Preparing a Waste Analysis Plan at Class I Injection Well Facilities

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 5 -- UNDERGROUND INJECTION CONTROL (UIC) SECTION
REGIONAL GUIDANCE #8

January 21, 1994

Contents

PART I. RATIONALE

Title 40 of the Code of Federal Regulations (40 CFR), Section 146.13(b)(1) requires any operator of a Class I underground injection well to monitor and analyze the fluids injected into the well "with sufficient frequency to yield representative data of their characteristics." In addition, 40 CFR Section 146.68(a) specifies that owners or operators of Class I wells injecting hazardous waste "shall develop and follow an approved written waste analysis plan that describes the procedures to be carried out to obtain a detailed chemical and physical analysis of a representative sample of the waste, including the quality assurance procedures used." 40 CFR Section 146.68(a) further specifies that "At a minimum, the plan shall specify : (i) the parameters for which the waste will be analyzed and the rationale for the selection of these parameters; (ii) the test methods that will be used to test for these parameters; and (iii) the sampling method that will be used to obtain a representative sample of the waste to be analyzed."

There are several reasons for issuing a guidance document in order to assist operators in meeting these regulatory requirements. At those facilities seeking a new permit, it is this portion of the permit application which describes the source of the waste, the composition of the waste and incorporates quality assurance to ensure that all reported data pertaining to waste are reliable and representative. When considering issuance of a permit to these facilities, the United States Environmental Protection Agency (USEPA) needs to be adequately familiar with the chemical and physical characteristics of waste entering a stratum of the subsurface in order to determine that permitted injection practices will be environmentally protective.

The methods for characterization of waste as either hazardous or non-hazardous can have important implications for Class I facilities. Requirements in hazardous permits are different from those in non-hazardous permits. The choice of appropriate permit conditions is based, in

part, on adequate knowledge of the nature of the injected wastestream. It is crucial that the waste analysis process at a facility properly characterize waste as either hazardous or non-hazardous.

While this guidance is intended to be as comprehensive as possible, it is recognized that there may be site-specific examples which would necessitate sampling and analysis methodologies, testing rationale, or other aspects of the waste analysis plan different from those recommended in the following Part. Region 5 will consider any justifiable waste analysis plan that also meets all regulatory requirements.

A few examples of the importance of following a waste analysis plan (WAP) are described here for illustrative purposes: (1) Compatibility of waste with the injection and confining zone lithologies and the well materials is virtually indeterminant unless the injected fluid has been satisfactorily described. (2) Wells operating near their maximum permitted surface injection pressure can induce fractures in the injection zone by exceeding the formation fracture pressure if a sufficient increase in injectate density occurs. This could cause fluid movement into unpermitted zones through the induced fractures. (3) The interpretation of data gathered through deep groundwater monitoring near a Class I injection well is heavily influenced by prior knowledge of what waste has entered the injection zone. (4) Regulatory changes may require either the cessation of injection of certain wastes or the restriction of certain constituent concentrations in the waste. (5) A WAP at commercial facilities and facilities with multiple wastestreams is particularly important when batches of waste from varying sources need to be characterized and where composited wastes change in character with time. (6) Facilities that operate under certain chemical or other waste property limitations must be able to assure Region 5 that these limitations are not being exceeded.

Accordingly, the USEPA Region 5 UIC Section has issued this guidance document to assist all operators of Class I injection wells.

PART II. WASTE ANALYSIS PLAN TESTING PROCEDURES

The following items should be included in any WAP submitted to Region 5 by applicants for or operators of Class I injection well permits:

A. Waste Characterization

The WAP should describe the facility's waste management process in enough detail to demonstrate that testing procedures are adequate. This should include a complete description of waste generation, storage, transport and disposal. Region 5 must be satisfied that the waste is being adequately characterized.

Furthermore, the waste analysis objectives should be specified in this section and should include the necessary detection threshold for each parameter. The detection threshold specified must meet the regulatory requirements, where applicable. If no regulatory requirement specifies a detection threshold, the waste analysis objectives should contain a rationale for the detection threshold chosen.

1. Hazardous Waste - Minimum Requirements

The items specified in the following paragraphs are necessary for waste characterization at Class I hazardous facilities. All samples should be taken at the wellhead:

	Suggested Frequency:
a. Hazardous Waste from Specific and Non-Specific Sources	Monthly

40 CFR § 261, Subpart D contains information by which waste may be specifically listed as hazardous because of its source. These wastes are designated with codes F, K, P, or U under the regulations implementing the Resource Conservation and Recovery Act (RCRA). Any portion of the wastestream generated at a Class I facility which meets the definition of such a listed hazardous waste must be identified. Facilities which inject waste containing any of these RCRA coded wastes should test their wastestream for the constituents likely to be found in the same coded waste injected at the facility. Inventories of these constituents are found at 40 CFR Sections 268.41 and 268.43. If a Class I facility injects none of these coded wastes, an explanatory statement signed pursuant to 40 CFR Section 144.32 may be submitted in lieu of analytical identification of listed hazardous wastes.

