INSTRUCTOR'S MANUAL

FOR

UIC INSPECTOR TRAINING COURSE

PREPARED FOR

U.S. ENVIRONMENTAL PROTECTION AGENCY

HEADQUARTERS-WASHINGTON, D.C.

EEI
ENGINEERING
ENTERPRISES, INC.

WATER RESOURCES SPECIALISTS

LOE CONTRACT NO. 68-03-3416

WORK ASSIGNMENT NO. 3-0-7-3

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TABLE OF CONTENTS

TABLE OF CONTENTS
PAGE TWO

TABLE OF CONTENTS
PAGE THREE

SECTION 1

USE OF THE INSTRUCTOR'S MANUAL

The Instructor's Manual for the UIC Inspector Training Course is designed so that (unless otherwise noted) the instructor may read directly from the manual while teaching the course. Guidance for the instructor is denoted by use of a full margin (see the top of page 3-1). Discussions to be led by the instructor are denoted by indented, blocked text (see the bottom of page 3-1). References made for the use of slides and video cassette tapes are found in the left hand margin of the text (see page 4-2 for an example). Slides are numbered by section and sequence.

COURSE PRESENTATION

SECTION 2

PRESENTATION OF THE COURSE

The UIC Inspector Training course has been presented on three separate occasions by the L.O.E. contractor under UIC Contract No. 68-03-3416. The agenda has been altered for each presentation in order to emphasize the specific information requested by the host EPA Region. The major difference in the presentations has been with regard to the amount of Class II and Class V information presented during each course.

Portions of the UIC Inspector Training course may be effectively presented in the following order:

- Overview of Handout Materials
- Introduction to Training Requirements
- Inspector Certification Pretest
- Presentation of Course Materials
- Field Work Requirement
- Inspector Certification Test

OVERVIEW OF MATERIALS

SECTION 3

WELCOME AND OVERVIEW OF COURSE MATERIALS

The instructor should introduce himself/herself and welcome the class participants. Mention should be made in regard to the various Regions and States represented by attendees. The instructor should make sure that all participants have a name tag. Any other course instructors should be briefly mentioned at this time.

The instructor should refer the class to the handout materials from which much of the course presentation will be drawn. It is important that, while discussing handouts, the instructor allow plenty of time for the class members to briefly review the course materials.

DISCUSSION The handout materials include two notebooks, entitled:

- UIC Inspector Training; and
- UIC Inspector Training - Class V Addendum.

The large notebook entitled UIC Inspector Training, contains two bound documents:

- UIC Inspection Manual; and
- Technical Assistance Document - Cementing for the Plugging and Abandonment of Injection Wells.

The UIC Inspection Manual is divided into five sections. It is suggested that the class familiarize themselves with the appendices. These sections contain information which may be useful to the inspector while conducting inspection duties.

The cementing document has been included to provide the inspector with guidance in regard to proper plugging and abandonment procedures, and important items to consider while witnessing a plugging operation. NOTE: The instructor may wish to credit the authors of both manuals at this time.

The notebook also contains:

- Region VIII memorandum written by Mr. Jim Ellerbe;
- Packet on Plugging and Abandonment;
- Packet on Well Logging; and
- Packet on Well Construction Types.

The second notebook, entitled Class V addendum, contains information specific to the Class V program. The notebook is divided into four major sections, and contains the following:

- An Overview of Class V Injection Wells;
- How to Inventory and Investigate Class V Injection Wells;
- Inspection Tips for Class V Injection Wells;

- Documenting and Reporting Class V Inspection Activities;
- Standard Operating Procedures for Injectate and Sediment Sampling at Class V Facilities;
- Site-Specific Sampling Plan; and
- Site-Specific Health & Safety Plan.

The Addendum also includes handouts, entitled:

- Preparing for Inspections; and
- In-Depth Inspection Checklist.

Other reference materials distributed to supplement the course are provided by the National Enforcement Investigation Center. These materials include:

- NEIC Policies and Procedures Manual; and
- A Description of Automated Information Systems Accessible by NEIC

SECTION 4

INTRODUCTION TO TRAINING

This section presents a basic discussion of EPA's Inspector Training Requirements.

DISCUSSION

It is the policy of the Environmental Protection Agency to ensure that those who lead environmental compliance inspections/field investigations be properly trained to perform those functions in a legally and technically sound manner.

EPA Order 3500.1, approved in June of 1988, establishes a consistent agency-wide training and development program for employees leading environmental compliance inspections/field investigations.

SLIDE #4-1

EPA's training program consists of three parts:

- Occupational Health and Safety Curriculum;
- Basic Curriculum; and
- Program-Specific Curriculum.

The Occupational Health and Safety Curriculum consists of a 40-hour course that is approved by the Occupational Safety and Health Administration (OSHA). An 8-hour refresher course is required annually. The courses are available through numerous sources nationwide.

