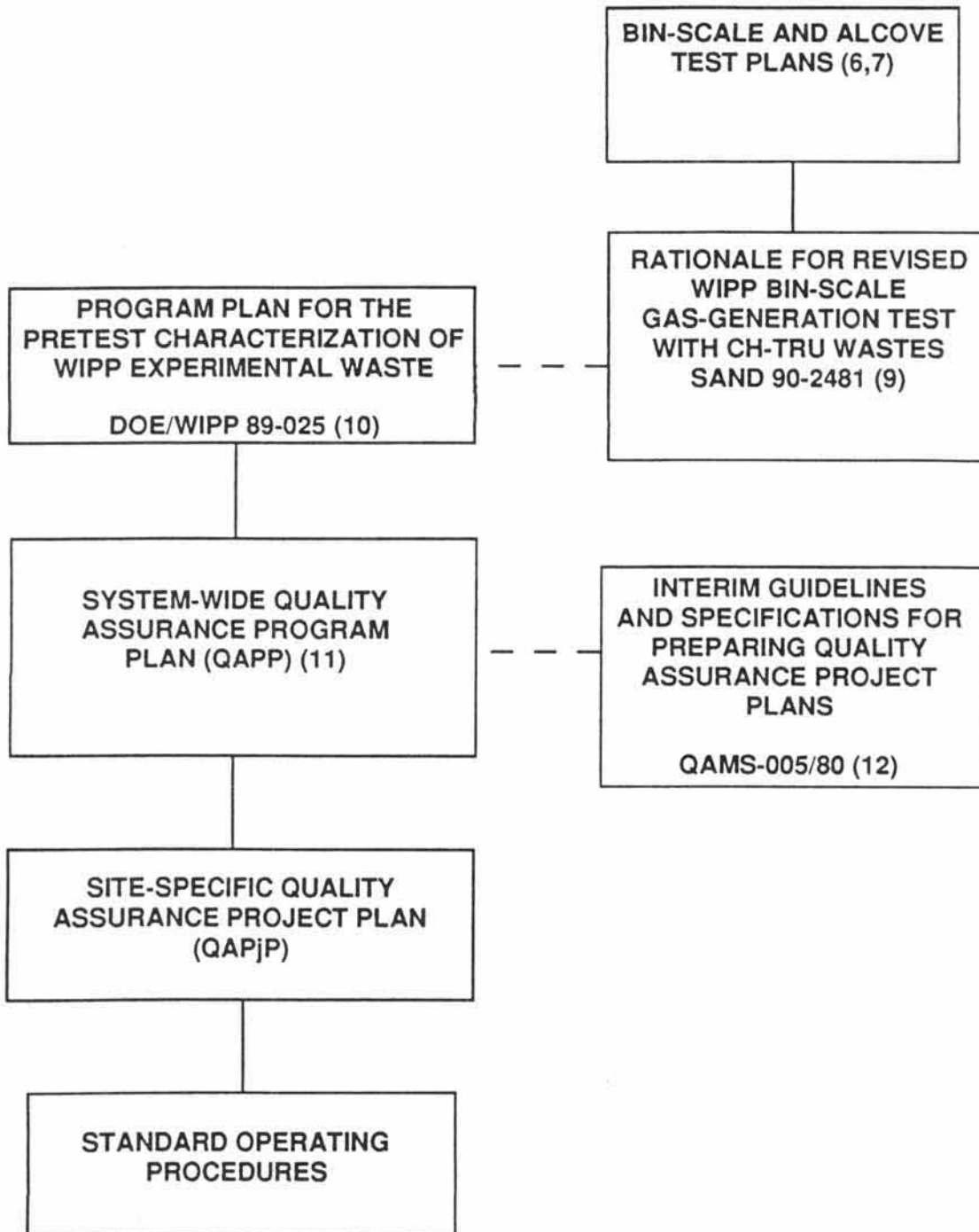


Fig. 1. Documents governing pretest waste characterization.

for the TRUPACT-II package (14) are met by the experimental waste. The TRUPACT-II is a double-contained, Type B package, designed for the transportation of contact-handled (CH) TRU waste from the different DOE sites to the WIPP site. A Certificate of Compliance was issued for the TRUPACT-II package by the Nuclear Regulatory Commission (NRC) in August 1989.

