

FILLING THE PIPELINE: THE TRANSURANIC WASTE CHARACTERIZATION TASK FORCE

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ABSTRACT

The Transuranic Waste Characterization Task Force was formed in May 1998 to “focus on increasing the efficiency, effectiveness, and regulatory confidence of characterization operations while reducing the overall cost of waste characterization.” It includes representatives from the Waste Isolation Pilot Plant (WIPP) and the TRU waste generator/storage sites. The Task Force has followed a structured approach in reviewing current waste characterization requirements, identifying the source for requirements, and recommending specific changes. Characterization requirements derive from several sources, including external regulatory agencies. Several waste characterization methods are currently used, including acceptable knowledge (AK); sampling and analysis is used to supplement data obtained by AK. The Task Force recommends that headspace gas sampling be reduced and that intrusive characterization be minimized. The Task Force’s final report will be submitted to the U.S. Department of Energy-Carlsbad Area Office (DOE-CAO) manager in the spring of 1999.

INTRODUCTION

The Waste Isolation Pilot Plant (WIPP) is a U.S. Department of Energy (DOE) facility designed to demonstrate the safe, permanent disposal of radioactive transuranic (TRU) waste left from the production of nuclear weapons. Project facilities include excavated rooms 2,150 feet underground in an ancient, stable salt formation in southeastern New Mexico. The WIPP will provide for disposal of TRU waste currently located in temporary storage facilities at 10 major DOE sites and 13 other locations across the United States.

The DOE created the Carlsbad Area Office (CAO) in 1993 to lead the nation's TRU waste disposal efforts. The CAO manages both the development and operation of the geologic repository and establishes the requirements for the waste characterization programs at the TRU waste sites that will be shipping waste there. Characterization of TRU waste at the sites is ongoing and will continue to be a major expense during the WIPP’s operational life.

The TRU Waste Characterization Task Force was formed in May 1998 by the CAO manager. It is chartered to “focus on increasing the efficiency, effectiveness, and regulatory confidence of characterization operations while reducing the overall cost of waste characterization.” The Task Force performs the following activities:

- Investigates current regulatory and technical bases of the waste characterization requirements and waste acceptance criteria for TRU waste
- Identifies system-scale problems that need to be solved in order to increase efficiency of the total waste characterization system

- Identifies innovative technologies that can potentially improve waste characterization processes
- Recommends to CAO changes to waste characterization requirements and new technology that may lead to more cost-effective characterization.

ORGANIZATION OF THE TASK FORCE

The TRU Waste Characterization Task Force is composed of representatives from the generator/storage sites who are familiar with waste characterization requirements and procedures; representatives from the CAO waste characterization program; and representatives familiar with transportation, legal, and regulatory issues. Participants include both DOE and contractor employees. The structure of the Task Force is flexible to allow the group to quickly respond to specific needs.

TASK FORCE APPROACH

The approach used by the Task Force to evaluate opportunities for improvements in waste characterization (summarized in Figure 1) followed a structured, systematic methodology. The CAO has listed all waste characterization requirements in two summary documents. For each waste characterization requirement, the Task Force identified the specific legal and regulatory drivers (i.e., federal agency regulations or Congressional laws). If a legal or regulatory driver could not be identified, the Task Force considered recommending deletion of the requirement.

The Task Force then assessed the technical and safety bases of the requirements. When no clear technical or safety bases were identified, the Task Force considered recommending development of long-term plans to potentially change the driving laws or regulations in order to modify or delete those requirements.