The Basic Curriculum has been developed by the Office of Enforcement and Compliance Monitoring (OECM) to provide a comprehensive overview of knowledge and skills needed to perform compliance inspections/field investigations under EPA statutes.

UIC Inspector Training will constitute the third part of EPA training requirements, the Program-Specific Curriculum.

The effective date of the training order is June 29 of 1988, the issuance date; the following dates also apply:

- New Inspectors are those inspectors newly employed by EPA subsequent to the issuance date. Beginning October 1, 1989, new inspectors shall not conduct inspections unless they have completed the Basic Curriculum and have completed or been excepted from the Program-Specific Training Curriculum.

- Experienced inspectors are those inspectors employed on or previous to the issuance date. Beginning October 1, 1991, experienced inspectors shall not conduct inspections unless they have completed or been excepted from the Basic and Program-Specific Training Curricula.

- First Line Supervisors supervise the day-to-day work of an individual who leads compliance inspections/field investigations. A first-line supervisor may be new or experienced. Beginning October 1, 1989, first-line supervisors shall meet the requirements of the training order within one year of appointment to the supervisory position, if they have not already done so. Experienced first-line supervisors may be excepted from the Basic Curriculum, but new ones may not. There may be limited exceptions to program-specific requirements for new and experienced first-line supervisors.

- Training requirements for Contract Inspectors and others shall be phased into future contracts.

SECTION 5

INSPECTOR CERTIFICATION PRETEST

The inspector certification test is to be administered to the class participants **before** the course materials are presented. This pretest serves as a tool to emphasize the important points which will be covered during the training course. It is not necessary to grade and return the pretest; however, the instructor may find pretest results helpful in indicating the level of knowledge exhibited by class participants. Depending upon pretest results, the instructor may choose to place more emphasis on certain subjects presented throughout the training course.

UIC INSPECTOR CERTIFICATION PRETEST

REGULATORY STRUCTURE

1) The National Pollutant Discharge Elimination Systems was established by which environmental act?

   a) Safe Drinking Water Act
   b) Clean Water Act
   c) Resource Conservation and Recovery Act
   d) Toxic Substance Control Act
   e) Solid Waste Disposal Act

2) Point source discharges to waters of the U.S. are authorized by the:

   a) Safe Drinking Water Act
   b) National Pollutant Discharge Elimination Systems
   c) Resource Conservation and Recovery Act
   d) Toxic Substance Control Act
   e) Solid Waste Disposal Act

3) Spill Prevention Control Countermeasure regulations were established by which of the following?

   a) Resource Conservation and Recovery Act
   b) Safe Drinking Water Act
   c) Clean Water Act
   d) Toxic Substance Control Act
   e) 40 CFR

4) Which program was established to protect USDWs from endangerment by subsurface emplacements of fluids?

   a) Underground Injection Control
   b) National Pollutant Discharge Elimination System
   c) Superfund
   d) Wellhead Protection Program

5) The Underground Injection Control program was established under which of the following?

   a) Resource Conservation and Recovery Act
   b) Clean Water Act
   c) Safe Drinking Water Act

6) Management of hazardous waste falls under Subtitle C of the:

a) Safe Drinking Water Act
b) Federal Water Pollution Control Act
c) Resource Conservation and Recovery Act
d) Comprehensive Environmental Response, Compensation and Liability Act

7) Listed hazardous wastes are contained in:

a) Resource Conservation and Recovery Act
b) Solid Waste Disposal Act
c) Federal Water Pollution Control Act
d) Comprehensive Environmental Response Compensation and Liability Act
e) 40 CFR

8) Which act mandated a study to be performed to determine the effects of drilling fluids, produced water and other wastes associated with production of crude oil and natural gas?

a) Federal Water Pollution Control Act
b) Safe Drinking Water Act
c) Resource Conservation and Recovery Act
d) Clean Water Act

9) List the four criteria by which a waste can be considered characteristically hazardous as defined by RCRA.

1. ______________________
2. ______________________
3. ______________________
4. ______________________

10) Oil Pollution Prevention Regulations are established in:

a) Federal Water Pollution Control Act
b) Resource Conservation and Recovery Act
c) 40 CFR
d) Safe Drinking Water Act
e) Solid Waste Disposal Act

11) The National Priorities List refers to which of the following?

a) 40 CFR
b) Resource Conservation and Recovery Act
c) Safe Drinking Water Act
d) Comprehensive Environmental Response Compensation and Liability Act

12) Name three of seven containment systems acceptable to prevent discharged oil from reaching navigable waters.

1. ______________________
2. ______________________
3. ______________________

13) 40 CFR Part _____ establishes criteria and standards for underground injection wells.

a) 144
b) 145
c) 146
d) None of the above

14) The Land Disposal Restrictions Program regulates liquid hazardous wastes or free liquids associated with treatment of hazardous wastes.

a) True b) False

15) Transporters of listed hazardous wastes may store the wastes for up to...

a) 5 days
b) 10 days
c) 15 days
d) 30 days

16) Dilution of wastes is allowed as a method of treatment in the Land Disposal Restriction regulations.

a) True b) False

17) Name three areas that are prohibited for use as disposal sites by the Land Disposal Restrictions Program.

