Current Permitted Methodologies for CH TRU Wastes

INTRODUCTION

TRU waste for disposal at the WIPP is characterized to meet RCRA driven requirements; EPA characterization requirements stemming from 40 CFR Parts 191 (EPA 1993) and 194, (EPA 1998) transportation requirements; and WIPP operations and safety requirements. Only the RCRA and 40 CFR 194 requirements are subjects of this review; hence, the transportation and WIPP characterization requirements are not discussed in this report.

RCRA CH TRU WASTE CHARACTERIZATION

Waste characterization for disposal at the WIPP is conducted on a waste stream basis (i.e., waste material generated from a single process or activity that is similar in material, physical form, isotropic make-up, and hazardous constituents) and also on a container basis. Defense production facilities assign the waste stream identifier for each container of waste that is shipped. The waste designation is selected from one of three broad categories of solid wastes: Homogenous Solids, Soil/Gravel, and Debris Wastes (NMED 1999). In addition, a number of sub-categories are assigned to the wastes. Characterization and analysis methods vary for each category and sub-category of waste.

The Waste Analysis Plan (WAP), which is part of the Permit (DOE 1997), describes waste characterization activities that a TRU waste generator/storage site must complete before shipping waste to the WIPP for disposal. These activities include test methods; details of planned waste sampling and analysis processes; a description of the waste shipment screening and verification process; and a description of the quality assurance/quality control program. Before the WIPP manages, stores, or disposes of CH TRU mixed waste from a generator/storage site, the site is required to characterize waste in accordance with WAP requirements. For each container of waste destined for disposal, defense production facilities provide the WIPP operators with a written characterization summary known as a Waste Stream Profile Form (WSPF). A four-page sample is shown in Fig. 4 (NMED 1999).

WIPP WASTE STREAM PROFILE FORM

Waste Stream Profile Number: ______________________

Generator Site Name: ________________________ Technical Contact: ____________________

Generator Site EPA ID: __________________ Technical Contact phone number: ________________

Date of audit report approval by NMED: ____

Title, version number, and date of documents used for WAP certification: ________________

____

Did your facility generate this waste? ☐ Yes ☐ No

If no, provide the name and EPA ID of the original generator: ____________________________

____

WIPP ID: _________________________ Summary Category Group: ________________________

Waste Matrix Code Group: _____________________ Waste Stream Name: __________________

Description from the WTWBIR: ____

____

Defense Waste: ☐ Yes ☐ No Check one: ☐ CH ☐ RH

Number of SWBs: __________ Number of Drums: __________ Number of Canisters: __________

Batch Data Report numbers supporting this waste stream characterization: ________________

List applicable EPA Hazardous Waste Codes: ____

Applicable TRUCON Content Codes: ____

<u>Acceptable Knowledge Information</u>

[For the following, enter supporting the documentation used (i.e., references and dates)]

<u>Required Program Information</u>

- Map of site: ____
- Facility mission description: ____

Fig. 4. WIPP waste stream profile form.

- Description of operations that generate waste: ______________________________

____

- Waste identification/categorization schemes: ______________________________
- Types and quantities of waste generated: ______________________________
- Correlation of waste streams generated from the same building and process, as appropriate: __________

____

- Waste certification procedures: ______________________________

Required Waste Stream Information

- Area(s) and building(s) from which the waste stream was generated: ______________
- Waste stream volume and time period of generation: ______________________
- Waste generating process description for each building: ______________________
- Process flow diagrams: ______________________________

____

- Material inputs or other information identifying chemical/radionuclide content and physical waste form: ______________________________

____

- Which Defense Activity generated the waste: (check one)
  - ☐ Weapons activities including defense inertial confinement fusion
  - ☐ Naval Reactors development
  - ☐ Verification and control technology
  - ☐ Defense Research and development
  - ☐ Defense nuclear waste and material by products management
  - ☐ Defense nuclear materials production
  - ☐ Defense nuclear waste and materials security and safeguards and security investigations

Supplemental Documentation

Process design documents: ______________________________

Fig. 4. (cont'd)

Standard operating procedures: ______

Safety Analysis Reports: ______

Waste packaging logs: ______

Test plans/research project reports: ______

Site data bases: ______

Information from site personnel: ______

Standard industry documents: ______

Previous analytical data: ______

Material safety data sheets: ______

Sampling and analysis data from comparable/surrogate waste: ______

Laboratory notebooks: ______

Sampling and Analysis Information

[For the following, when applicable, enter procedure title(s), number(s), and date(s)]

Radiography: ______

Visual examination: ______

Headspace Gas Analysis

VOCs: ______

Flammable: ______

Other gases (specify): ______

Homogeneous Solids/Soils/Gravel Sample Analysis

Total metals: ______

PCBs: ______

VOCs: ______

Nonhalogenated VOCs: ______

Semi-VOCs: ______

Other (specify): ______

Waste Stream Profile Form Certification

I hereby certify that I have reviewed the information in this Waste Stream Profile Form, and it is complete and accurate to the best of my knowledge, I understand that this information will be made available to regulatory agencies and that there are significant penalties for submitting false information, including the possibility of fines and imprisonment for knowing violations.