For each F, K, P, or U-coded waste injected, all chemicals which are found in the correlative waste code inventory at 40 CFR Sections 268.41 and 268.43 should be analyzed for on a monthly basis. Facilities that inject waste identified by multiple RCRA waste codes containing overlapping chemical constituents need only analyze once for each chemical constituent for each sample taken. If another monitoring frequency would be more appropriate the USEPA will consider a justified proposal.

b. Hazardous Waste Defined by Characteristic Only	Monthly

40 CFR Part 261, Subpart C contains all information by which a waste may be characteristically hazardous. These wastes are designated with the waste code D. There are four hazardous characteristics: (1) corrosivity, (2) reactivity, (3) ignitability, and (4) toxicity. Operators of Class I hazardous facilities should test their waste for all four characteristics on a monthly basis. If another monitoring frequency would be more appropriate the USEPA will consider a justified proposal. The test for toxicity shall follow the Toxicity Characteristic Leaching Procedure and should include all appropriate constituents which cause waste to be characteristically hazardous. If the operator wishes to test for fewer than the complete toxicity parameter list found at 40 CFR Section 261.24, an explanatory statement signed pursuant to 40 CFR Section 144.32 may be submitted in lieu of those parameters not tested for;

c. pH;	Daily
d. Eh;	Daily
e. Specific conductance;	Daily
f. Specific gravity;	Daily

g. Temperature;	Daily
h. Total dissolved solids;	Monthly
i. Total organic carbon; and	Monthly
j. All other constituents of the wastestream which constitute a major portion of the wastestream. This would include constituents that individually contribute a significant percentage of the wastestream (greater than 0.01% by mass);	Monthly

2. Non-Hazardous Waste - Minimum Requirements

The items specified in the following paragraphs are necessary for waste characterization at Class I non-hazardous facilities:

	Suggested Frequency:
a. Demonstrating Absence of Characteristic Hazardous Waste	Monthly

40 CFR Part 261, Subpart C contains all information by which a waste may be characteristically hazardous. There are four hazardous characteristics: (1) corrosivity, (2) reactivity, (3) ignitability, and (4) toxicity. Operators of Class I non-hazardous facilities should test their waste for all four characteristics on a monthly basis, to demonstrate that no characteristically hazardous waste is present in the wastestream. If another monitoring frequency would be more appropriate the USEPA will consider a justified proposal. Every new source of waste must be similarly analyzed prior to injection into a Class I non-hazardous well. This is particularly important at any commercial Class I non-hazardous facility. The test for toxicity shall follow the Toxicity Characteristic Leaching Procedure and should include all appropriate constituents which cause waste to be characteristically hazardous. If the operator wishes to test for fewer than the complete toxicity parameter list found at 40 CFR Section 261.24, an explanatory statement may be submitted pursuant to 40 CFR Section 144.32 in lieu of those parameters not tested for;

b. pH;	Daily
c. Eh;	Daily
d. Specific conductance;	Daily
e. Specific gravity;	Daily
f. Temperature;	Daily
g. Wellhead total dissolved solids;	Monthly
h. Wellhead total organic carbon; and	Monthly
i. All other constituents of the wastestream which constitute a major portion of the wastestream. This would include constituents that make up a significant percentage of the wastestream (greater than 0.01% by mass);	Monthly

3. Parameters Also Included in an Approved UIC-Required Groundwater Monitoring Plan

a. At facilities conducting groundwater monitoring pursuant to an approved UIC-required groundwater monitoring plan, all parameters included in the groundwater monitoring plan analyses should be among those tested for in the wastestream. At a minimum, these parameters must include sodium, calcium, magnesium, potassium, bicarbonate, sulfate, and chloride. Such inorganic elements are common constituents in groundwater and the purpose of testing for them in the wastestream would be to compare these parameters in the injected waste with those in the monitoring zone;

b. Additional Parameters: Depending on the wastestream, additional parameters may be necessary to adequately characterize the waste. Isotopic parameters are strongly recommended at facilities conducting UIC-related groundwater monitoring. Some of these are listed below:

i. Stable isotopes of nuclides (e.g. ^{18}O, ^{2}H, ^{13}C, ^{34}S, ^{37}Cl);
ii. Radiogenic isotopes of nuclides (e.g. ^{3}H, ^{14}C); and
iii. Additional elements or compounds, including metals, halogens, non-volatile, semi-volatile and volatile organic constituents.

B. Waste Re-Characterization

The WAP should allow for waste re-characterization, where necessary, due to chemical reactions taking place in storage tanks, or changes in the waste chemistry through time. This may be addressed through sampling frequency and sampling location, different from those specified in Part II(A) above.

