

## **STREAMLINING THE WIPP WASTE CHARACTERIZATION PROCESS**

Michael R. Brown, Department of Energy–Carlsbad Area Office, Carlsbad, NM 88220  
Thomas E. Bearden, P.E., NFT, Inc., Carlsbad, NM 88220

### **ABSTRACT**

Now that the Waste Isolation Pilot Plant (WIPP) is open for business, there is ample opportunity to streamline many of the waste characterization processes and tests that are currently required. The WIPP waste characterization program evolved over a decade of changing goals and requirements. As a result, many of the sampling and testing requirements are no longer technically justified; however, these requirements are still necessary because of prior DOE commitments to regulators and stakeholders.

The WIPP waste characterization program includes the following methods:

- Gathering of acceptable knowledge information
- Headspace gas sampling and analysis
- Radiography
- Visual examination
- Sampling and analysis of homogeneous wastes
- Radioassay

Except for radioassay, all of these methods are required by WIPP's Hazardous Waste Facility Permit (HWFP). To change these methods, the WIPP HWFP must be modified, which is a time-consuming and complex process. However, given that WIPP will operate for 30+ years, it is cost-effective for DOE to seek permit modifications that streamline characterization so that only data actually needed to safely transport and dispose of transuranic (TRU) waste is obtained.

Radionuclide data are required to safely transport the waste in Nuclear Regulatory Commission (NRC)-approved packaging and to track key radionuclides important to long-term repository performance. Significant changes to the radioassay program may require revisions to the TRUPACT-II Safety Analysis Report for Packaging (SARP), which must be approved by the NRC. In some cases, these changes may also require the notification of the Environmental Protection Agency (EPA).

The DOE-Carlsbad Area Office (CAO) is pursuing an incremental policy of streamlining waste characterization requirements so that taxpayer monies are conserved without compromising the safety of workers and the public.

### **INTRODUCTION**

The WIPP is America's only operational deep geologic repository for the disposal of radioactive waste. The EPA has approved the opening of WIPP (1) based on an extensive performance assessment that evaluated all credible pathways for release of long-lived environmental

contamination. The performance assessment is based on very conservative assumptions and models. This assessment showed that the WIPP repository met federal release limits (2, 3) assuming all release mechanisms.

One of the conditions of EPA's approval is that the DOE will maintain a current inventory of the radioactive material emplaced in the WIPP. Specifically, the DOE is required to track 10 radionuclides. More recent analysis has shown, however, that four radionuclides (plutonium [Pu]-238, <sup>239</sup>Pu, <sup>240</sup>Pu, and americium-241) constitute over 99 percent of the risk. DOE is proposing that the number of radionuclides tracked (for long-term repository performance) be reduced to these four. The EPA is currently evaluating DOE's proposal.

Another condition is that the total weight of cellulose, rubber, and plastics emplaced in the WIPP not exceed 20 million kilograms. The DOE has not proposed to increase this limit; rather, they have proposed that the method of estimating the weight of cellulose, rubber, and plastics in waste be simplified. Currently, the weight is estimated on a container basis using radiography and/or visual examination. The DOE proposes that an alternative method, acceptable knowledge, be used to estimate an average weight per container of these materials on a waste stream basis. This average weight is then tracked for each container. The DOE has shown that this simplified method gives more than adequate weight estimates and is much less costly and hazardous to workers than characterization by container. The EPA and the New Mexico Environment Department (NMED) are evaluating this proposal, which will require that a HWFP modification be implemented.

## **TRANSPORTATION SAFETY**

Currently, contact-handled TRU waste must be transported to the WIPP using the TRUPACT-II shipping container. This system was specifically designed to transport TRU waste and has been fully certified by the NRC. Due to limited data on hydrogen and other flammable gas generation in waste, the TRUPACT-II Authorized Methods for Payload Control (TRAMPAC) (4) limits on decay heat are very low.

The quantities of some waste forms, especially those containing <sup>238</sup>Pu, are restricted, which greatly increases the number of containers and shipments required. The DOE is reviewing the assumptions used in predicting gas generation and additional test data to arrive at more realistic decay heat limits that will allow more radioactive material per shipment without compromising safety. The NRC will review and approve all changes prior to implementation.

