A Plan for characterizing waste for the Defense Special Weapons Agency at the Nevada Test Site

Tiffany A. Hatcher

University of Nevada Las Vegas

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A Plan for Characterizing Waste for the Defense Special Weapons Agency at the Nevada Test Site

Prepared by
Tiffany A. Hatcher

December 1997
A Plan for Characterizing Waste for the
Defense Special Weapons Agency at the Nevada Test Site

A thesis submitted in partial satisfaction
of the requirement for the degree
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in

Environmental Studies
University of Nevada, Las Vegas

by

Tiffany A. Hatcher

Fall 1997

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List of Acronyms and Abbreviations

AEC – Atomic Energy Commission
°C – Degree(s) Celsius
CFR – Code of Federal Regulations
CWA – Clean Water Act
DoD – Department of Defense
DSWA – Defense Special Weapons Agency
EPA – Environmental Protection Agency
°F – Degree(s) Fahrenheit
in – inch(es)
mg/L – milligram(s) per liter
mm – millimeter(s)
pH – Negative logarithm of the hydrogen ion concentration
NRS – Nevada Revised Statutes
NTS – Nevada Test Site
Sec. – Section(s)
RCRA – Resource Conservation and Recovery Act
TNT – trinitrotoluene
TSCA – Toxic Substances Control Act
USGS – United States Geological Survey
Introduction

In 1976, Congress adopted the Resource Conservation and Recovery Act (RCRA) to govern hazardous waste. The Act was amended in 1984 with the Hazardous and Solid Waste Amendments in order to further define the requirements of RCRA. RCRA is meant to protect human health and the environment from the effects of hazardous waste, promote waste minimization, and encourage material recycling and recovery. For this purpose, regulations are implemented that cover every aspect of the hazardous waste problem, including generation, transport, treatment, storage, and disposal.

Generators of waste are the most important part of this chain. As defined in RCRA, a generator is “any person, by site, whose act or process produces hazardous waste identified or listed in Part 261... or whose act first causes a hazardous waste to become subject to regulation”. It is the generator’s responsibility to ensure its waste is stored properly once it is generated (40 CFR §262.34), to determine if the waste is hazardous (40 CFR §262.11), to notify the Environmental Protection Agency (EPA) if it is (40 CFR §262.12), and to identify proper waste treatment or disposal options (40 CFR §262.20). Failure by the generator to perform this “cradle-to-grave” tracking of its waste can expose the generator to significant fines and penalties of up to $25,000 per day, per violation (40 CFR §262.10). Therefore, it is incumbent upon the generator to identify its waste products prior to the waste’s generation.

What is a waste characterization plan?

A waste characterization plan is a document that identifies the waste a generator will create during the course of a specific process, determines if the waste is hazardous or not, and
makes recommendations for the treatment and/or disposal of the waste based on that information.

Why is a waste characterization plan important?

A waste characterization plan is important for many reasons. First of all, a hazardous waste determination is required from the generator of hazardous waste, per 40 CFR §262.11. The intent of this section is that the waste characterization be done before the actual generation of the waste. Doing a waste characterization plan in advance has many advantages. If it is determined that a hazardous waste will be generated, the feedstock or process can be altered in order to minimize hazardous waste generation.

A waste characterization plan involves formulating disposal options. This is important because if the generator waits until after the waste is generated to characterize, the waste could be mishandled before a plan for handling and disposal is formulated. Depending on the disposal deadlines, a generator may not have enough time to characterize the waste and formulate a disposal plan before the disposal deadline. This could lead to expensive fines and penalties, as stated in 40 CFR §262.10(e), which reads, 'A person who generates a hazardous waste as defined by 40 CFR Part 261 is subject to the compliance requirements and penalties prescribed in Section 3008 of the Act if he does not comply with the requirements of this part.' These penalties can be up to $25,000 per day, per violation. (Sec. 3008 -- Any penalty assessed in the order shall not exceed $25,000 per day of non-compliance for each violation of a requirement in this subtitle.)
Defense Special Weapons Agency (DSWA)

The Defense Special Weapons Agency (DSWA) is the Department of Defense's (DoD) primary agency for weapons effects testing. The majority of this testing is performed at the Nevada Test Site (NTS). DSWA supports field exercises and testing in both tunnel and aboveground structures. A waste characterization plan is required for many of these activities.

Purposes of this document

The purposes of this document are to provide a definitive outline to be utilized by the Defense Special Weapons Agency (DSWA) for future waste characterization plans, and to take the reader through the waste characterization plan step by step by using an actual process as an example. These objectives will be achieved by first examining the parts of a waste characterization plan (beginning with the background), and then by using each section as a format for future waste characterization plans, using a DSWA explosives test named Dipole Hail as an example.