3. Data from the pretest waste characterization will be used to verify that all of the WIPP Waste Acceptance Criteria (WIPP-WAC) (15) are met by the experimental waste. The WIPP-WAC impose limits on the physical, chemical, and radiological characteristics of the waste.
4. Data from the pretest waste characterization will be used to support RCRA characterization of the waste (needed in support of showing compliance with 40 CFR 264 and 40 CFR 270) and verify process knowledge with respect to the RCRA constituents in the waste.

Experimental Aspects of Pretest Waste Characterization

Figure 2 and 3 depict the variables that will be characterized for the waste for the bin-scale and alcove test respectively. As shown in Fig. 3, only a statistical population of the waste containers to be used in the alcove tests will be characterized completely. The basis for, and the sample size for this statistical population, are being developed by SNL. All of the waste containers selected for the bin-scale experiments will be characterized completely. The basis for selecting the waste containers for the tests is described in a separate document (9). The variable shown in Fig. 2 and 3 are listed and discussed below.

Real-time Radiography (RTR) Examination of Waste Containers: RTR is a non-destructive examination technique (analogous to a real-time image from an x-ray examination) that will be used to examine the waste containers to provide information on certain parameters. Examples of these parameters are the presence of free liquids, sealed containers, and compressed gases which are restricted for transportation and storage purposes. Results from the RTR examination will subsequently be compared with results from visual examination performed after opening of any waste containers.

Isotopic Distribution and Assay: All waste containers to be part of the test phase will be assayed to determine their isotopic composition and corresponding decay heats. Acceptable assay methods are described in an appendix to the TRUPACT-II Safety Analysis Report (13), and are routinely used at the sites. This characterization is needed to provide information on the radionuclide source term in the experiments.

Headspace Gas Analyses: Headspace gas analyses will be performed for the waste containers in order to gather information on the gas generating mechanisms in the waste

and characterize the composition of the gases present. As described in the program plan (10), the headspace gas samples will be analyzed for a spectrum of gases including Volatile Organic Compounds, to help characterize the RCRA components in the waste. The system-wide QAPP under development (11) will detail the analytical techniques to be used for these analyses.

Visual Examination and Weighing of Waste Containers: Visual examination of the waste containers will be performed to verify the RTR results, and to verify compliance with the transportation and WIPP-WAC restrictions. The waste components (paper, plastics, cellulose, etc.) will then be weighed to provide information on the non-radionuclide source term in the waste.

Solids Characterization in the Waste: The characterization of solids in the waste is limited to identification of the individual components in the waste containers, and along with the weighing of the components is meant to characterize the nonradionuclide source term in the experimental waste.

Sludge Characterization in the Waste: Waste containers with sludges (solidified materials) will be characterized with respect to major cations, anions, and pH. These variables affect the radionuclide solubilities and the fractions of radionuclides that can be released to the environment over the performance period of the repository. Additional characterization of some of the waste containers for RCRA constituents in the sludges is also currently planned. Analytical methods for this additional characterization are presently under development, and will be included in the system-wide QAPP (11).

SUMMARY

Pretest waste characterization efforts, to characterize the waste to be used in the WIPP experimental phase, have been described in this paper. Wherever required, specific analytical protocols are being developed to meet these waste characterization needs, while conforming to the guidelines and specifications set by the EPA. This waste characterization is expected to support related programmatic efforts, and to serve as a template for future waste characterization efforts at the different DOE sites. Variables that comprise this waste characterization have also been described in this paper. The program plan for this waste characterization is being updated and refined as additional requirements are being identified. A number of regulatory and oversight agencies, including the EPA, the New Mexico State Environmental Improvement Division (NM-EID) and the Blue Ribbon Panel are actively involved in the development and review of this program plan.