Section 5.4 of the TRAMPAC also requires that flammable volatile organic compounds (VOCs) be limited to 500 parts per million (ppm) in the headspace of any container. This is a very conservative limit and was intended to ensure that the flammable VOCs did not need to be included in the overall flammability estimate. The DOE has prepared a change for submittal in Amendment 19 of the TRUPACT-II SARP that will allow shipping greater than 500 ppm flammable VOCs.

## HAZARDOUS WASTE FACILITY PERMIT REQUIREMENTS

The WIPP HWFP (5), approved by the NMED, requires WIPP to conduct extensive waste characterization to comply with the Resource Conservation and Recovery Act (RCRA). The major waste characterization activities required by the HWFP include:

- Acceptable knowledge (AK)
- Headspace gas sampling and analysis
- Homogeneous waste sampling and analysis
- Radiography
- Visual examination (VE)
- Data management

One of DOE's top priorities is to simplify and reduce HWFP requirements. In particular, the following proposals are being considered:

- 1. Reduce the Requirement for Headspace Gas Sampling and Analysis for 100 Percent of Containers.** Allow statistical sampling of containers on a waste stream basis, and assign average VOC concentrations to every container in a waste stream. Under other RCRA sampling and analysis programs, statistically based representative sampling is allowed for the purpose of collecting data needed for compliance. In general, headspace gas sampling data are used to confirm and verify AK of the waste. If additional VOCs are identified through headspace gas sampling, additional EPA hazardous waste numbers may be added to the waste stream. Mixed (hazardous) waste and non-mixed waste are not handled differently at the WIPP, so adding new hazardous waste numbers would not be an additional operational burden.
- 2. Reduce the Number of Containers that Require VE.** Currently, VE is used in two ways:
  - For waste characterized before and during packaging, VE (also known as visual verification) is performed as the waste is packaged, eliminating the need for any additional physical characterization.
  - For previously packaged waste, VE is used to verify the results of radiography.

When VE is used to verify radiography, a statistical sample of containers certified by radiography are randomly selected and visually examined. The number of VEs performed in a given year depends on several factors, including the number of containers from each waste stream certified in the current year and the number of miscertifications in the previous year. Initially, a high miscertification rate of 11 percent is assumed. However, for low annual rates of certification (fewer than 50 containers per waste stream), the required number of VEs is very high (50 percent) regardless of mis-certification rate. This very high fraction of required VEs unnecessarily increases the cost and hazard of physical characterization.

DOE is working to modify the methodology for determining the number of required VEs. In time, DOE hopes to show that radiography is a highly reliable physical characterization technique that requires minimal verification.

- 3. Quality Assurance Objectives (QAOs) for Waste Characterization Measurements.** Specific QAOs for waste characterization measurements are imposed by the Waste Analysis Plan or WAP (attachment B of the HWFP). They are derived from the data quality objectives (DQOs), which are qualitative statements that define the goals the data must achieve. Based on the DQOs, specific quantitative QAOs are developed for each parameter of interest. Typical QAOs include measurement accuracy, precision, and completeness. Many of the QAOs specified in the WAP go beyond what is necessary to meet the applicable DQOs. The DOE is conducting a systematic evaluation of all QAOs to determine changes that will simplify compliance while maintaining adequate data quality.
- 4. Flexibility in Headspace Gas Sampling Methods.** The WAP includes very prescriptive requirements on the types of headspace gas (HSG) sampling conditions and equipment allowed. Two methods are described in detail: manifold and direct canister. The level of detail prescribed in the WAP regarding the sampling conditions and hardware needed to perform the sampling is excessive and hampers the ability of TRU waste sites to customize their sampling conditions and hardware to their unique needs. Greater flexibility in sampling conditions and hardware should be allowed as long as the data obtained are of acceptable quality. DOE is working to remove unnecessary detail from the WAP sampling methods.
- 5. Exemptions from Homogeneous Waste Sampling.** The WAP requires that all homogeneous waste streams be sampled and analyzed for VOCs, semi-volatile organic compounds (SVOCs), and metals. These data are used to confirm that the correct EPA hazardous waste numbers have been applied to the waste stream using AK. In many cases, these waste streams have been extensively characterized in the past, and the AK data is highly reliable. For these waste streams, the DOE seeks relief from the homogeneous waste sampling requirements in the WAP. Sampling and analysis of homogeneous waste is a costly and hazardous procedure that may directly expose workers to radioactive material.