______	______	______
Signature of Site Project Manager	Printed Name and Title	Date

NOTE: (1) Use back of sheet or continuation sheets, if required.
(2) If radiography, visual examination, headspace gas analysis, and/or homogeneous solids/soils/gravel sample analysis were used to determine EPA Hazardous Waste Codes, attach signed Characterization Information Summary documenting this determination.

Fig. 4. (cont'd)

Waste characterization based on 40 CFR 194

Waste characterization as described in 40 CFR 194 (EPA 1998) requires that a system be in place to track and control the inventory of waste components to assure that limits associated with the components are not exceeded. The waste components to be tracked and controlled, and the associated limits, are set by a Performance Assessment (PA) conducted by the DOE to show that the WIPP complies with the performance criteria of 40 CFR 191(EPA 1993). The waste components and the limits, all of which are total inventory limits at repository closure, are presented in the WIPP Compliance Certification Application (CCA).

The current CH/TRU waste characterization program characterizes each container of TRU waste for each of the limited components. However, characterizing on a waste stream basis, as is done for RCRA waste characterization, is more than adequate to assure adherence to the large limits allowed at repository closure. The Performance Agreement (PA) and the Compliance Certification Application (CCA) specify no corresponding limit associated with radionuclides; however, the current CH/TRU waste characterization program also quantifies a list of specified radionuclides on a container basis.

ORIGIN OF CH TRU WASTE AND ITS ACCEPTANCE CRITERIA AT WIPP

The TRU mixed wastes that are shipped to the WIPP originate at DOE generator/storage sites and contain both radiological and hazardous waste constituents. The DOE and EPA agreed that, of the hundreds of radionuclides present within these wastes, only ten are important for the WIPP performance assessment: ^{241}Am, ^{244}Cm, ^{137}Cs, ^{238}Pu, ^{239}Pu, ^{240}Pu, ^{241}Pu, ^{90}Sr, ^{233}U, and ^{234}U. Of these ten, ^{234}Sr, ^{233}U, and ^{137}Cs are important for RH but not for CH waste streams.

Major types of operations generating waste

Examples of the major types of operations that generate this waste include the following:

Production of nuclear products: This category includes reactor operation; radionuclide separation or finishing; and weapons fabrication and manufacturing. The majority of the TRU mixed wastes were generated by weapons fabrication and radionuclide separation or finishing processes. More specifically, wastes resulting from this category consist of residues from chemical processes; air and liquid filtration; casting; machining; cleaning; product quality sampling; analytical activities; and maintenance and refurbishment of equipment and facilities.

Plutonium recovery: These wastes are residues from the recovery of plutonium-contaminated molds; metals; glass; plastics; rags; salts used in electro-refining; precipitates; firebrick; soot; and filters.

Research and development: This group includes a variety of hot-cell or glovebox activities that often simulate full-scale operations described above, producing similar TRU mixed wastes. Other types of R&D projects include metallurgical research; actinide separations; process demonstrations; and chemical and physical properties determinations.

Decontamination and decommissioning: Facilities and equipment that are no longer needed or usable are decontaminated and decommissioned, resulting in TRU mixed wastes consisting of scrap materials; cleaning agents; tools; piping; filters; plexiglass; gloveboxes; concrete rubble; asphalt; cinder blocks; and other building materials. These materials are expected to be the largest category by volume of TRU mixed waste to be generated in the future.

The TRU mixed wastes that are to be shipped to the WIPP facility for disposal have been placed into waste categories based on their physical and chemical properties (Table 1). The waste generating processes can be described in five general categories:

1. Wastes (such as combustible waste) that result from cleaning and decontamination activities in which items such as towels and rags become contaminated both with hazardous waste constituents and radioactivity. In these cases, the hazardous waste and the radioactive constituent are intimately mixed, both on the rag or towel used for cleaning and as residuals on the surface of the object being cleaned. These waste forms are not homogeneous in nature; however, they are generated in a fashion that ensures that the hazardous and radioactive contaminants coexist throughout the waste matrix.
2. Wastes generated when materials which contain metals and metal ions believed to exhibit the toxicity characteristic (EPA 1996b) become contaminated with radioactivity as the result of plutonium operations (leaded rubber, some glass, and metal waste are typical examples). These materials may also become contaminated with solvents during decontamination or plutonium recovery activities.
3. A class of plutonium processes where non-metallic objects are used and become contaminated with radioactive materials. These objects are subsequently cleaned with solvents to recover plutonium. Surfaces of the objects (such as graphite, filters, and glass) are contaminated with both radioactive and hazardous constituents.
4. Waste generating processes involving foundry operations where impurities are removed from plutonium. These impurities may result in the deposition of toxicity characteristic (EPA 1996b) metals and metal ions
5. In all of the process waste categories in the second half of Table 1, the hazardous and radioactive constituents are physically mixed together as a result of the treatment process. In these wastes, the release of any portion of the waste matrix will involve both the hazardous and the radioactive waste components, because the treatment process generates a relatively homogeneous waste form.