Background

The goal of the background section of a waste characterization plan is to reveal the objective of the process being characterized; describe what information is to be gained from the plan; and discuss the reasons the process is thought to be important. The background section usually contains a short description of the process and its purpose.
Background for Dipole Hail

Thanks to advances in mining techniques, many countries are able to position their facilities and munitions in underground tunnels or inside mountains. This protects these targets from attacks by conventional weapons and from satellite intelligence gathering systems.

It may be possible to render these targets useless for a strategic period of time by using penetrator-type weapons. By destroying the entrance to the tunnels or bunkers, the target will not be able to be used until the entrance is repaired. The purpose of the Dipole Hail test series is to evaluate the damage done to a tunnel system from a penetrator weapon and to assess the amount of time and materials needed to repair it.

A 2000-pound conventional penetrator bomb, the BLU-109, will be emplaced in a 20-inch diameter hole over the tunnel complex in order to simulate the penetration of an air-dropped bomb. The bomb has a heavy-walled case made from a steel alloy. The BLU-109 will contain 562 pounds 80/20 tritonal explosive, which consists of 80 percent Trinitrotoluene (TNT) and 20 percent aluminum powder. The explosion will be initiated by one to two pounds of C-4, a malleable plastic explosive. The test will be repeated at varying tunnel depths.

Purpose

As previously stated, a waste characterization plan serves many purposes. A waste characterization plan keeps the generator in compliance with the regulations. It provides information about the wastes generated before the actual process takes place, allowing the generator to revise the process, or what goes into it, to minimize or eliminate waste. The
waste characterization plan also formulates disposal options, saving time after waste generation, and possibly saving the generator from penalties.

**Purpose of Waste Characterization Plan for Dipole Hail**

The purpose of this plan is to identify the waste streams to be generated by the Dipole Hail test series, characterize these wastes to the greatest extent possible prior to their actual generation, and identify proper waste management procedures.

**Waste Streams**

The EPA defines a waste stream as "the total flow of solid waste from homes, businesses, institutions, and manufacturing plants that are recycled, burned, or disposed of in landfills, or segments thereof such as the "residential waste stream" or the "recyclable waste stream." " (EPA, 1994). For the purposes of this study, the term 'waste stream' shall also include wastewater and emissions which are defined by the EPA as follows:

- **Wastewater**: The spent or used water from a home, community, farm, or industry that contains dissolved or suspended matter.

- **Emission**: Pollution discharged into the atmosphere from smokestacks, other vents, and surface areas of commercial or industrial facilities; from residential chimneys; and from motor vehicle, locomotive, or aircraft exhausts.

-- EPA, 1994
Waste streams to be identified

1. Air emissions

In addition to the EPA definition of emission, the Nevada Air Quality Statutes define an 'air contaminant' as "any substance discharged into the atmosphere except water vapor and water droplets." (NRS §445.411, 1989). Using these definitions, particles such as dust and exhaust are considered to be air contaminants and therefore part of the waste stream.

2. Liquid effluents

The term 'effluent' is defined by the EPA as follows:

Effluent: Wastewater, treated or untreated, that flows out of a treatment plant, sewer, or industrial outfall. Generally refers to wastes discharged into surface waters.

-- EPA, 1994

The liquid effluents to be identified do not include those considered solid waste under RCRA, but rather those to be considered under the Clean Water Act (CWA). The CWA required the EPA to establish limits on the amounts of specific pollutants that may be discharged. These limits are referred to as "effluent limitations." (33 U.S.C.A. §§ 1311 to 1312)

3. Solid wastes

A solid waste is defined by RCRA as any discarded material that is not excluded by 40 CFR §261.4(a) or that is not excluded by variance under 40 CFR §§260.30 and 260.31. A discarded material is any material that is abandoned, recycled, or considered inherently waste-like (40 CFR §261.2).

- Abandoned material is material that has been disposed of, material that has been
burned or incinerated; or material that has been accumulated, stored, or treated before or in lieu of being abandoned by being disposed of, burned, or incinerated.

- Recycled material is material that is used in a manner constituting disposal; material that is burned for energy recovery; material that has been reclaimed; or material that has been accumulated speculatively.

- Inherently waste-like materials are listed as such in 40 CFR §262.2(d).

Figure 1 describes the steps in determining whether or not a waste is a solid waste.