1. ______________________
2. ______________________
3. ______________________

UIC STRUCTURE

1) UIC Regulations are found in 40 CFR Part(s)...

   a) 144
   b) 146
   c) 144, 145, 146
   d) 144 through 148
   e) None of the above

2) States which have primary enforcement responsibility for the UIC program are called ____________________ states.

3) States which have Federally administered UIC programs are called ____________________ states.

4) Match each well to its class of well type.

1.	Class I	A.	Oil and gas enhanced recovery injection well
2.	Class II	B.	All other well types
3.	Class III	C.	Hazardous waste injection well
4.	Class IV	D.	Mineral extraction well
5.	Class V	E.	Radioactive waste injection well injecting above the USDW

5) Which of these is <u>not</u> a well according to the EPA definition?

   a) 24-inch casing driven 10 feet deep
   b) A pit with surface dimensions 4' by 4' by 6' deep
   c) A hole that is 4 feet deep and 6 feet in diameter
   d) A drilled hole 12 feet deep and 6 inches in diameter

6) A well completed with casing, tubing, and packer is an example of a ____________________ completion.

7) Name three types of unconventional completions.

   1. ____________________
   2. ____________________
   3. ____________________

8) Which of these is not a Class III well type?

a) Frasch sulfur mining well
b) Enhanced recovery well
c) In-situ leaching well
d) Solution mining well

CLASS V WELLS

1) How many subclasses of Class V wells have been identified to date?

   a) 16   b) 24   c) 32   d) 48

2) Which of the following represents a high-tech Class V well?

   a) Improved sinkhole (5D3)
   b) Cesspool (5W10)
   c) Automobile service station disposal well (5X28)
   d) Radioactive waste disposal wells (5N24)
   e) None of the above

3) A 4' by 4' by 3' deep rock-filled pit located at an industrial facility and accepting only storm-water runoff is classified as a:

   a) Storm-Water Drainage Well (5D2)
   b) Industrial Drainage Well (5D4)
   c) Special Drainage Well (5G30)
   d) None of the above

4) A drainage well located in a parking lot of an industrial facility, designed to accept stormwater, appears to be accepting spills (stains on asphalt) from a chemical storage area located up-gradient. The well should be classified as a:

   a) Storm-Water Drainage Well (5D2)
   b) Industrial Drainage Well (5D4)
   c) Industrial Process Water and Waste Disposal Well (5W20)
   d) Special Drainage Well (5G30)
   e) None of the above

5) Which of the following items should be noted at each inspection site?

   a) The facility is connected to sanitary and/or storm sewer

   b) The injectate is treated prior to injection

   c) The construction date of the well

   d) Only a and b

   e) All of the above

6) When an oil/water separator, located in a service bay, is piped directly to a septic tank and drainfield system, the well should be designated as a:

a) Automobile Service Station Disposal Well (5X28)
b) Septic System - drainfield disposal method (5W32)
c) Septic System - undifferentiated disposal method (5W11)
d) Industrial Process Water and Waste Disposal Well (5W20)
e) None of the above

7) It is common to discover information that changes a well classification during a facility tour.

a) True b) False

8) Which of the following is not essential to rate an injection well for follow-up investigations?

a) Approximate horizontal distances to nearest public or private water supply well

b) Frequency of injection or volume being injected

c) Years of operation

d) All are essential

9) Which of the following is not a Class V well?

a) Drainage well accepting stormwater which is 2' in diameter and 35' deep

b) Septic tank accepting solely sanitary waste and serving 45 people per day that is discharging to a drainfield 3' below surface and 25' long

c) Septic tank accepting solely sanitary waste and serving 10 people per day that is discharging to a well 1' in diameter and 10' deep

d) Rock-filled retention pit accepting stormwater with surface dimension of 4' by 4' and is 6' deep.

10) Which scenario would most likely pose the greatest environmental threat?

a) Service bay waste, treatment prior to injection, nearest water supply well <1 mile, low permeability injection zone, 100' vertical distance between injection zone and currently used USDW

b) Electroplating waste, treatment prior to injection, 1/2 mile to water supply well, moderate permeability, 25' vertical distance between injection zone and USDW

c) Silkscreening shop waste, no treatment, 3/4 mile to water supply well, high permeability (karst), 75' vertical distance between injection zone and USDW.