Table 1. Summary of waste generation processes and waste forms.

Waste Category	Hazardous Waste Codes	Description of Processes	Description of Waste Form
Combustibles	F001, F002, F003, D008, D019	Cloth and paper wipes are used to clean parts and wash down gloveboxes. Wood and plastic parts are removed from gloveboxes after they are cleaned. Lead may occur as shielding tape or as minor noncombustible waste in this category.	Materials such as metals may retain traces of organics left on surfaces that were cleaned. Waste may remain on the cloth and paper that was used for cleaning or for wiping up spills.
Graphite		Graphite molds, which may contain impurities of metals, are scraped and cleaned with solvents to remove the recoverable plutonium.	Surfaces may retain residual solvents. Lead may be used as shielding or may be an impurity in the graphite.
Filters	F001, F002	Filters are used to capture radioactive particulate in air streams associated with numerous plutonium operations and to filter particulate from aqueous streams.	Filter media may retain organic solvents that were present in the air or liquid streams.
Benelex® and Plexiglas®	F001, F002, D008	Materials are used in gloveboxes as neutron absorbers. The glovebox assembly often includes leaded glass. All surfaces may be wiped down with solvents to remove residual plutonium.	Surfaces may retain residual solvents from wiping operations. Leaded glass may also be present.
Firebrick and Ceramic Crucibles	F001, F002, F005, D006, D007, D008	Firebrick is used to line plutonium processing furnaces. Ceramic crucibles are used in plutonium analytical laboratories. Both may contain metals as surface contaminants.	Metals deposited during plutonium refining or analytical operations could remain as residuals on surfaces. Surfaces may retain residual solvents.
Leaded Rubber	D008	Leaded rubber includes lead oxide impregnated materials such as gloves and aprons.	The leaded rubber could potentially exhibit the toxicity characteristic.

Table 1. (cont'd)

Waste Category	Hazardous Waste Codes	Description of Processes	Description of Waste Form
Metal	F001, F002, D008	Metals range from large pieces removed from equipment and structures to nuts, bolts, wire, and small parts. Many times, metal parts will be cleaned with solvents to remove residual plutonium.	Solvents may exist on the surfaces of metal parts. The metals themselves potentially exhibit the toxicity characteristic.
Glass	F001, F002, D006, D007, D008, D009	Glass includes Raschig rings removed from processing tanks, leaded glass removed from gloveboxes, and miscellaneous laboratory glassware.	Solvents may exist as residuals on glass surfaces and in empty containers. The leaded glass may exhibit the toxicity characteristic.
Inorganic Wastewater Treatment Sludge	F001-F003, D006-D009, P015	Sludge is vacuum filtered and stabilized with cement or other appropriate sorbent prior to packaging.	Traces of solvents and heavy metals may be contained in the treated sludge which is in the form of a solid dry monolith, highly viscous gel-like material, or dry crumbly solid.
Organic Liquid and Sludge	F001, F003	Organic liquids such as oils, solvents, and lathe coolants are immobilized through the use of various solidification agents or sorbent materials.	Solvents and metals may be present within the matrix of the solids created through the immobilization process.
Solidified Liquid	F001, F003, D006, D008	Liquids that are not compatible with the primary treatment processes and have to be batched. Typically these liquids are solidified with portland or magnesium cement.	Solvents and metals may be present within the matrix of the solids created through the immobilization process.
Inorganic Process Solids and Soil	F001, F002, F003, D008	Solids that cannot be reprocessed or process residues from tanks, firebrick fines, ash, grit, salts, metal oxides, and filter sludge. Typically solidified with portland or gypsum-based cements.	Solvents and metals may be present within the matrix of the solids created through the immobilization process.

Table 1. (cont'd)

Waste Category	Hazardous Waste Codes	Description of Processes	Description of Waste Form
Pyrochemical Salts	D007	Molten salt is used to purify plutonium and americium. After the radioactive metals are removed, the salt is discarded.	Residual metals may exist in the salt depending on impurities in the feedstock.
Cation and Anion Exchange Resins	D008	Plutonium is sorbed on resins and is eluted and precipitated.	Feed solutions may contain traces of solvents or metals depending on the preceding process.