4. **Radioactive materials**

Radioactive materials, as defined by the EPA, are those materials which emit ionizing radiation. Ionizing radiation is radiation that can strip electrons from atoms, i.e., alpha, beta, and gamma radiation. (EPA, 1994)

5. **Mixed waste**

Mixed waste is radioactive waste that also contains hazardous waste (as defined by RCRA), and is therefore subject to regulations for both categories of waste (Eisenbud, 1997).

6. **Petroleum waste**

Petroleum waste is not considered to be hazardous waste under 40 CFR §261.4(b)(10) if it fails to exhibit the toxicity characteristic stated in 40 CFR §261.24.

7. **Asbestos waste**

Asbestos is a mineral fiber that can pollute air or water and cause cancer or asbestosis when inhaled. EPA has banned or severely restricted its use in manufacturing and construction (EPA, 1994). Asbestos is regulated under the Toxic Substances Control Act (TSCA). Title II of TSCA (15 U.S.C.A §§2641 to 2656) which regulates asbestos, was added by
All materials

Garbage, refuse or sludge

Solid, liquid, semi-solid or contained gaseous material which is:
1. discarded
2. served its intended purpose
3. a manufacturing or mining by-product

Other

Does §261.4(a) excluded your material from regulation under RCRA because it is one of the following:
1. Domestic sewage
2. CWA point source discharge
3. Irrigation return flow
4. AEC source, special nuclear or by-product material
5. In situ mining waste

THE MATERIAL IS NOT A RCRA SOLID WASTE

THE MATERIAL IS A RCRA SOLID WASTE irrespective of whether you:
1. discard it
2. use it
3. reuse it
4. recycle it
5. reclaim it
6. store it or accumulate it for purposes 1-5 above

FIGURE 1

DEFINITION OF A SOLID WASTE

(Reprinted from Goffredi et al, 1996)
amendment in 1986, and specifically calls for determination and implementation of appropriate response actions for asbestos (Tabb, 1992).

Waste streams from Dipole Hail

1. **Air emissions**

Air emissions resulting from the Dipole Hail test series will include exhaust due to machinery used in construction, transportation, and emplacement of the bombs. Also contributing to air emissions will be the explosion itself, from which a dust cloud will likely result.

2. **Liquid effluents**

The tunnel complex being utilized for the Dipole Hail test series is a "dry" tunnel; that is, there is no groundwater present whatsoever. Therefore, no wastewater will result and no pollutants will be discharged into a water body.

3. **Solid wastes**

Solid wastes resulting from the Dipole Hail test series include: rock waste and soil waste, and debris from the bomb casing. Due to the emplacement of the bomb in a 20-inch diameter drill hole, the explosives will burn up upon detonation. If the bomb were to be detonated in the atmosphere, scattering of unburned explosives could be expected, but due to the close confines of the drill hole, no unburned explosives are expected after the explosion (Ashbaugh and Reynolds, 1995).

4. **Radioactive materials**

There are no ionizing radiation sources involved in the construction and testing at the tunnel
complex. Sampling was done prior to any construction taking place, and radiation monitors have been placed in the ventilation system as a precaution.

5. **Mixed waste**

Since there are no radioactive materials involved in the Dipole Hail testing process or in the tunnel complex, there can be no mixed wastes. Mixed waste contains both hazardous materials and radioactive materials.

6. **Petroleum waste**

All surplus equipment used in the test will be drained of lubricants, oils, and other regulated materials prior to the test. Therefore, no petroleum wastes are expected. However, any spills or releases will be cleaned up and disposed of in accordance with NTS procedures.

7. **Asbestos waste**

No wastes containing asbestos will be produced.

---

**Hazardous Waste Determination**

The hazardous waste determination is the most important section of the waste characterization plan. In the waste determination, the waste materials expected to result from the process are actually characterized and determined to be hazardous or not (see Figure 2). 40 CFR §262.11 describes the method generators should use to determine if their wastes are hazardous.

1. **Is the waste excluded from regulation in 40 CFR 261.4?** (40 CFR §262.11(a))

Some materials are not considered to be hazardous in 40 CFR §262.11(a). These materials
FIGURE 2

DEFINITION OF A HAZARDOUS WASTE

(Reprinted from Goffredi et al, 1996)
are known as 'exclusions.' Exclusions include materials in the following categories:

- Materials which are not solid wastes
- Solid wastes which are not hazardous wastes
- Hazardous wastes which are exempted from certain regulations
- Samples
- Treatability study samples
- Samples undergoing treatability studies at laboratories and testing facilities.