11) During a site inspection, the facility operator informs you that all waste fluids generated are discharged to the city sewer, except for storm water which is handled by drainage wells. Therefore, you --

a) only inspect the drainage wells and ignore a sump in the service bay and a floor drain in the painting booth.

b) inspect all drainage wells, sump, and floor drain.

c) verify that the facility is hooked into the city sewer system.

d) a and c

e) b and c

12) What two well types appear to pose the greatest threat to USDWs?

a) Industrial Drainage Wells (5D4) and Industrial Process Water and Waste Disposal Wells (5W20)

b) Industrial Drainage Wells (5D4) and Automobile Service Station Disposal Wells (5X28)

c) Industrial Process Water and Waste Disposal Wells (5W20) and Automobile Service Station Disposal Wells (5X28)

d) Industrial Process Water and Waste Disposal Wells (5W20) and Untreated Sewage Waste Disposal Wells (5W9)

SAMPLING

1) When sampling a Class V system, the preferred sampling point is:

   a) as near to the potential contaminants as possible (drainage sump)

   b) at an intermediate stage between the point of origination and injection (septic tank)

   c) as near to the injection point as possible (monitoring tube)

   d) none of the above

2) To avoid sample contamination due to equipment materials, fluid sampling equipment should be constructed out of these materials:

   a) Teflon
   b) PVC
   c) Glass
   d) Stainless steel
   f) a, c, and d
   g) All are preferred materials

3) Fluid samples collected for a Volatile Organics Analysis should be transferred to the following container type:

   a) 2-40 ml. glass vials
   b) 1-80 ml. glass vial
   c) 2-500 ml. glass bottles
   d) 1-1 liter glass bottle

4) All sampling equipment should be decontaminated...

   a) before each sampling event.
   b) after each sampling event.
   c) prior to each day's sampling.
   d) following each day's sampling.
   e) a and b

5) Equipment blanks are:

a) supplied by the lab to assure no cross contamination in transport.

b) supplied by the lab to assure contamination is not present in their lab equipment.

c) prepared in the field to assure proper sampling techniques.

d) prepared in the field to assure proper equipment decontamination.

6) A fluid is considered RCRA hazardous based on pH if the pH is...

a) $\leq$ 1 or $\geq$ 11.5
b) $\leq$ 2 or $\geq$ 12.5
c) $\leq$ 3 or $\geq$ 13.5
d) $\leq$ 4 or $\geq$ 10

7) All waste fluids generated during the sampling process...

a) can be dumped back into the disposal well.

b) must be containered and put in the trash.

c) must be containered and stored on-site until analysis is complete for further determination of proper handling.

d) must be containered and always treated as hazardous waste.

8) Site health and safety plans should contain the following information:

a) Material Safety Data Sheets
b) Route map to nearest hospital emergency room
c) Police and fire department phone numbers
d) a and b
e) All of the above

FIELD SAFETY

1) Name the four basic routes of entry to the human body relative to exposure of harmful substances:

1. ______________________
2. ______________________
3. ______________________
4. ______________________

2) Which level of protection provides maximum protection from potentially hazardous contaminants?

a) 1
b) 4
c) A
d) D

3) Which route of entry is the most common accidental form of exposure and most likely cause of systemic illness?

____

4) Which four body parts should be afforded protective equipment to prevent injury during regular inspection activities?

1. ______________________
2. ______________________
3. ______________________
4. ______________________

MECHANICAL INTEGRITY TESTING

1) Wells completed with a small tubular string cemented to surface are ____________ completions.

   a) packerless
   b) slimhole
   c) tubingless
   d) dual
   e) annular disposal

2) Wells which injected between the surface casing and long string casing are ______________ completions.

   a) packerless
   b) slimhole
   c) tubingless
   d) dual
   e) annular disposal

3) When witnessing the cementing of a well, it is important to record all volumes of cement pumped, pressures exerted, and sizes of casings.

   a) True   b) False

4) Name three types of internal mechanical integrity tests:

   1. ________________________
   2. ________________________
   3. ________________________

5) When conducting the standard annular pressure test, the pressure in the tubing has no bearing on the test pressure used for the test.

   a) True   b) False

6) Which of the following is a viable method of pressuring up the annulus for the standard annular pressure test?

   a) Pump truck
   b) Hand pump
   c) Nitrogen bottle
   d) Injection line pressure
   e) All of the above

7) It is good operating practice for the inspector to witness and record the amount of fluid returned from a pressure test.

a) True   b) False

8) Which of the following is allowed by regulations to demonstrate external mechanical integrity?

a) Casing bond log
b) Noise log
c) Cement evaluation log
d) Temperature log
e) b and d

UIC INSPECTIONS

1) Which section of the Safe Drinking Water Act provides authority for inspectors to enter upon and inspect any facility subject to the UIC program?

   a) 1422
   b) 1425
   c) 1445
   d) 1545

2) When conducting an on-site field inspection it is important to...

   a) present proper credentials to the operator before conducting the inspection.
   b) gain entry unnoticed and identify yourself only when noticed by the operator.
   c) identify yourself to the operator before conducting the inspection.
   d) a and c
   e) All of the above

3) A notice of inspection form needs to be completed for every inspection.

   a) True   b) False

4) Operators must always be notified when an inspection is going to take place at their facility.

   a) True   b) False

5) Which of the following is <u>not</u> information that should be recorded at a Class II well inspection?

   a) Injection pressure
   b) Evidence of surface discharge
   c) Evidence of recent workover
   d) Annulus pressure
   e) Color of the wellhead sign

6) Inspection reports should be completed....

   a) within 24 hours
   b) within a week
   c) by the end of the month
   d) All of the above
   e) None of the above

7) Name three types of well inspections.