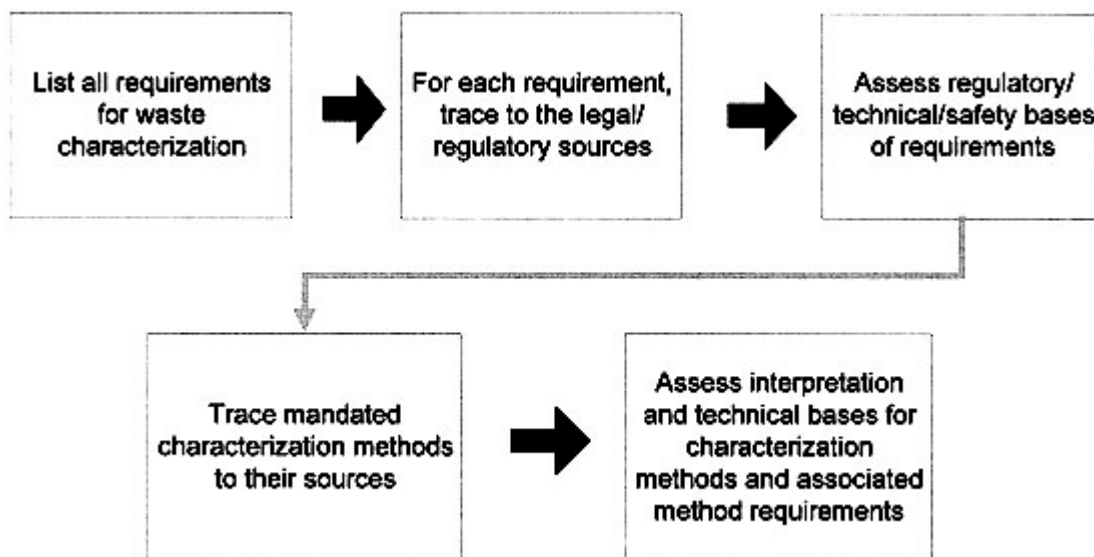


Figure 1. Task Force approach to evaluating waste characterization issues.

For each remaining characterization requirement, the Task Force examined the method of implementing the requirement (e.g., headspace gas sampling or radioassay). First, an assessment was conducted to determine whether a compliance method was mandated. Characterization requirements with mandatory compliance were not evaluated further.

For the remaining characterization requirements, the Task Force then conducted more detailed assessments, including evaluation of the interpretation and technical basis for the implementation method, evaluation of alternative interpretations, technical completeness, cost-benefit analyses, and assessment of “as low as reasonably achievable” (ALARA) considerations.

The Task Force analyzed the difficulties involved with implementing alternative methods. Potential difficulties included lack of technology, excessive cost of changing from existing methods, required changes in DOE Orders, re-negotiation with the State of New Mexico or the U.S. Environmental Protection Agency (EPA), or required changes in Congressional laws.

Finally, this assessment, the Task Force provided recommendations about the disposition of each waste characterization requirement and its associated implementation method. Recommendations will be forwarded to the CAO manager, who will decide which CAO organization should implement specific changes.

OVERVIEW OF THE TRU WASTE CHARACTERIZATION REQUIREMENTS

The TRU Waste Characterization Program implements the waste characterization requirements from several sources. These include:

- WIPP operations and safety requirements
- Long term repository performance
- Hazardous waste requirements
- Transportation requirements
- Legal and policy requirements

WIPP operations and safety requirements have been identified in the WIPP Safety Analysis Report (1) as being necessary for the safety of WIPP workers and the public. These requirements are listed below:

- Prohibition of explosives, corrosives, or compressed gases in the waste
- External radiation dose of contact-handled (CH) TRU waste containers not to exceed 200 mrem/hr
- Limit on fissile radioactive material; no greater than 200 fissile gram equivalent (FGE) per drum or 325 FGE per standard waste box (SWB) or ten-drum overpack.
- Limits on plutonium; 80 plutonium-equivalent curies (PE-Ci) per drum and 130 PE-Ci per SWB. Overpacked or treated waste has higher limits
- Limits on pyrophorics

- Thermal power limits; requires the thermal power of each container be measured and reported.

Long-term repository performance requirements come from the Compliance Certification Application (2) and related EPA Final Rule for the WIPP (3). They include the following:

- Measure and track radioactive isotopes emplaced in the repository.
- Limit the total amount of cellulose, rubber, and plastics emplaced in the repository to 20 million kilograms.

Hazardous waste requirements come from the draft WIPP hazardous waste permit (4) issued by the State of New Mexico. They include the following:

- Prohibition on incompatible chemicals
- Requirements for assigning EPA hazardous waste numbers
- Explosives, corrosives, compressed gases
- Free liquids
- Volatile organic compounds (VOCs) in headspace gases
- Requirement for mixed waste determination
- Polychlorinated biphenyl (PCB) concentrations
- VOCs, semi-volatile organic compounds (SVOCs), and metals in homogeneous waste
- Limit types of hazardous wastes accepted by WIPP to those listed in the Part A Permit Application for hazardous waste disposal

The transportation requirements for CH-TRU waste come from the TRUPACT-II SARP (5), and transportation requirements for remote-handled (RH) TRU waste come from the RH-72B SARP (6). Unique transportation requirements include the following:

- Limits on flammable VOCs, hydrogen, and methane
- Determination of shipping category
- TRUCON requirements (assigning appropriate TRUPACT-II content codes to waste[7])
- Weight limits
- Packaging configuration limits

Finally, there are legal and policy requirements that apply to TRU waste:

- TRU waste determination
- Limits on total volumes of CH- and RH-TRU waste emplaced in WIPP
- Defense waste determination

SUMMARY OF WASTE CHARACTERIZATION METHODS

In order to meet these requirements, DOE-CAO has identified several waste characterization methods that, in total, provide sufficient data to meet all of these requirements.