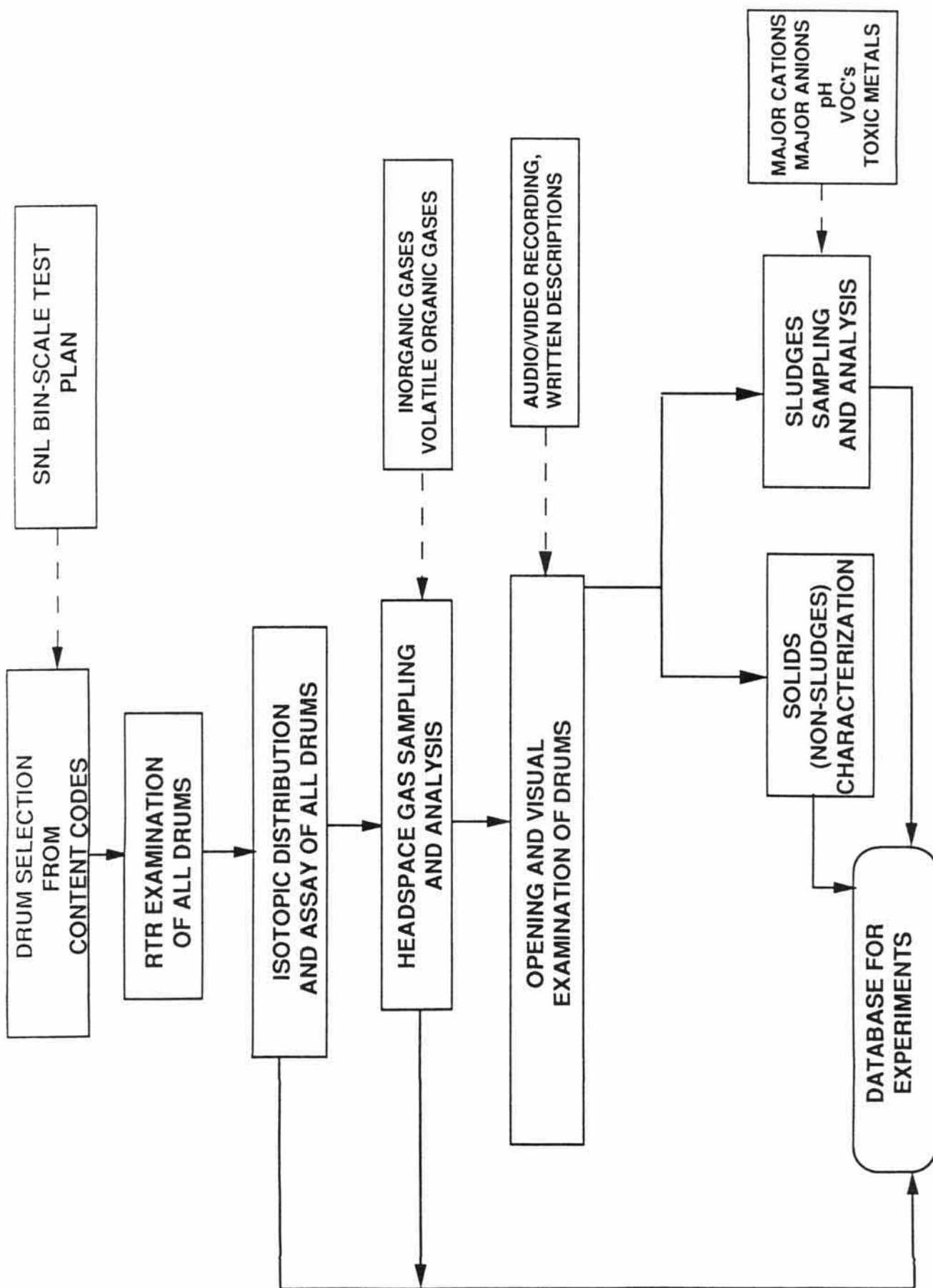


Fig. 2. Pretest characterization of waste for bin-scale experiments.