1. ______________________
2. ______________________
3. ______________________

8) Name three situations in which warrantless facility access is legally justified.

1. ______________________
2. ______________________
3. ______________________

9) When gaining entry into a facility, it is acceptable for the inspector to allow the operator to make a copy of the inspector's credentials.

a) True b) False

10) Specific information regarding the planned activities during the inspection should be written on the notice-of-inspection form prior to presentation to the operator.

a) True b) False

11) Inspection notes should be written in a:

a) spiral notebook
b) any pad of paper
c) bound notebook
d) bound notebook with numbered pages

12) Corrections to field notebooks should be handled by:

a) tearing out page and throwing away
b) correcting by copying on a separate sheet and discarding initial notes
c) marking out and putting initials near correction
d) erasing mistake and making correction

13) Interviewing employees at a facility that you are inspecting is a waste of time since they will not give you any good information due to their company loyalty.

a) True b) False

14) During a sampling inspection, when the owner/operator of the facility requests split samples, you should:

a) give the operator samples in the containers which he provides you with
b) give the operator samples in spare containers brought along for the inspection
c) refuse the operator samples
d) None of the above

PLUGGING AND ABANDONMENT

1) Produced water is suitable for mixing cement.

a) True b) False

2) When setting multiple plugs, each plug should be allowed to set for how long before the hole is recirculated and another plug sets?

a) 2 hours
b) 4 hours
c) 8 - 24 hours
d) Until the test cement at the surface hardens
e) None of the above

3) Removal of equipment (tubing, packer, etc.) in the well is the first operational step in plugging and abandoning the well.

a) True b) False

4) List 3 activities or considerations that can ensure cement plug quality:

1. ______________________
2. ______________________
3. ______________________

WELL LOGGING

1) Because planned procedures are always altered at the well site, it does no good to be familiar with the well or procedure before you arrive on location.

   a) True   b) False

2) How long should a well be shut in before running a base temperature log?

   a) 0 hours
   b) at least 3 hours
   c) at least 8 hours
   d) at least 12 hours
   e) at least 24 hours

3) The cement bond log depends on sonic energy traveling through the casing fluid, casing, cement, and formations and returning to the sensor to give an indication of cement bond to the casing and formation.

   a) True   b) False

4) Cut off frequencies for the noise log output are (in Hz):

   a) 10; 100; 1000; 10,000
   b) 1; 5; 10; 20
   c) 200; 600; 1000; 2000
   d) 100; 500; 1000; 2000

5) The primary advantage of the Cement Evaluation Tool over the Cement Bond Log is that:

   a) it investigates radially
   b) it is a newer generation tool
   c) it is less expensive
   d) it is standardized

REGS. OF INTEREST

SECTION 6

REGULATIONS OF INTEREST

This section contains material associated with regulations pertinent to the UIC program. Particular topics discussed include:

- Clean Water Act (CWA)
- Safe Drinking Water Act (SDWA)
- Resource Conservation and Recovery Act (RCRA)
- Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)
- Outline of Regulations Pertinent to the UIC Program

DISCUSSION

EPA has no single authority by which it is charged to protect ground water. Virtually every major piece of environmental legislation addresses the need to protect ground water.

SLIDE #6-1

There are six major legislative Acts contributing to the protection of ground water:

- Clean Water Act (1972)
- Safe Drinking Water Act (1974)
- Resource Conservation and Recovery Act (1976)
- Comprehensive Environmental Response, Compensation, and Liability Act (1980)
- Federal Insecticide, Fungicide, Rodenticide Act (1972)
- Toxic Substance Control Act (1976)

National standards have been established by these statutes that control the handling, discharge, and disposal of potentially harmful substances. The programs that seek to ensure compliance with these standards are either implemented directly by the EPA or may be delegated to the States.

In most cases, permit programs control the release of pollutants into the environment. The EPA establishes the Federal standards and requirements, and approves State programs for permit issuance. Some of the larger programs which have been delegated by the EPA to qualifying States are:

- The Clean Water Act (CWA)
  - Water Quality Standards
  - NPDES

- Safe Drinking Water Act (SDWA)
  - Drinking Water
  - UIC Program

- The Resource Conservation and Recovery Act (RCRA)
  - Hazardous Waste Program

Developing the ability to recognize the existence of UIC violations may be acquired from familiarization with applicable portions of the SDWA and 40 CFR. UIC inspectors also need to become familiar with other regulatory structures since other violations which are not enforceable through the UIC program may exist at injection facilities.