2. Is the waste listed as hazardous waste in Subpart D of 40 CFR Part 261? (40 CFR §262.11(b))

Certain wastes have been determined by the EPA to be hazardous. These wastes are listed in Subpart D of 40 CFR Part 261. These wastes are always considered hazardous, no matter what the concentration is. The lists are:

- F List -- Hazardous wastes from non-specific sources
- K List -- Hazardous wastes from specific sources
- P List -- Acute hazardous wastes
- U List -- Toxic wastes

3. Is the waste a characteristic hazardous waste in Subpart C of 40 CFR Part 261? (40 CFR §262.11(c))

Sometimes a hazardous waste can be identified by the characteristics the waste exhibits. Even if a waste is not listed in the F, K, P, or U Lists, it may still be considered a hazardous waste based on its characteristics. The following characteristics are considered in RCRA:

- 261.21 Characteristic of ignitability: A solid waste exhibits the characteristic of
ignitability if it has any of the following properties:

1) It is a liquid with a flash point less than 60ºC (140ºF).

2) It is not a liquid and capable of causing fire through friction, absorption of moisture, or spontaneous chemical changes (under standard temperature and pressure) and burns so vigorously and persistently that it creates a hazard.

3) It is an ignitable compressed gas.

4) It is an oxidizer.

• 261.22 Characteristic of corrosivity: A solid waste exhibits the characteristic of corrosivity if it has either of the following properties:

   1) It is aqueous with a pH ≤ 2, or ≥ 12.5.

   2) It is a liquid that can corrode steel at a rate ≥ 6.35mm (0.250in) per year at 55ºC (130ºF).

• 261.23 Characteristic of reactivity: A solid waste exhibits the characteristic of reactivity if it has any of the following properties.

   1) It is normally unstable and readily undergoes violent change without detonating.

   2) It reacts violently with water.

   3) It forms potentially explosive mixtures with water.

   4) It generates toxic gases, vapors or fumes that are dangerous to human health and the environment when mixed with water.

   5) It is a cyanide or sulfide bearing waste which generates toxic gases, vapors,
or fumes (when exposed to pH conditions between 2 and 12.5) that can be
dangerous to human health and the environment.

6) It is capable of detonation or explosive reaction if it is subjected to a
strong initiating force or if heated under confinement.

7) It is readily capable of detonation or explosive reaction or decomposition at
standard temperature and pressure.

8) It is a forbidden explosive (49 CFR 173.51), a Class A explosive (49 CFR
173.53), or a Class B explosive (49 CFR 173.88).

- 261.24 Characteristic of toxicity: A solid waste exhibits the characteristic of
toxicity if it contains any of the contaminants listed in Table 1 at the concentration
equal to or greater than the respective value given in that table.

4. Has the generator determined whether the waste is identified in Subpart C of 40 CFR Part
261 by testing the waste according to methods set forth in Subpart C of 40 CFR Part 261
or 260.21? (40 CFR §262.11(c)(1))