Acceptable Knowledge

All waste is initially characterized using acceptable knowledge (AK) (or process knowledge), which is defined as knowledge of the waste based on the materials and processes used to generate it. Acceptable knowledge is used to define waste streams, assign summary categories; assign EPA hazardous waste numbers; estimate the weight of cellulose, rubber, and plastics; and estimate isotopic ratios. The general philosophy of waste characterization is that AK is first used to identify all necessary information. After all available information has been extracted from AK, then sampling and analysis is used, if necessary, to supplement the data obtained from AK.

Headspace Gas Sampling and Analysis

Currently, the headspace gas of all containers sent to WIPP is required to be sampled and analyzed for VOCs. The data is used to confirm EPA hazardous waste numbers for waste streams, verify that concentrations of 11 toxic VOCs are within hazardous waste permit limits, and verify that the concentration of flammable VOCs are within the limits for transportation safety. DOE requirements are currently being revised to reduce the number of samples required from 100% of containers to a much smaller (about 2-5%) statistical sample of containers. This change greatly reduces costs and personnel exposures without compromising safety or environmental protection.

Homogeneous Waste Sampling and Analysis

Currently, a statistical number of containers from each homogeneous waste stream is required to be sampled and analyzed for VOCs, SVOCs, and metals. For previously packaged waste, sampling includes drilling into the waste container and retrieving a core sample of the radioactive material. The core sample is then sub-sampled, and the waste samples are packaged and sent to a certified radioactive laboratory for analysis. Because the samples contain transuranic materials, they must be carefully handled and disposed of. The data obtained from homogeneous waste analysis is used to confirm EPA hazardous waste numbers.

DOE requirements are currently being revised to reduce the number of containers that must be sampled (1-2%). Even with this reduction, homogeneous waste sampling and analysis is one of the most expensive and hazardous activities currently conducted. The data is of limited value as well.

Radiography and Visual Examination

Radiography and visual examination are used to physically characterize the waste to confirm that containers have been assigned to the correct waste stream and to verify the absence of prohibited

items such as free liquids or compressed gases. Currently, all previously packaged waste containers must be radiographed.

An annual sample of radiographed containers is required to be visually examined to verify radiography. DOE requirements are currently being revised to significantly reduce the number of visual examinations required to verify radiography. Visual examination of previously packaged waste is a costly and hazardous procedure, exposing workers to radioactive material. Radiography is not required for waste characterized before or during packaging, because visual examination is easily done as part of the packaging process.

Radioassay

Radioassay techniques are used to determine the radionuclide content of waste or to determine that kind and amount of radioactive materials present in the waste. Radioassay is used to determine whether waste meets the definition of transuranic waste, calculate the FGE for criticality safety, calculate the decay heat for transportation safety, and track the amount of key radioisotopes emplaced in WIPP.

Radioassay methods include both nondestructive and destructive techniques: nondestructive assay (NDA) refers only to assay techniques that are nonintrusive, whereas radiochemistry (RC) is the destructive radiochemical analysis of a representative sample of the waste.

Nondestructive Assay

NDA techniques allow an item to be assayed without altering its physical or chemical form. Common NDA techniques rely on detection of either gamma rays or neutrons. Currently used NDA techniques often do not directly identify and quantify all the individual radionuclides present in TRU waste. Instead, they typically measure a few key radionuclides, which are then used to calculate quantities of unmeasured radionuclides by use of isotopic ratios. These ratios can be estimated by knowledge of the radioactive materials used in the process, by direct measurements using relative gamma spectrum analysis, or by RC techniques.

Radiochemistry

Radiochemistry requires the retrieval of a representative waste sample. The sample is then physically and/or chemically processed for subsequent analysis by standard radioactivity counting methods. When sites are using RC methods for assay purposes, they must perform them in compliance with established method-specific procedures. RC is most often used to quantify the radioisotopic content of well-mixed samples of waste from homogeneous waste streams (sludges or solidified liquids) for which, because of large quantities of hydrogen and a dense matrix, neither neutron nor gamma NDA techniques are as accurate. RC methods should contain the following general provisions:

- Assay standards must be prepared and used as indicated in the standard test methods.
- The waste should be homogeneous, with essentially uniform distribution of the radionuclides throughout. Sampling, weighing, and handling the sample must be performed in a manner

that ensures that the sample is representative and traceable to its specific waste batch or waste container.