With this in mind, let's discuss the provisions of the various environmental regulatory Acts as they may apply to UIC inspections.

We will look at the Clean Water Act (CWA); The Safe Drinking Water Act (SDWA); the Resource Conservation and Recovery Act (RCRA); and the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). We will also refer to 40 CFR to become more familiar with regulations concerning production facilities and injection wells.

THE CLEAN WATER ACT

In 1972, The Federal Water Pollution Control Act was significantly amended. The changes emphasized a new approach combining water quality standards and effluent limitations. The amendments of 1972 were enacted primarily to control point source discharges into United States waters.

In 1977, the Federal Water Pollution Control Act was further amended and renamed the Clean Water Act.

The objective, as stated by the Act, is to restore and maintain the chemical, physical, and biological integrity of the nation's waters. The Clean Water Act consists of six titles.

Title III of the Clean Water Act is entitled, "Standards and Enforcement."

SLIDE #6-2 We will now summarize some of the highlights of Title III.

Section 301 of Title III establishes that the discharge of any pollutant by any person shall be unlawful, except as in compliance with Title IV of the Act. Discharge includes spilling, leaking, pumping, pouring, emptying, or dumping, but excludes discharges in compliance with Section 402 of this Act, the National Pollutant Discharge Elimination System.

Section 304 of Tile III is important because it calls for the development of:

- Criteria for water quality;
- Information identifying conventional pollutants;
- Guidelines for effluent limitations; and
- Methods to control pollution resulting from the disposal of pollutants in wells.

Section 311 addresses oil and hazardous substance liability. This section declares that there shall be no discharges of oil or hazardous substances to the navigable waters of the United States. Penalties are established for discharges up to $500,000 onshore and $5,000,000 from a vessel. The legislation requires that operators immediately notify the appropriate agency in the event of a discharge. Failure to immediately notify the proper authorities may result in a $10,000 fine.

Section 311 calls for preparing and publishing a National Contingency Plan for the removal of oil and hazardous substances. The plan shall provide for effective action to minimize damage through containment, dispersal, and removal. Section 311 also calls for the development of substances designated as hazardous. The list of hazardous substances are found in 40 CFR, Part 116.4.

Whenever a maritime accident has created a substantial threat of pollution, the United States may coordinate all public and private efforts directed at the removal of such a threat.

Except where the operator can prove that the discharge was caused solely by an act of God, an act of war, negligence on the part of the United States government, or a third party, the operator shall be liable to the government for the full amount of incurred costs not to exceed 50 million dollars.

The Administrator is authorized to establish reasonable classifications of those onshore facilities having a total fixed storage capacity of less than 1,000 barrels. These regulations are found in 40 CFR, Part 113, entitled "Liability Limits for Small Onshore Storage Facilities."

Regulations, consistent with the National Contingency Plan shall be issued, establishing procedures, methods, and equipment necessary to prevent the discharge of oil and hazardous substances from vessels and onshore facilities, and to contain such discharges.

40 CFR, Part 112, entitled "Oil Pollution Prevention," satisfies the requirement of this portion of Section 311.

Spill Prevention Control and Countermeasures

40 CFR, Part 112.3 states that operators are required to prepare Spill Prevention Control and Countermeasure (SPCC) plans for non-transportation related facilities in areas where spills can potentially enter waters of the United States. The SPCC program sets minimum standards for certain aspects of facility design and operation.

The guidelines for preparing and implementing an SPCC Plan are found in 40 CFR, Part 112.7 (as mandated by the CWA, Section 311). Part 112.7(c) states that appropriate containment and/or diversionary structure or equipment to prevent oil discharge from reaching a navigable water course should be provided.

SLIDE #6-3

One of the following preventative systems or its equivalent should be used as a minimum:

- Dikes, berms or retaining walls sufficiently impervious to contain spilled Oil;
- Curbing;
- Culverting, gutters, or other drainage systems;
- Weirs booms or other barriers;
- Spill diversion ponds;
- Retention ponds; or
- Sorbent materials.

Familiarity with such containment structures may be valuable when performing Class II inspections.

SLIDES #6-4 THRU #6-6

These slides illustrate examples of the kinds of containment structures you might see in the field.

In addition to the containment requirements, the Spill Prevention Control and Countermeasure Plan must also address:

- Facility drainage;
- Bulk storage tanks (excluding production facilities);
- Facility transfer operations;
- Tank truck loading/unloading rack;
- Oil production facilities;
- Oil drilling and workover facilities (onshore and offshore);
- Inspections and records;
- Security of facility; and
- Personnel training and spill prevention procedures.