The EPA considers a sample to be representative of a waste when a generator samples the
waste material according to the methods outlined in Subpart C of 40 CFR Part 261 or the
methods that have been added to Parts 261, 264, or 265 due to successful petitions. This
means that if the generator samples the waste in accordance with the regulations, the EPA
believes that the sampled and the entire body of waste have the same properties. Therefore, if
the sample is not hazardous, neither is the waste itself.
<table>
<thead>
<tr>
<th>EPA HW No. ¹</th>
<th>Contaminant</th>
<th>CAS No. ²</th>
<th>Regulatory Level (mg/L)</th>
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<tbody>
<tr>
<td>D004</td>
<td>Arsenic</td>
<td>7440-38-2</td>
<td>5.0</td>
</tr>
<tr>
<td>D005</td>
<td>Barium</td>
<td>7440-39-3</td>
<td>100.0</td>
</tr>
<tr>
<td>D018</td>
<td>Benzene</td>
<td>71-43-2</td>
<td>0.5</td>
</tr>
<tr>
<td>D006</td>
<td>Cadmium</td>
<td>7440-43-9</td>
<td>1.0</td>
</tr>
<tr>
<td>D019</td>
<td>Carbon tetrachloride</td>
<td>56-23-5</td>
<td>0.5</td>
</tr>
<tr>
<td>D020</td>
<td>Chlordane</td>
<td>57-74-9</td>
<td>0.03</td>
</tr>
<tr>
<td>D021</td>
<td>Chlorobenzene</td>
<td>108-90-7</td>
<td>100.0</td>
</tr>
<tr>
<td>D022</td>
<td>Chloroform</td>
<td>67-66-3</td>
<td>6.0</td>
</tr>
<tr>
<td>D007</td>
<td>Chromium</td>
<td>7440-47-3</td>
<td>5.0</td>
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<tr>
<td>D023</td>
<td>o-Cresol</td>
<td>95-48-7</td>
<td>²200.0</td>
</tr>
<tr>
<td>D024</td>
<td>m-Cresol</td>
<td>108-39-4</td>
<td>²200.0</td>
</tr>
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<td>D025</td>
<td>p-Cresol</td>
<td>106-44-5</td>
<td>²200.0</td>
</tr>
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<td>D026</td>
<td>Cresol</td>
<td></td>
<td>²200.0</td>
</tr>
<tr>
<td>D016</td>
<td>2,4-D</td>
<td>94-75-7</td>
<td>10.0</td>
</tr>
<tr>
<td>D027</td>
<td>1,4-Dichlorobenzene</td>
<td>106-46-7</td>
<td>7.5</td>
</tr>
<tr>
<td>D028</td>
<td>1,2-Dichloroethane</td>
<td>107-06-2</td>
<td>0.5</td>
</tr>
<tr>
<td>D029</td>
<td>1,1-Dichloroethylene</td>
<td>75-35-4</td>
<td>0.7</td>
</tr>
<tr>
<td>D030</td>
<td>2,4-Dinitrotoluene</td>
<td>121-14-2</td>
<td>³0.13</td>
</tr>
<tr>
<td>D012</td>
<td>Endrin</td>
<td>72-20-8</td>
<td>0.02</td>
</tr>
<tr>
<td>D031</td>
<td>Heptachlor (and its epoxide)</td>
<td>76-44-8</td>
<td>0.008</td>
</tr>
<tr>
<td>D032</td>
<td>Hexachlorobenzene</td>
<td>118-74-1</td>
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<td>D033</td>
<td>Hexachlorobutadiene</td>
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<td>D034</td>
<td>Hexachloroethane</td>
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<td>D008</td>
<td>Lead</td>
<td>7439-92-1</td>
<td>5.0 RCRA 275</td>
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<td>D013</td>
<td>Lindane</td>
<td>58-89-9</td>
<td>0.4</td>
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<tr>
<td>D009</td>
<td>Mercury</td>
<td>7439-97-6</td>
<td>0.2 RCRA 211</td>
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<tr>
<td>D014</td>
<td>Methoxycarbonyl</td>
<td>72-43-5</td>
<td>10.0</td>
</tr>
<tr>
<td>D035</td>
<td>Methyl ethyl ketone</td>
<td>78-93-3</td>
<td>200.0</td>
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<tr>
<td>D036</td>
<td>Nitrobenzene</td>
<td>98-95-3</td>
<td>2.0</td>
</tr>
<tr>
<td>D037</td>
<td>Pentachlorophenol</td>
<td>87-86-5</td>
<td>100.0</td>
</tr>
<tr>
<td>D038</td>
<td>Pyridine</td>
<td>110-86-1</td>
<td>⁵5.0</td>
</tr>
<tr>
<td>D010</td>
<td>Selenium</td>
<td>7782-49-2</td>
<td>1.0</td>
</tr>
<tr>
<td>D011</td>
<td>Silver</td>
<td>7440-22-4</td>
<td>5.0</td>
</tr>
<tr>
<td>D039</td>
<td>Tetrachloroethylene</td>
<td>127-18-4</td>
<td>0.7</td>
</tr>
<tr>
<td>D015</td>
<td>Toxaphene</td>
<td>8001-35-2</td>
<td>0.5</td>
</tr>
<tr>
<td>D040</td>
<td>Trichloroethylene</td>
<td>79-01-6</td>
<td>0.5</td>
</tr>
<tr>
<td>D041</td>
<td>2,4,5-Trichlorophenol</td>
<td>95-95-4</td>
<td>400.0</td>
</tr>
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<td>D042</td>
<td>2,4,6-Trichlorophenol</td>
<td>88-06-2</td>
<td>2.0</td>
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<td>2,4,5-TP (Silvex)</td>
<td>93-72-1</td>
<td>1.0</td>
</tr>
<tr>
<td>D043</td>
<td>Vinyl chloride</td>
<td>75-01-4</td>
<td>0.2</td>
</tr>
</tbody>
</table>

¹Hazardous waste number
²Chemical abstracts service number
³Quantitation limit is greater than the calculated regulatory level. The quantitation limit therefore becomes the regulatory level.
⁴If o-, m-, and p-Cresol concentrations cannot be differentiated, the total cresol (D026) concentration is used. The regulatory level of total cresol is 200 mg/l.