- The waste must have been thoroughly mixed prior to collection of assay samples.
- The test result for each sample must be associated with a specific lot or batch number.
- All methods will be preceded by radiochemical separation and/or preparation for measurement.

PRELIMINARY RECOMMENDATIONS

The Task Force will complete their work in the spring of 1999 and will deliver their final report to the CAO manager. Their recommendations have not been finalized pending further investigation; however, preliminary recommendations include the following:

- Waste characterization requirements should be streamlined to include only those that respond to a specific regulatory driver.
- There is an excessive administrative burden placed on the generator/storage sites by the current requirements. The Task Force is identifying specific changes that will reduce this burden.
- In general, DOE should pursue requirements that give the generator/storage sites more flexibility in the specific characterization procedures they use. DOE should use performance-based, rather than process-based, requirements.

Many of the recommended improvements involve waste characterization methods:

- Headspace gas sampling and analysis can be reduced without sacrificing quality. For most waste streams, 100% sampling is unnecessary and expensive. Valid statistical techniques exist to apply statistical sampling to each waste stream. The amount of sampling for each waste stream will vary; however, many waste streams can be effectively characterized using sampling rates as low as 1%
- Intrusive characterization such as homogeneous waste sampling and visual examination should be reduced where possible. In many cases, the cost and risk of contamination outweighs the value of the data obtained by these methods. These methods should be phased out as more experience is gained
- Weight estimates of cellulose, rubber, and plastics can be made on a waste stream basis instead of a container basis

SUMMARY

Characterization activities for TRU waste are driven by a suite of requirements that each DOE TRU waste site must meet in order for the waste to be certified by the CAO manager for receipt and disposal at the WIPP. These requirements were derived, in a phased approach over many

years, from a variety of high-level regulatory documents. In addition, some of the requirements were derived based on assumptions that are now overly conservative and that often lead to unnecessary expense and rejection of waste containers. As a result, implementation of the current waste characterization requirements is cumbersome, time-consuming, and costly.

Although currently in preliminary form, the final recommendations of the TRU Waste Characterization Task Force will identify significant areas for improvement in the TRU waste management system. Preliminary assessments indicate that few changes may be recommended to the waste characterization requirements. However, the Task Force may recommend major improvements to the methods used to comply with the waste characterization requirements. The effects on the waste characterization requirements may be minimal; the effects on the waste characterization methods may be significant (Figure 2).

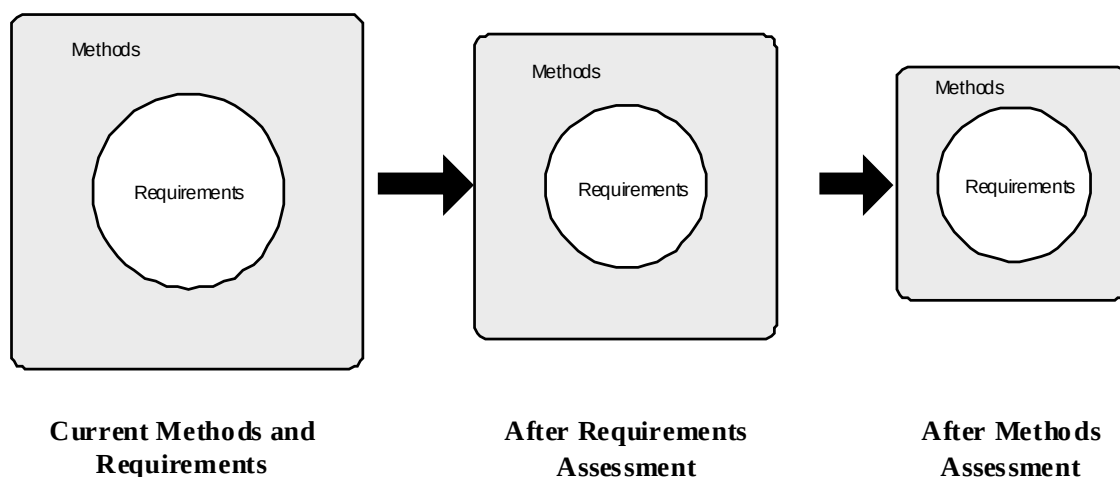


Figure 2. Anticipated results of Task Force assessments.

The assessments provided by the Task Force will show ways to increase system throughput, efficiency, and cost benefit. Many of these improvements are expected to augment worker safety; all of them are achievable without jeopardizing the environment or compromising public safety.

REFERENCES

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5. U.S. NUCLEAR REGULATORY COMMISSION, "Safety Analysis Report for the TRUPACT-II Shipping Package," NRC Docket 71-9218.
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