PART III WASTE ANALYSIS PLAN QUALITY ASSURANCE

A. Description of Sampling and Analytical Methods

The WAP should describe all methods, protocols, location(s), and frequency of sampling and analysis. This detailed description of the sampling protocol must be followed by properly trained personnel conducting the sample collection. It is recommended that the operator follow the guidelines set forth in a document such as "Test Methods for Evaluating Solid Waste", SW-846 or "Methods for Chemical Analysis of Water and Wastes", EPA 600/4-79/020. A list of approved sample preservation techniques is found at 40 C.F.R. Section 136.3. The sampling and analysis description should include, but is not limited to, the following for each parameter:

1. Sample collector (include sampling company name);
2. Sampler's title;
3. Sample collection method;
4. Sample collection point;
5. Sample preservation technique;
6. Sampling frequency;
7. Analytical method for parameter detection/quantification;
8. Anticipated analytical method accuracy;

9. Anticipated upper & lower analytical method quantification limit; and
10. Adequate field documentation of sampling.

B. Quality Assurance and Quality Control

The WAP should also contain a section describing the Quality Assurance/Quality Control (QA/QC) aspect of all sampling and analytical work done on the samples. This should be a technical description of the pertinent aspects of the WAP. The QA/QC section should include, but is not limited to, incorporation of the elements shown below:

1. Equipment cleaning blanks

Equipment blanks are taken for the purpose of detecting cross-contamination due to improper decontamination of sampling equipment. After sampling the most concentrated wastestream (if known), the sampling device should be decontaminated according to the sampling plan protocol. The sampling device should then be rinsed with de-ionized, distilled water and the rinsate collected in a container for transport to the laboratory for analysis of, at a minimum, the same parameters chosen in the sampling plan at Part II(A)(1)(b) and Part II(A)(2)(a) above, and any other appropriate parameters. If only one sample is taken, an equipment blank should be taken prior to the sampling event;

2. Trip blanks

Trip blanks are sample containers filled with Type II reagent grade water at the laboratory, sealed at the laboratory, which accompany the sample containers used throughout the sampling event. The sample containers must be handled in the same manner as the samples. The trip blank(s) should be returned to the laboratory for analysis of, at a minimum, the same parameters chosen in the sampling plan at Part II(A)(1)(b) and Part II(A)(2)(a) above, and any other appropriate parameters. At least one (1) trip blank per sampling event is recommended;

3. Sample duplicates

Sample duplicates are taken in order to check the QA/QC of the laboratory conducting the analysis. The sample should be drawn from the site which is considered to be the most concentrated (if known). The duplicate sample must be split from the original sample in a manner to emphasize sample representativeness. The duplicate must be labeled with a sample number which will not conflict with the other samples, but will not be discernable to the laboratory as a duplicate sample. One duplicate sample per sampling event should be taken and should be analyzed for the same parameters chosen in Part II above;

4. Sample chain-of-custody protocol

Sample chain-of-custody should be followed at all times during the sampling and subsequent analysis. The chain-of-custody establishes the documentation on handling and control necessary to identify and trace a sample from collection to final analytical results. Such documentation

includes records of personnel handling the samples, labeling to prevent mixup, container seals to prevent unauthorized tampering with the contents of the sample containers and secure custody;

5. Equipment calibration

The QA/QC section should specify the frequency and type of instrument calibration performed at the laboratory and in the field. The calibration should be conducted according to instrument manufacturer specifications and at the recommended frequency;

6. Data reduction

Data reduction is the process of transcription of the raw data printouts and displays into the reportable units. An example of such reduction is the proper conversion from the number of counts per second observed on an inductively-coupled plasma spectrometer to the concentration of sodium in the sample in mg/liter. Data reduction should be specified by formula for each parameter tested and is specific to the laboratory used;

7. Data validation

Data validation is the process of double-checking the results of analytical methods in order to determine that they meet the scope of the project objectives. This process involves review of chain-of-custody forms, review of equipment calibration methods, as well as review of raw data and the subsequent data reduction;

8. Internal quality control

This aspect of quality assurance deals with the standard and routine efforts which the laboratory undertakes to ensure that all data generated meets the quality which is necessary for compliance with its own reporting requirements. Internal quality control should be addressed by discussion of the laboratory's use of blanks, matrix spikes and matrix spike duplicates, preparation of reagents, and laboratory duplicate or replicate analyses;

9. Laboratory audits

Laboratory audits should be conducted as part of the routine quality assurance program. There should be periodic and dependable inspections of the laboratory facilities and personnel by impartial parties;

10. Corrective actions

Corrective actions should be implemented when any aspect of the analytical or sampling method does not achieve the project objectives. This may entail re-sampling the wastestream and/or re-analyzing the fluid for a particular parameter, re-calibrating an analytical device, or any other such action. The action levels for each such process should be shown in tabular form; and

11. Reports to USEPA

The report to USEPA should contain all the results, data and sampling description necessary to enable Region 5 to assess the accuracy, completeness and repeatability of the reported analytical results. The report should contain a table which specifies the type of sample (blank, waste, etc.), sampling date, sampling location, analytical method, method detection limit, validation result and analytical result. The results of analyses and all accompanying data, including chain-of-custody forms, should be reported to USEPA within 45 days of the sampling event, unless conditions beyond the control of the operator prohibit such a reporting schedule.