Categories of TRU mixed waste

TRU mixed wastes from the above operations are listed by defense production facilities as belonging in one of three broad Summary Category Groups. The characterization is based on the final physical form of the wastes as follows:

Summary category group S3000—homogeneous solids: These wastes include a minimum of 50% (by volume) solid inorganic process residues such as inorganic sludge, salt waste, and pyrochemical salt waste—but exclude soil. Other waste streams are included in this Summary Category Group based on the specific waste stream types and final waste form. This Summary Category Group is expected to contain toxic metals and spent solvents.

Summary Category Group S4000—Soils/Gravel: This Category is assigned to waste streams containing at least 50% (by volume) soil and gravel. This Summary Category Group is expected to contain toxic metals and is also further categorized by the amount of debris included in the matrix.

Summary Category Group S5000—Debris Wastes: These are heterogenous wastes that are at least 50% (by volume) materials that exceed 2.36 inch (60 mm) particle size and that are manufactured objects; plant or animal matter; or natural geologic materials. Smaller particles may be considered debris if they are manufactured objects and if they do not belong to S3000 or S4000. Examples of S5000 waste include gloves; hoses; aprons; floor tile; insulation; plastic; rubber; wood; paper; cloth; and biological materials.

The most common RCRA-regulated hazardous constituents in TRU mixed waste

1. Metals and metal ions: Some of the TRU mixed waste to be emplaced in the WIPP facility contains toxic metals contained in EPA hazardous waste codes D004 through D011 (EPA 2000a). Cadmium, chromium, lead, mercury, selenium, and silver are present in discarded tools and equipment; solidified sludge; cemented laboratory liquids; and waste from decontamination and decommissioning activities. A large percentage of the waste eonsists of lead-lined gloveboxes; leaded rubber gloves and aprons; lead bricks and piping; lead tape; and other lead items. Lead, because of its radiation-shielding applications, is the most prevalent toxicity-characteristic metal present.

2. Halogenated volatile organic compounds: Some of the TRU mixed waste to be emplaced in the WIPP facility contains spent halogenated volatile organic compound (VOC) solvents listed as EPA hazardous waste numbers F001 through F005 (EPA 2000a). Tetrachloroethylene; trichloroethylene; methylene chloride; carbon tetrachloride; 1,1,1-trichloroethane; and 1,1,2-trichloro-1,2,2-trifluoroethane (EPA hazardous waste codes F001 and F002) are the most prevalent halogenated organic compounds identified in TRU mixed waste that may be managed at the WIPP facility during the Disposal Phase. These compounds are commonly used to clean metal surfaces prior to plating, polishing, or fabrication; to dissolve other compounds; or as coolants. Because they are highly volatile, only small amounts typically remain on equipment after cleaning or, in the case of treated wastewater, in the sludge after clarification and flocculation. Radiolysis may also generate halogenated volatile organic compounds.

3. Non-halogenated volatile organic compounds: Xylene, methanol, and n-butanol are the most prevalent nonhalogenated VOCs in TRU mixed waste that may be managed at the WIPP facility. Like the halogenated VOCs, they are used as degreasers and solvents and are similarly volatile. The same analytical methods that are used for halogenated VOCs are used to detect the presence of nonhalogenated VOCs.

Prohibited Items

The TRU mixed waste forms describe both radioactive and hazardous characteristics exhibited by the wastes. The Permit Treatment, Storage, and Disposal Facility Waste Acceptance Criteria (TSDF-WAC) places limits on the waste that can be shipped to the WIPP facility based on the characteristics of the waste form. The following TRU mixed wastes are prohibited at the WIPP facility:

1. Liquid waste. Residual liquid in the container in excess of what is reasonably achievable by pouring, pumping, and/or aspirating; liquid in the internal container in excess of 1 inch (2.5 cm) of liquid in the bottom of the container; or total residual liquid in any payload container (e.g., 55 gallon drum or standard waste box) in excess of 1% (by volume) of that container.
2. Pyrophoric materials, such as elemental potassium.
3. Hazardous wastes not occurring as co-contaminants with TRU wastes.
4. Wastes incompatible with backfill; seal and panel closures materials; container and packaging materials; shipping container materials; or other wastes.
5. Wastes containing explosives or compressed gases.
6. Wastes with polychlorinated biphenyl (PCB) concentration of 50ppm (50 mg/kg) or more.
7. Wastes exhibiting the characteristic of ignitability, corrosivity, or reactivity (EPA Hazardous Waste Numbers D001, D002, or D003).
8. Any waste container that does not have VOC concentration values reported for the headspace.
9. Any waste container which has not undergone either radiographic or visual examination.
10. Any waste container from a waste stream which has not been preceded by an appropriate, certified Waste Stream Profile Form.