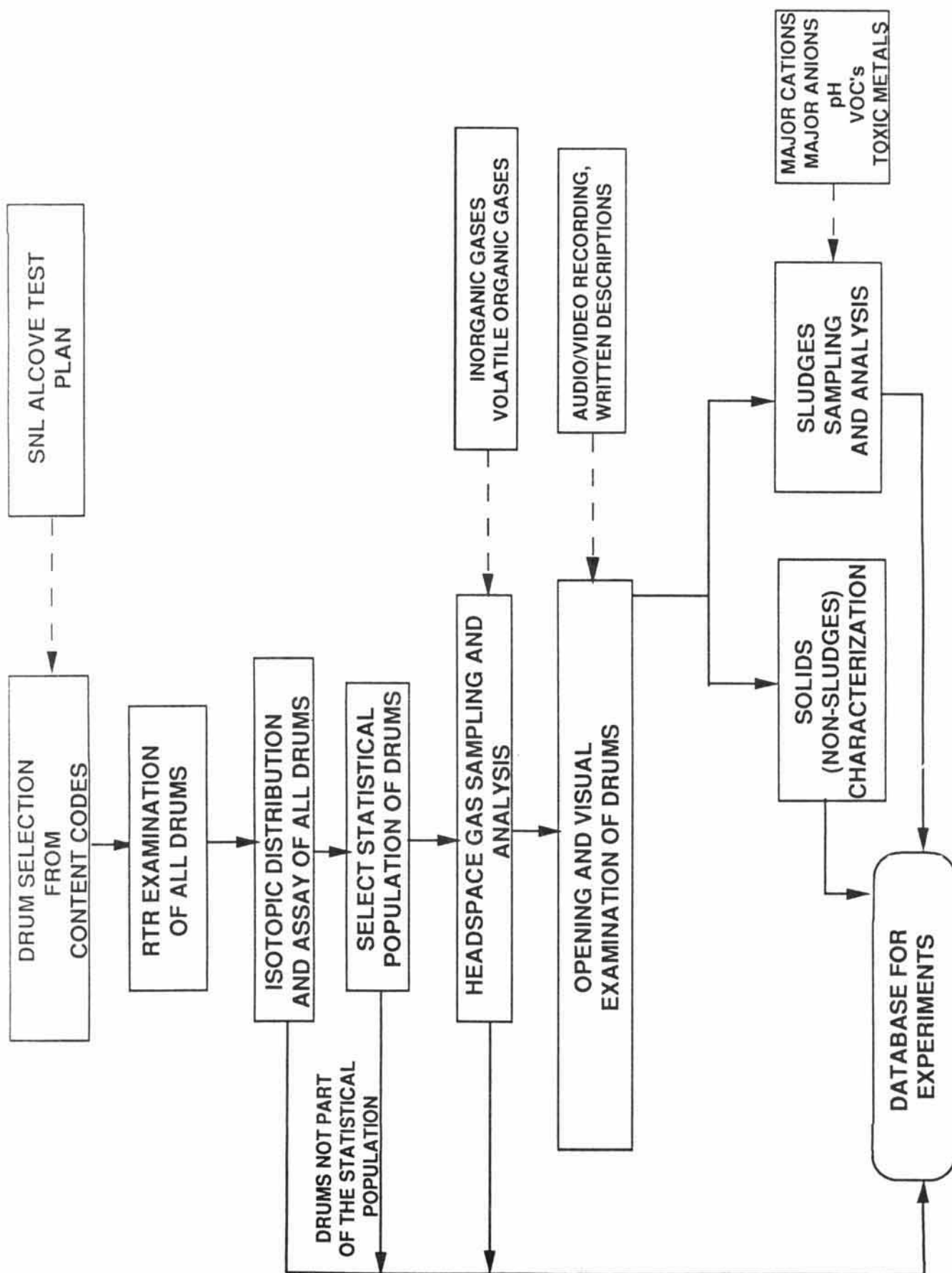


Fig. 3. Pretest characterization of waste for alcove experiments.