Section 402 of Title III of the Clean Water Act is entitled, "National Pollutant Discharge Elimination System (NPDES)." NPDES is defined as the national program for issuing, revoking, reissuing, terminating, and monitoring permits for discharge of pollutants within the effluent limitations of previous sections in the act. NPDES allows for State administration of a permit program.

40 CFR, Part 122 contains all the provisions for the NPDES program established under Sections 318, 402, and 405 of the Clean Water Act.

In accordance with Part 122.21, applicants for NPDES permits must provide the following information:

- Activities conducted by the applicant which require it to obtain an NPDES permit;
- Name, address, and location of the facility; and
- A listing of all permits or construction approvals received or applied for under any of the following programs;
  - Hazardous waste management (RCRA)
  - UIC program (SDWA)
  - NPDES program (CWA) and others

The NPDES program requires permits for the discharge of pollutants from any point source into waters of the United States.

Surface discharge is frequently encountered. Familiarization with the contents of 40 CFR, Part 122 as mandated by Section 402 of the Clean Water Act, may make identification of violations under this Act more easy to recognize during UIC inspection activities.

THE SAFE DRINKING WATER ACT

Part A of the SDWA includes definitions.

Part B of the SDWA is entitled, "Public Systems" and includes Sections 1411 through 1417. Of particular interest is Section 1412, which calls for the establishment of Maximum Contaminant Level goals and National Primary Drinking Water Regulations for each contaminant listed by the Administrator.

40 CFR, Part 141 establishes Primary Drinking Water Regulations pursuant to Section 1412 of the Safe Drinking Water Act.

40 CFR, Part 142 sets forth regulations for the implementation and enforcement of the National Primary Drinking Water regulations contained in Part 141.

Part C of the Safe Drinking Water Act is entitled "Protection of Underground Sources of Drinking Water."

SLIDE #6-7 Part C of the SDWA consists of:

- Section 1421 - Regulations for State Programs
- Section 1422 - State Primary Enforcement Responsibility
- Section 1423 - Enforcement of Program
- Section 1424 - Interim Regulation of Underground Injection

- Section 1425 - Optional Demonstration by States Relating to Oil and Natural Gas
- Section 1426 - Regulation of State Programs
- Section 1427 - Sole Source Aquifer Demonstration Program
- Section 1428 - State Program to Establish Wellhead Protection
- Section 1445 - Records and Inspections
- Section 1451 - Indian Tribes

In order to fully comprehend mandates set forth by the SDWA, it is important to define an underground source of drinking water (USDW). Let's turn to page 2-3, Section 2:7 of the UIC Inspection Manual.

40 CFR, Part 146.3 defines a USDW as:

- Any aquifer or its portion
    - Which supplies any public water system; or
    - Which contains a sufficient quantity of ground water to supply a public water system; and
        - Currently supplies drinking water for human consumption; or
        - Contains fewer than 10,000 mg/l TDS dissolved solids; and
    - Which is not an exempted aquifer.

Let's see how the act sets out to protect USDWs.

Section 1421 of the SDWA

As described in 40 CFR, Part 144.1, Section 1421 of the SDWA requires the Administrator to promulgate regulations establishing minimum requirements for effective State UIC programs.

- The regulations set forth in Section 1421 call for the publishing of proposed regulations for State UIC programs by the Administrator within 6 months after enactment of the Act.

- Any regulation must be in accordance with Section 553 of Title 5 (relates to rule making), and must provide the opportunity for a public hearing.

- The regulations shall contain minimum requirements for effective programs. The regulations:

  - Shall prohibit injection unless a permit is issued by the State (rule-authorized exceptions);

  - Must satisfy the State that underground injection will not endanger drinking water;

  - Shall include inspection, monitoring, recordkeeping, and reporting requirements; and

  - Shall apply to Federal agencies and other persons associated with underground injection.

- Regulations of the Administrator of State programs may not prescribe requirements which impede:

  - The underground injection of brine brought to surface by oil and gas production; or

  - Any underground injection for the recovery of oil and gas.

- The regulations of the Administration shall provide for consideration of varying geological, hydrological, or historical conditions in different regions.

- The Administrator shall avoid requirements which would disrupt programs which are being enforced in a substantial manner. A regulation is considered to disrupt if it would be infeasible to comply with both the regulation and the State UIC program. A regulation shall be deemed unnecessary only if, without such regulation, USDWs will not be endangered by injection.

- No part can be construed to affect the duty to assure that USDWs will, within Section 1421, not be endangered by any underground injection.

- The Administrator may, upon application of the Governor of a State, authorize temporary permits for injection effective for 4 years if:

  - The Administrator finds that the State is unable to process all permit applications within the time available;

  - The Administrator determines that the adverse environmental effect is not unwarranted;

  - Such temporary permits may only be issued to active wells at the time of approval of State program; and

  - The Administrator determines that the temporary permits require safeguards.