(Reproduced from 40 CFR §261.24)
5. **Has the generator applied knowledge of the hazard characteristic of the waste in light of materials or processes used?** (40 CFR §262.11(c)(1))

When the methods or materials used in a process have been used a number of times in the past, those methods or materials become proven. In these cases, it is possible to use process knowledge in order to predict the outcome of the process. Process knowledge is the knowledge gained from having used the process or materials in the past. For example, detonation products or waste materials could be predicted using process knowledge.

**Hazardous waste determination for Dipole Hail**

The waste streams considered for the waste determination are those which are present for the Dipole Hail test series: air emissions and solid waste.

1. **Is the waste excluded from regulation in 40 CFR 261.4?** (40 CFR §262.11(a))

The air emissions (exhaust and dust resulting from the explosion) are not considered a solid waste. A solid waste can be a solid, liquid, semisolid, or contained gaseous material (Gottfredi et al, 1996). Since the air emissions mentioned are none of these, they are not a solid waste and are therefore, not hazardous.

The solid waste stream, the steel bomb casing and rock and soil debris, are solid wastes and are not excluded under 40 CFR §262.11(a).

2. **Is the waste listed as hazardous waste in Subpart D of 40 CFR 261?** (40 CFR §262.11(b))

The steel bomb casing is not listed in Subpart D of 40 CFR 261 as F-, K-, P-, or U-listed hazardous wastes.

The geologic wastes are not listed in Subpart D of 40 CFR 261 as F-, K-, P-, or U-listed
hazardous wastes.

3. Is the waste a characteristic hazardous waste in Subpart C of 40 CFR Part 261? (40 CFR §262.11(c))

261.21 Characteristic of ignitability:

The steel bomb casing exhibits none of the characteristics of ignitability.

The geologic wastes exhibit none of the characteristics of ignitability.

261.22 Characteristic of corrosivity:

The steel bomb casing is neither aqueous nor a liquid, and therefore cannot exhibit the characteristic of corrosivity.

The geologic wastes are neither aqueous nor liquids, and therefore cannot exhibit the characteristic of corrosivity.

261.23 Characteristic of reactivity:

The steel bomb casing exhibits none of the characteristics of reactivity.

The geologic wastes exhibit none of the characteristics of reactivity.

261.24 Characteristic of toxicity:

The steel bomb casing contains none of the contaminants listed in Table 1.

The rock and soil in the test area is known to be very similar to that of an area tested previously for toxic contaminants (Davis, 1962). The previous sampling showed that the rock and soil contained some of the contaminants listed in Table 1, but at a concentrations less than the values given in the table (see Appendix A). Therefore, the geologic wastes are not expected to contain any of these contaminants in concentrations greater than or equal to those listed in Table 1.
4. **Has the generator determined whether the waste is identified in Subpart C of 40 CFR part 261 by testing the waste according to methods set forth in Subpart C of 40 CFR part 261 or 260.21?** (40 CFR §262.11(c)(1))

Sampling will be done in the tunnel complex following the first Dipole Hail explosives test. Any material that could be potentially contaminated by the feedstock in the testing process will be analyzed for hazardous content.

5. **Has the generator applied knowledge of the hazard characteristic of the waste in light of materials or processes used?** (40 CFR §261.11(c)(1))

The BLU-109 has been used before; it is a proven bomb. The casing has been tested in the past and it has been determined that it is not hazardous.

Rock and soil similar to that in the area has been sampled before; it was found to contain no hazardous materials and exhibit no hazardous characteristics (see Appendix A).

**Results of waste determination for Dipole Hail**

No hazardous materials will be generated by either the procedure followed for the Dipole Hail testing series or from the feedstock used, but laboratory analysis of the debris will be required to confirm this.

**Recommendations**

Recommendations made in a waste characterization plan will reflect the information contained within the plan. Based on that information, recommendations regarding the process or the waste generated by it can be made.
Sampling requirements

Sampling can be recommended when it is not known what will result from a specific process, or when the generator wants to be sure no hazardous materials have been created.

Sampling requirements for Dipole Hail

Sampling is recommended after the first Dipole Hail explosives test is completed, for the purpose of ascertaining that no materials were contaminated in any way during the test.

Waste handling

Waste handling refers to how the waste is handled after the process is finished. Often, the wastes produced will be sampled to confirm whether they are hazardous or not. If the wastes are moved after the process, and are ultimately determined to be hazardous, then those wastes may have been mishandled, or may have required expensive containerization to meet regulatory storage requirements during laboratory characterization. For this reason, it is important to determine beforehand how the wastes will be handled in order to avoid additional expenses, potential fines, and time constraints.