REFERENCES

1. U.S. DOE, "Final Supplemental Environmental Impact Statement," DOE/EIS-0026-DS, U.S. Department of Energy, Washington, D.C., (1990).
2. A. R. LAPPIN and R. L. HUNTER, eds., D. P. GARBNER and P. B. DAVIES, assoc. eds., "Systems Analysis, Long-Term Radionuclide Transport and Dose Assessments, Waste Isolation Pilot Plant (WIPP), Southeastern New Mexico," SAND89-0462, Sandia National Laboratories, Albuquerque, New Mexico, (March 1989).
3. U.S. ENVIRONMENTAL PROTECTION AGENCY, "Environmental Protection Radiation Standards for Management and Disposal of Spent Nuclear Fuel, High-Level, and Transuranic Radioactive Waste," Title 40, Code of Federal Regulations, Part 191, (40 CFR Part 191), U.S. Environmental Protection Agency, Washington, D.C., (1985).
4. U.S. ENVIRONMENTAL PROTECTION AGENCY, "Land Disposal Restrictions," Title 40, Code of Federal Regulations, Part 268, (40 CFR Part 268), U.S. Environmental Protection Agency, Washington, D.C., (1989).
5. L. H. BRUSH, "Test Plan for Laboratory and Modeling Studies of Repository and Radionuclide Chemistry for the Waste Isolation Pilot Plant," SAND 90-0266, Sandia National Laboratories, Albuquerque, (1990).
6. M. A. MOLECKE "Test Plan: WIPP Bin-Scale CH TRU Waste Test," Sandia National Laboratories, Albuquerque, (1990).
7. M. A. MOLECKE "Test Plan: WIPP In Situ Alcove CH TRU Waste Tests," Sandia National Laboratories, Albuquerque, (1990).
8. M. A. MOLECKE "Test Plan Addendum #1 (rev. 2): WIPP Bin-Scale CH TRU Waste Tests," (Draft) Sandia National Laboratories, Albuquerque, (1990).
9. SANDIA NATIONAL LABORATORIES, "Rationale for Revised WIPP Bin-Scale Gas-Generation Test with CH TRU Wastes" (Draft), SAND 90-2481, Sandia National Laboratories, Albuquerque, (1990).
10. U.S. DOE, "Program Plan for the Pretest Characterization of WIPP Experimental Waste," DOE/WIPP 89-025, Draft Revision 6.1, U.S. Department of Energy, Waste Isolation Pilot Plant Project Office, Carlsbad, New Mexico, (1990).
11. U.S. DOE, "Quality Assurance Program Plan for WIPP Waste Characterization Program," U.S. Department of Energy, Washington, D.C., (1990).
12. U.S. ENVIRONMENTAL PROTECTION AGENCY, "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, Environmental Protection Agency, Washington, D.C., (1983).
13. P. E. DREZ, M. DEVARAKONDA, and J. CRUSE, "Summary and Status of Waste Characterization," to be presented at Waste Management '91, Tucson, Arizona.
14. NUPAC, "Safety Analysis Report for the TRUPACT-II Shipping Package," Revision 4, Nuclear Packaging, Inc., Federal Way, Washington, (1989).
15. U.S. DOE, "TRU Waste Acceptance Criteria for the Waste Isolation Pilot Plant," WIPP/DOE-069, Revision 3, U.S. Department of Energy, Waste Isolation Pilot Plant Project Office, Carlsbad, New Mexico, (1989).