The data obtained from analysis of these samples are of limited value because the data are only used to confirm EPA hazardous waste numbers. These numbers are conservatively assigned using AK, and numbers are never removed based on sampling data; the only possible change is that one or more numbers will be added. This is a rare occurrence and has no operational impact on the transportation and disposal of the waste. The DOE is exploring ways to exempt well-characterized homogeneous waste from further unnecessary sampling and analysis.

- 6. Streamlined AK Process in Compliance with Joint EPA/NRC Guidance.** Transuranic waste characterization relies to a great extent on AK (also known as process knowledge) of the waste. Because of AK's importance to the characterization of radioactive mixed waste, the EPA and the NRC jointly issued specific guidance on its use for waste characterization. This guidance includes the following major points:

- Waste may be characterized using AK alone when sufficient information is available.
- Mixed waste, because of its hazardous nature, is an especially good candidate for characterization using AK.
- When there is doubt regarding a particular hazardous determination, the generator should assume the waste is hazardous and treat it accordingly.

Unfortunately, this guidance was issued after the DOE had submitted its permit application to the NMED. Through the permit negotiation process, the DOE proposed that this guidance largely replace what had been submitted earlier; however, the NMED declined to do so. The joint guidance represents the latest and best thinking on using AK for mixed waste characterization, and the DOE is working to incorporate its principal features into the HWFP.

- 7. Reduce or Eliminate the Drum Age Criteria.** For newly generated waste, the WAP requires that sites wait a minimum time before the headspace gas of the waste is sampled. This minimum time, called a drum age criteria (DAC), can vary between 142 and 225 days depending on the waste type. The DAC was developed to ensure that the headspace gas of newly generated waste had sufficient time to reach equilibrium before being sampled. If sampling occurs too soon after packaging, the concentrations of VOCs will be below the equilibrium value and may result in false negatives for some analytes. The minimum time prior to sampling is based on several factors, including the contents of the waste and the packaging configuration (or levels of confinement).

The DAC was developed based on laboratory studies; however, more recent studies have shown that the DAC is very conservative and can be shortened in most cases. The DOE is working to reduce or eliminate the DAC and allow sites to determine the minimum time period prior to sampling based on their knowledge of the waste, its contents, and the packaging configuration.

- 8. Streamline Waste Characterization Data Review and Approval.** The WAP requires that at least six people at three levels approve analytical data: three people from the laboratory that generated the data, two from the project that manages the laboratory, and one person from the CAO. This amount of data review and approval is unnecessary, redundant, and in some cases counterproductive.

The DOE is working to streamline and automate waste characterization data review and approval by

- Identifying the minimum data management requirements and procedures necessary to ensure that waste characterization data meet quality requirements
- Investigating alternative EPA-approved data management systems
- Encouraging automated data management procedures for data review and transfer.

## CONCLUSION

The waste characterization requirements for WIPP have evolved over a decade based on changes in the regulatory environment and on technical needs. Characterization requirements flow down from three regulators: the EPA, the NRC, and the NMED. Many of these requirements are redundant or are unnecessary for the safe disposal of transuranic waste. DOE has extensively studied the source of each of these requirements and developed a detailed plan of action for simplifying them. DOE is committed to aggressively streamlining the waste characterization process at WIPP so that TRU waste sites can efficiently and effectively prepare their waste for disposal.

## REFERENCES

1. 63 FR 27353. "Criteria for the Certification and Re-Certification of the Waste Isolation Pilot Plant's Compliance with the Disposal Regulations: Certification Decision, EPA Final Rule." *Federal Register* 63: 27353-27406. Washington, DC (1998).
2. 40 CFR Part 191. "Environmental Radiation Protection Standards for the Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Wastes." *Code of Federal Regulations*, Washington, DC, Office of the Federal Register, National Archives and Records Administration.
3. 40 CFR Part 194. "Criteria for the Certification and Re-certification of the Waste Isolation Pilot Plant's Compliance with the 40 CFR Part 191 Disposal Regulations." *Code of Federal Regulations*, Washington, DC, Office of the Federal Register, National Archives and Records Administration.
4. "Safety Analysis Report for the TRUPACT-II for Packaging (SARP, Appendix 1.3.7, TRUPACT-II Authorized Methods for Payload Control [TRAMPAC])." Carlsbad, New Mexico, Carlsbad Area Office, U.S. Department of Energy (1998).
5. "Hazardous Waste Facility Permit Issued to the Waste Isolation Pilot Plant." EPA No. NM4890139088, October 27, 1999, New Mexico Environment Department.