Before accepting a container holding TRU mixed waste, WIPP operators audit the radiography or visual examination (VE) data records of the generator/storage sites to verify that the container holds no unvented compressed gas, and that residual liquid does not exceed 1% (volume) in any payload container. Radiography tapes are to be selected randomly for at least 1% of containers received at the WIPP, at which time they are reviewed and compared to radiographic data forms. If waste does not include at least 50% of any given category by volume, characterization shall be performed using the waste characterization process required for the category constituting the greatest volume of waste for that waste stream. To ensure the integrity of the WIPP facility, waste streams identified as containing incompatible materials or materials incompatible with waste containers are not to be shipped to the WIPP unless they are treated to remove the incompatibility.

Waste generated as a result of waste container handling and processing activities at the WIPP facility are known as "derived" wastes. Because derived wastes can contain only those RCRA-regulated materials present in the waste from which they were derived, no additional characterization of the derived waste is required for disposal purposes. In other words, generator/storage site characterization data as well as knowledge of the processes at the WIPP facility will be used to identify and characterize hazardous waste and hazardous constituents in derived waste.

TRU waste, by definition, must contain 100 nCi or more of transuranic elements per gram of waste, which means that the radioactive component of the waste will always be present within the waste in significant concentrations. The TSDF-WAC limitations and restrictions are provided to ensure that any waste form received at the WIPP facility is stable and can be managed safely. One benefit of waste form restrictions— such as no liquids—is that they limit the kinds of releases that could occur to those that would be readily detectable through visual inspection (i.e., large objects that fall out of ruptured containers) or through the use of radiation monitoring—either locally or within the adjacent area—to detect materials that have escaped from containers.

Releases and spills

Some waste forms only contain radioactive contamination on the surface, because they are not the result of a treatment process or are not porous in form. These include glass, leaded rubber, metals, graphite, ceramics, firebricks, and plastics. In theory, a hazardous waste release could occur if the interiors of these materials became exposed and were involved in a release or spill. Such an occurrence is not likely during operations, because no activities are planned or anticipated that would result in the breaking of these materials to expose fresh surfaces. The WIPP facility will handle only sealed containers of waste and derived waste. The practice of handling sealed containers minimizes the opportunity for releases or spills. For the purposes of safety analysis, it was assumed that releases and spills during operations occur by either of two mechanisms: 1) surface contamination, and 2) accidents.

Regardless of how the release occurs, the nature of the waste and the processes that generated it is such that the radioactive and hazardous components are intimately mixed. A release of one without the other is not likely, except for releases of VOCs from containers. Surface contamination is the only credible source of contamination external to the containers during normal operations. Surface contamination is assumed to be caused by waste management activities at the generator site that result in the contamination of the outside of a waste container. Contamination would most likely consist of particulate matter (dirt or dust) that would be deposited during generator-site handling/loading activities. This contamination may not be detected by visible inspections. Surface contamination is monitored upon arrival at the WIPP facility through the use of swipes and radiation monitoring equipment, as specified in the WIPP Permit (NM Hazardous Waste Regulations, Title 20; NMED 1999). Detection using radioactivity is very sensitive and allows for the detection of contamination that may not be visible on the surface of the container. This exceeds the capability required by the RCRA, which is generally limited to inspections that detect only visible evidence of spills or leaks. Releases can occur from accidents, and those that occur within the waste handling process are assumed to result in the release of radioactive contaminants and VOCs. Radioactive releases are detectable using surface-sampling (swipe) techniques. The most common RCRA-regulated hazardous constituents in TRU mixed waste to be managed at the WIPP facility consist of: metals; halogenated volatile organic compounds; and nonhalogenated volatile organic compounds.

WASTE STREAM IDENTIFICATION

Waste characterization activities at generator/storage sites include the following, although not all of these techniques will be used on each container:

1. Radiography, which is an x-ray technique, to determine physical contents of containers.
2. Visual examination (VE) of opened containers as an alternative way to determine their physical contents or to verify radiography results.
3. Headspace-gas sampling to determine VOC content of gases in the void volume of the containers.
4. Sampling and analysis of waste forms that are homogeneous and can be representatively sampled to determine concentrations of hazardous waste constituents and toxicity-characteristic contaminants of waste in containers.

5. Compilation of acceptable knowledge (AK) documentation into an auditable record, including process knowledge and prior sampling and analysis data.
6. Non-destructive assay, typically segmented gamma scans (SGS) and passive/active neutron interrogation (PAN), to quantify radionuclides for 40 CFR 194 waste characterization compliance.

Auditable records allow DOE operators to conduct a systematic assessment, analysis, and evaluation of generator/storage site compliance with the WAP and the Permit. Waste analysis parameters to be characterized include confirmation of physical form; presence of toxicity characteristic contaminants; and exclusion of prohibited items. The characterization techniques used by generator/storage sites include AK, which incorporates confirmation by headspace-gas sampling and analysis; radiography; and homogeneous waste sampling and analysis. All confirmation and characterization activities are to be performed in accordance with the WAP. The analytical requirements are specified by the analytical method being used (e.g., Fourier Transform Infrared Spectroscopy (FTIRS), Gas Chromatography/Mass Spectrometry (GC/MS)).