Waste handling for Dipole Hail

Sampling is recommended at the end of the first Dipole Hail test to confirm that no hazardous material have resulted from the test. However, the tunnel complex will be needed for the next Dipole Hail test. This means that the wastes will have to be removed from the tunnel to be sampled. The Dipole Hail test management plan also requires that the waste be
sieved on order to determine particle size (Ashbaugh and Reynolds, 1995). This should be done outside the tunnel, so that the next Dipole Hail test can commence. In order to avoid mishandling the waste (should it prove to be hazardous), it is recommended that the moving and sieving of the waste materials become part of the actual Dipole Hail process. In this way, the materials are not considered wastes by the regulations until they are no longer needed in the process. They can be moved, sieved, sampled, and await analysis, without delaying future testing in the tunnel. Once the moving and sieving of the materials is made part of the process, the materials are not considered wastes until the after sieving and cannot be mishandled.

Changes to the process

Changes to the process can be recommended if it is determined that a hazardous waste will result from the process. Recommended changes should minimize or eliminate the generation of hazardous waste, freeing the would-be generator from the rigors of the cradle-to-grave process.

Changes to the process of Dipole Hail

Only one change to the process is recommended for Dipole Hail. The process should be amended to include the removal of the test material from the tunnel complex, to facilitate sieving the materials to determine particle size. By doing this, the materials removed from the tunnel cannot be mishandled, and do not require expensive containerized storage while awaiting characterization. No changes are recommended to the remainder of the process.
Changes to the feedstock

The materials that go into a process, such as explosives, are called feedstock. Changes made to the feedstock would involve substituting less hazardous or different materials in order to change the waste materials created by the process. Any changes recommended would serve the purpose of minimizing or eliminating hazardous waste generation.

Changes to the feedstock of Dipole Hail

Since the bomb and its placement into the geologic medium are critical feedstock components, and no hazardous wastes will be generated by using these materials as currently stated in the Test Management Plan, no changes to the feedstock are recommended for the Dipole Hail testing procedure.

Disposal

Disposal options for any waste generated should be outlined in this section, as well as recommendation for the option(s) best suited for the generator.

Disposal for wastes generated by Dipole Hail

The wastes generated by Dipole Hail are not expected to be hazardous. Therefore, following laboratory analysis to confirm this, the waste should be disposed of in the debris pile created from the tunnel complex’s construction, where all of the non-hazardous debris from other activities at the tunnel has been disposed of. This large pile is referred to as a ‘muckpile.’
Summary

The summary is a quick overview of the entire waste characterization plan, with just the important points included. The summary of the waste characterization plan helps the upper level management see immediately whether or not a hazardous waste will be generated, the ramifications of the waste generation, and the recommendations of the plan without reading the entire document.

Summary of Waste Characterization Plan for Dipole Hail

The Dipole Hail test program is not expected to generate any hazardous wastes. The waste streams identifies as possible results from the test series are air emissions, debris from the bomb casing, and rock and soil waste from the tunnel. These waste streams have initially been determined to be non-hazardous. Therefore no hazardous materials are expected from Dipole Hail.

Sampling is recommended after the conclusion of the first Dipole Hail test, for the purpose of confirming that no hazardous wastes resulted from the test. In order to sample and sieve the resulting materials, they must be removed from the tunnel, as the next Dipole Hail test is scheduled to take place in the tunnel. To avoid mishandling the waste, which could happen once the materials are moved and if they are determined to be hazardous, it is recommended that the process of Dipole Hail be altered to include the removal and sieving of the materials outside the tunnel. The material is then not considered a waste, as it is still part of the actual process, and it can be sampled and analyzed without expensive containerization and testing delays. Then, if the waste is determined to be hazardous, it has not been mishandled.
The waste generated by Dipole Hail are not expected to be hazardous, and it is recommended that they be disposed of in the tunnel muckpile, following confirmatory sampling and analysis.
References


Resource Conservation and Recovery Act


Appendix A

Analyses and Specific Gravity Determination of Selected Samples from the Oak Spring Formation, Nevada Test Site
Unit 2—Continued

scattered biotite, pyroxene, and an opaque oxide. Good ledge former.

1. Tuff, alternating beds of yellowish-gray and pink. Yellowish-gray layers are fine (porcelanitic) to medium grained. Abundant pumice fragments; moderately abundant obsidian and ash shards, scattered brown quartzite fragments, and blebs of porcelanitic material. Moderately abundant phenocrysts. Dense fine-grained pink beds are mottled with light gray (greenish cast). Bed is a good ledge former.