Waste analysis parameters characterized for the 40 CFR 194 (EPA 1998) characterization program are quantity of metals; quantities of cellulosics; plastics; and rubber; quantity of free water; and a list of ten radionuclides. The characterization techniques used by generator/storage sites for these parameters also include AK and radiography as well as non-destructive assay (NDA).

Radiography

Radiography techniques have been developed by the DOE to aid in the examination and identification of containerized waste. There are specific requirements that relate to radiography methods used at respective facilities. A radiography system typically consists of: 1) an X-ray-producing device; 2) an imaging system; 3) an enclosure for radiation protection; 4) a waste container handling system; 5) an audio/video recording system; and 6) an operator control and data acquisition station.

Although these six components are required, it is expected that there will be some variation within a given system between sites. The radiography of a waste container is recorded by an audio/videotape or equivalently non-alterable media and is maintained as a non-permanent record. The estimated waste material parameter and weights should be determined by compiling an inventory of waste items, residual materials, and packaging materials. Containers whose contents prevent full examination to the extent expected for the radiography technique and waste form, are subject to visual examination.

Visual examination

As an additional quality control (QC) check on radiography, or in lieu of radiography, the waste container contents are verified directly by visual examination. The visual examination consists of a semi-quantitative and/or qualitative evaluation of the waste container contents, and is recorded on audio/videotape. Visual examination is performed on a statistically determined portion of waste containers to verify the results of radiography. This verification includes use of the Waste Matrix Code; waste material parameter weights; and the ensurance of the absence of prohibited items.

Visual examination includes describing the contents of a waste container, and estimating or measuring the weight of the contents. The description identifies the discernible waste items, residual materials, packaging materials, and waste material parameters. Estimated weights are established through the use of historically derived waste weight tables and an estimation of the waste volumes.

Headspace-gas sampling and analysis

Headspace-gas sampling is performed on waste containers that are in compliance with the container temperature equilibrium requirements (i.e., 72 h at 18°C or higher). Waste containers designated as summary category S5000 (Debris waste) are sampled for headspace gas a minimum of 142 d after packaging. Waste containers designated as Summary Categories S3000 (Homogenous solids) and

S4000 (Soil/gravel) are sampled a minimum of 225 d after packaging. This drumage criteria ensures that the drum contents have reached 90 % of steady state concentration within each layer of confinement to allow a representative sample to be taken (NMED 1999.) Two types of headspace-gas sampling protocols may be employed: 1) the manifold headspace-gas sampling protocol, and 2) the direct canister headspace-gas sampling protocol.

Once the headspace gas sample has been collected in accordance with the HWFP requirements, the sample is taken to a laboratory for analysis. The laboratory analyzes the sample using the allowable methods in the HWFP and reports the concentration of all analytes on the target analyte list. In addition, the presence of any tentatively identified compounds (TICs) observed during the analysis is reported.

Sampling and analysis of homogenous solids and soil/gravel

The methods used to collect samples of TRU mixed waste classified as homogenous solids and soil/gravel from waste containers, are designed to ensure that the samples are representative of the waste from which they are taken. A sufficient number of samples are collected to adequately represent the waste being sampled. For those waste streams defined as Summary Category Groups S3000 or S4000, debris that may also be present within these wastes need not be sampled. Samples of retrievably stored waste containers are collected using appropriate coring equipment or other EPA-approved methods to collect a representative sample. Newly-generated wastes that are sampled from a process as they are generated may be sampled using EPA-approved methods—including scoops and ladles—that are capable of collecting a representative sample.

The QC requirements for sampling homogenous solids and soil/gravel include: collecting co-located samples from cores or other sample types to determine precision; equipment blanks to verify cleanliness of the sampling and coring tools and sampling equipment; and analysis of reagent blanks to ensure that reagents, such as deionized or high pressure liquid chromatography (HPLC) water, are of sufficient quality.

Once the homogeneous solid or soil/gravel sample has been collected in accordance with the HWFP requirements, the sample is taken to a laboratory for analysis. The laboratory analyzes the sample using the allowable methods in the HWFP and reports the concentration of all analytes on the target analyte list. In addition, the presence of any tentatively-identified compounds (TICs) observed during the analysis is reported.

Acceptable knowledge

This characterization technique incorporates confirmation by headspace-gas sampling and analysis; radiography; and homogeneous waste sampling and analysis. Both RCRA regulations and the New Mexico Hazardous Waste Management Regulations (NMED 1997) authorize the use of AK in appropriate circumstances by waste generators—or treatment, storage, or disposal facilities—to characterize hazardous waste. Acceptable knowledge is described by the EPA (EPA 1994) as an alternative to sampling and analysis; it can be used to meet all or part of the waste characterization requirements under the RCRA. AK includes a number of techniques used to characterize TRU mixed waste, such as process knowledge; records of analysis acquired prior to RCRA; and other supplemental sampling and analysis data (EPA 1994). AK is used in TRU mixed waste characterization activities in three ways:

1. To delineate TRU mixed waste streams
2. To assess if TRU mixed heterogeneous debris wastes exhibit a toxicity characteristic (NMED 1997)
3. To assess if TRU mixed wastes are listed (NMED 1997)

TRU mixed waste streams are evaluated by applicable provisions of the AK process prior to management, storage, or disposal by the Permittees at the WIPP. TRU mixed waste management AK information defines waste categorization schemes and terminology; provides a breakdown of the types and quantities of TRU mixed wastes that are generated and stored at the site; and describes how wastes are tracked and managed at the site—including historical and current operations. Information related to TRU mixed waste certification procedures and the types of documentation (e.g., waste profile forms) used to summarize AK are also provided. The amount and type of supplemental AK information required from generator/storage sites is site-specific and cannot be mandated, but sites collect information as appropriate to support required AK information.

The AK written record includes a summary that identifies all sources of waste characterization information used to delineate the waste stream. For each TRU mixed waste stream, the generating sites compile all process information and data supporting the AK used to characterize that waste stream. The type and quantity of supporting documentation will vary by waste stream, depending on the process generating the waste and site-specific requirements imposed by the DOE.

Non-destructive assay (NDA)

Radioassay is a term used to define measurement methods for determining the radionuclide content of waste. The isotopic composition of RH-TRU waste is usually determined from documented AK and, in some cases, from measurements taken on the product material during processing at each site. NDA techniques allow an item to be assayed without altering its physical or chemical form. NDA techniques can be classified as active or passive. Passive NDA is based on the observation of spontaneously-emitted radiations created through radioactive decay of the isotopes of interest or their radioactive daughters. Most active NDA is based on the observation of gamma or neutron radiation that is emitted from a target isotope when that isotope undergoes a transformation resulting from an interaction with stimulating radiation provided by an appropriate external source.

STATISTICAL METHODS USED IN SAMPLING AND ANALYSIS

Generator/storage sites use statistical methods to: 1) select waste containers for visual inspection; 2) select retrievably-stored waste containers for totals analysis; 3) set the upper confidence limit; and 4) apply control charting for newly-generated waste stream sampling. Statistical sampling techniques are not currently employed in waste characterization activities employed for 40 CFR 194 (EPA 1999) compliance.

Selecting waste containers for visual examination

As a QC check on the radiographic examination of waste containers, a statistically-selected portion of the certified waste containers is opened and visually examined. The data from visual examination is used to verify the matrix parameter category, waste material parameter weights, and absence of prohibited items, as determined by radiography. The data obtained from the visual examination can also be used to determine— with acceptable confidence—the percentage of miscertified waste containers from the radiographic examination. Miscertified containers are those that radiography indicates meet the WIPP Waste Acceptance Criteria and Transuranic Package Transporter-II Authorized Methods for Payload Control, but visual examination indicates do not meet these criteria. Participating sites initially use an 11% miscertification rate to calculate the number of waste containers that are visually examined until a site-specific miscertification rate has been established.

The site-specific miscertification rate is applied initially to each Summary Category Group to determine the number of containers in that Summary Category Group requiring visual examination. However, a Summary Category Group-specific miscertification rate is determined when either six months have passed since radiographic characterization commenced on a given Summary Category Group or at least 50% of a given Summary Category Group has undergone radiographic characterization, whichever occurs first. The Summary Category Group is then subject to the visual examination requirements of this reevaluated Summary Category Group-specific miscertification rate to ensure that the entire Summary Category Group is appropriately characterized. The site-specific miscertification rate is reassessed annually.

Statistical sampling and analysis of homogeneous solids and soil/gravels for totals

The statistical approach for characterizing retrievably-stored homogeneous solids and soil/gravel waste using sampling and analysis relies on using acceptable knowledge to segregate waste containers into relatively homogeneous waste streams. Once segregated by waste stream, random selection and sampling of the waste containers followed by analysis of the waste samples are performed to ensure that the resulting mean contaminant concentration provides an unbiased representation of the true mean contaminant concentration for each waste stream.

Preliminary estimates of the mean concentration and variance of each RCRA-regulated contaminant in the waste are used to determine the number of waste containers to select for sampling and analysis. The preliminary estimates are made by obtaining a preliminary number of samples from the waste stream or from previous sampling from the waste stream. Preliminary estimates are based on samples from a minimum of five waste containers. Samples collected to establish preliminary estimates that are selected, sampled, and analyzed in accordance with applicable provisions of the WAP are used as part of the required number of samples to be collected.