Total thickness of beds 9 to 11 61.3

Rapid rock analyses, semiquantitative spectrographic analyses, and specific gravity determinations were made of samples from beds 19b, 20, 22e, 24f (Table 5). These analyses show only a small range in chemical composition among the beds sampled. These samples, moreover, are fairly representative of the whole of units 2, 3, and 4 of the Oak Spring formation. Of the major oxides SiO₂ ranges from 65 to 71.5 percent; Al₂O₃ ranges from 11.4 to 13.4 percent; K₂O ranges from 1.5 to 4.4 percent; CaO ranges from 0.63 to 3.7 percent; and Na₂O ranges from 1.4 to 2.1 percent. Oxides of iron, magnesium, manganese, phosphorus, and titanium are minor constituents. Minor amounts of barium, beryllium, chromium, copper, gallium lanthanum, manganese, nickel, lead, scandium, strontium, titanium, yttrium, ytterbium, and zirconium were detected spectrographically.

ENGINEERING CHARACTERISTICS OF THE OAK SPRING FORMATION

The rocks of the Oak Spring formation may be grouped into three general classes based on their engineering behavior and expressed in terms of relative rock strength and competence. Rocks of class 1 possess relatively high strength and competence, rocks of class 2 moderate strength and competence, and rocks of class 3 very low strength and competence. The following notes are based on observations made in the field at the test site and, hence, are largely qualitative.

**Table 5.—Analyses and specific gravity determinations of selected samples from the Oak Spring formation, USGS Tunnel area—Co**

<table>
<thead>
<tr>
<th>[Sample numbers correspond to bed numbers]</th>
<th>B-19b</th>
<th>B-20</th>
<th>B-22e</th>
<th>B-24f</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SiO₂</strong></td>
<td>71.0</td>
<td>70.3</td>
<td>67.8</td>
<td>68.0</td>
</tr>
<tr>
<td><strong>Al₂O₃</strong></td>
<td>11.4</td>
<td>11.8</td>
<td>12.2</td>
<td>12.4</td>
</tr>
<tr>
<td><strong>Fe₂O₃</strong></td>
<td>0.54</td>
<td>0.57</td>
<td>0.62</td>
<td>0.70</td>
</tr>
<tr>
<td><strong>MgO</strong></td>
<td>0.22</td>
<td>0.25</td>
<td>0.22</td>
<td>0.20</td>
</tr>
<tr>
<td><strong>CaO</strong></td>
<td>4.2</td>
<td>4.5</td>
<td>4.0</td>
<td>4.0</td>
</tr>
<tr>
<td><strong>TiO₂</strong></td>
<td>0.12</td>
<td>0.20</td>
<td>0.20</td>
<td>0.20</td>
</tr>
<tr>
<td><strong>Na₂O</strong></td>
<td>0.04</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td><strong>H₂O</strong></td>
<td>4.8</td>
<td>6.1</td>
<td>5.9</td>
<td>6.8</td>
</tr>
<tr>
<td><strong>CO₂</strong></td>
<td>0.16</td>
<td>0.09</td>
<td>0.15</td>
<td>0.16</td>
</tr>
</tbody>
</table>

**Sppr (tunnel)**

| Sp pr (powder) | 1.68 | 2.06 | 2.96 | 2.31 |

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**Sppr (powder)**

| Sp pr (powder) | 1.68 | 2.06 | 2.96 | 2.31 |
Appendix B

Format for Waste Characterization Plan
Format for Waste Characterization Plan

Background

Identify and describe the process in question, its purpose, and what it to be gained from it.

Purpose

Identify the purpose(s) of the waste characterization being done.

Waste Streams

Identify all potential waste streams resulting from the process, including:

- Air emissions
- Liquid effluents
- Solid wastes
- Radioactive materials
- Mixed waste
- Petroleum waste
- Asbestos waste

Hazardous Waste Determination

Determine whether any of the waste streams are hazardous, using the following questions:

- Is the waste excluded from regulation in 40 CFR 261.4?
- Is the waste listed as hazardous waste is Subpart D of 40 CFR Part 261?
- Is the waste a characteristic hazardous waste in Subpart C of 40 CFR Part 261?
- Has the generator determined whether the waste is identified in Subpart C of 40 CFR Part 261 by testing the waste according to methods set forth in Subpart C of 40 CFR Part 261 or 260.21?
- Has the generator applied knowledge of the hazard characteristic of the waste in light of materials or processes used?

Recommendations

Based on the results of the waste determination, make recommendations regarding:

- Sampling of the waste material
- Handling the waste
- Changes to the process (if any)
- Changes to the feedstock (if any)
- Disposal of the waste

Summary

Provide a clear and concise summary of the entire plan, including the waste determination and any recommendations.