The calculated total number of required waste containers can then be randomly sampled and analyzed. Waste container samples from the preliminary mean and variance estimates may be counted as part of the total number of calculated required samples if and only if:

1. There is documented evidence that the waste containers for the preliminary estimate samples were selected in the same random manner as is chosen for the required samples.
2. There is documented evidence that the method of sample collection in the preliminary estimate samples were identical to the methodology to be employed for the required samples.
3. There is documented evidence that the method of sample analysis in the preliminary estimate samples was identical to the analytical methodology employed for the required samples.
4. There is documented evidence that the validation of the sample analyses in the preliminary estimate samples was comparable to the validation employed for the required samples. In addition, the validated samples results should indicate that all sample results were valid according to the analytical methodology.

Upon collection and analysis of the preliminary samples, or at any time after the preliminary samples have been analyzed, the generator/storage site may assign hazardous waste codes to a waste stream. For waste streams with calculated upper confidence limits below the regulatory threshold, the site must collect the required number of samples if the site intends to establish that the constituent is below the regulatory threshold.

Statistical headspace gas sampling and analysis

If a waste stream meets the conditions for representative headspace gas sampling, then headspace-gas sampling of that waste stream may be done on a randomly-selected portion of containers in the waste stream. The minimum number of containers that are sampled is determined by taking an initial VOC sample from 10 randomly-selected containers. These samples are analyzed for all the target analytes.

Waste container samples from the preliminary mean and variance estimates may be counted as part of the total number of calculated required samples if and only if:

1. There is documented evidence that the waste containers for the preliminary estimate samples were selected in the same random manner as is chosen for the required samples.
2. There is documented evidence that the method of sample collection in the preliminary estimate samples were identical to the methodology to be employed for the required samples.
3. There is documented evidence that the method of sample analysis in the preliminary estimate samples were identical to the analytical methodology employed for the required samples.
4. There is documented evidence that the validation of the sample analyses in the preliminary estimate samples were comparable to the validation employed for the required samples. In addition, the validated samples results should indicate that all sample results were valid according to the analytical methodology.

The mean and standard deviation calculated after sampling *n* containers is then used to calculate a UCL_{90} for each of the headspace gas VOCs.

Control charting for newly-generated waste stream sampling

Significant process changes and process fluctuations associated with newly-generated waste are determined using statistical process control (SPC) charting techniques; these techniques require historical data for determining limits for indicator species, and subsequent periodic sampling to assess process behavior relative to historical limits. SPC is performed on waste prior to solidification or packaging for ease of sampling. If the limits are exceeded for any toxicity characteristic parameter, the waste stream can be recharacterized, and the characterization can be performed according to procedures required in the WAP.

A Shewhart control chart (Gilbert 1987) is a control chart for statistical means that is used for checking whether current data are consistent with past data and whether shifts or trends in means have occurred. If a current sample mean from the process lies within the limits, the process is said to be "in control," or consistent with historical data. If the current mean exceeds the limits, the process has likely changed from historical periods. Logical sets of historical data to be used for the construction of limits in this application are the data from the initial characterization of the waste stream, if available; from characterization of a different lot of the waste stream, or from a retrievably-stored waste stream of the same type from the same process. At a minimum, the logical set includes ten representative sample values collected and analyzed from the newly-generated waste stream. The data used for construction of the limits is justified. The underlying assumptions for control charts are that the data are independent and normally-distributed with constant mean μ and constant variance σ^2. The statistical tests for normality can be conducted and data transformation to normality performed, if necessary. Transformations should take place prior to any calculations that use the data.

Each limit is constructed such that there is a 90 % confidence that the true mean does not exceed a limit. One-sided control limits are used because once a waste stream has been determined to be RCRA-hazardous and the limit exceedance of interest is on the lower side—that is when the process may become nonhazardous. Likewise, once a waste stream has been determined not to be RCRA-hazardous and the limit exceedance of interest is on the upper side—that is when the process may become RCRA-hazardous. Whether or not exceeding the limit would result in a change in the RCRA-hazardous nature of the waste stream depends on how close the observed control limits are to RCRA limits.

Current process data are collected and averaged for comparison to the control limit for the mean. The collection period and number of samples included in the average are dependent on the waste stream characteristics. A small number of samples will reflect more of the process variability and there will be more limit exceedances. If two or three samples are collected for the mean in the required annual (or batch) sampling of a relatively homogeneous waste stream, limit exceedances may not occur. If the waste stream is less homogeneous, it will be necessary to collect more samples to meet the required confidence limit. Periodically, it will be necessary to update the control limit for a process. An update that includes all historical data is performed if there is no evidence of a trend in the process or a shift in the mean for the process. If there has been a shift in the mean, only more recent data that reflect the shift are used. Control limits shall be based on at least ten data points that are representative of the process and do not exhibit outliers or a trend with time.