- The Administrator may upon application of the Governor of a State which authorizes injection by means of permits, authorize a State to issue temporary permits, after reasonable notice and hearing, effective for 4 years if the State finds, on the record of such hearing;

  - That technology to permit safe injection in accordance with the applicable UIC program is not available;

  - That injection would be less harmful to health than other methods of disposal; and

    - That available technology or other means have been employed to minimize the potentially adverse effect of the injection on the public health.

- For the purpose of this part:

    - Underground injection means the subsurface emplacement of fluids by injection; it does not include storage of natural gas.

    - Underground injection "endangers" if such injection may result in the presence in underground water which supplies or can be expected to supply any public water system of any contaminant.

Section 1422 of the SDWA

Section 1422, "State Primary Enforcement," states that within 6 months, the Administrator shall list in the Federal Register the States that require a UIC program.

- Any State listed must, within 270 days, submit an application satisfactory to the Administrator that the State:

    - Has adopted a program that meets the requirements of the regulations; and

    - Will keep records and make reports as required by the regulations.

- States must submit a notice to the Administrator of any revisions or added requirements

- Within 90 days, the Administrator will approve or disapprove the State program.

- If the Administrator approves the program, then the State shall have primary enforcement responsibility.

- The Administrator shall provide opportunity for a public hearing. If the program is disapproved, the Administrator will, within 90 days, prescribe a program. Such a program may not impede:

  - The injection of brine brought to the surface in connection with oil and gas production; and

  - Any injection for the secondary or tertiary recovery of oil.

Section 1423 of the SDWA

Section 1423, "Enforcement of the Program," states that whenever the Administrator finds that any person is violating a requirement of the UIC program in a primacy State, he shall notify both the State and the party in violation. After 30 days, if the State has not commenced enforcement action, the Administrator shall commence civil action.

When the State does not have primary enforcement, the Administrator shall issue an order to comply, or the Administrator shall commence a civil action.

- Civil and Criminal Actions - Civil actions referred to shall be brought into the appropriate U.S. District Court. Any person who violates a requirement of an applicable UIC program or order:

  - shall be subject to a civil penalty of not more than $25,000 for each day of violation;

  - if such violation is willful, such person may in addition to or in lieu of the civil penalty be imprisoned for not more than 3 years.

- Administrative Orders

  - For cases in which the Administrator is authorized to bring civil action for violation other than those relating to:

    - the underground injection of brine brought to the surface in connection with oil and gas production; or

    - any injection associated with the secondary or tertiary recovery of oil and gas, the Administrator may issue an order assessing a civil penalty of not more than $10,000 for each day, up to a maximum administrative penalty of $125,000.

  - For cases in which the Administrator is authorized to bring civil action relating to:

    - the underground injection of brine brought to the surface in connection with oil and gas production; or

    - any injection for the secondary of tertiary recovery of oil and gas, the Administrator may issue an order assessing a civil penalty of not more than $5,000 for each day not to exceed $125,000.

  - An order shall be issued after opportunity for a hearing.

  - The Administrator shall provide public notice and opportunity for comment.

  - Any citizen who comments on any proposed order shall be given notice of any hearing and of any order.

  - Any order issued will become effective 30 days following its issuance.

Section 1425 of the SDWA

Section 1425, "Optional Demonstrations by States Relating to Oil and Gas" establishes an alternative method for a State to obtain primary enforcement for those portions of its UIC program related to the recovery and production of oil and gas.

Remember that Section 1422 specifies that, in order for a State to obtain approval for its UIC program, it must make a satisfactory showing that it has adopted and will implement a program that meets the requirements of regulations issued by the Administrator. Such regulations have been promulgated in 40 CFR, Parts 122, 123, 124, and 146.

In 1980, Congress amended the SDWA by adding Section 1425. Effective May 19, 1981, this section allows States to demonstrate the effectiveness of their in-place regulatory programs for Class II (oil- and gas-related) wells in lieu of demonstrating that they meet the minimum requirements specified in the UIC regulations. In order to be deemed effective, State Class II programs have to meet the same statutory requirements as the other classes of wells, including prohibition of unauthorized injection and protection of USDWs. All Class II programs currently approved by EPA were approved under Section 1425 of the SDWA.

Because of the large number of Class II wells, the Federal regulations allow for authorization-by-rule for existing enhanced recovery wells (i.e., wells that were injecting at the time that a State program was approved or prescribed by EPA). Wells authorized by rule are subject to requirements similar to those of permitted wells, but are not subject to the administrative difficulties associated with obtaining a permit. During the first 5 years of the program, EPA and the States have been conducting file reviews on all wells authorized by rule to ensure that injection wells not subject to permitting are technically adequate and will not endanger USDWs.

In approving programs under Section 1425, the Agency has accepted variations among States. This is consistent with the requirements of the SDWA. However, the program has been in place for several years now and the Agency has acquired experience in implementation of the regulations. Based on this experience, the Agency began to look at the adequacy of the current requirements. As a matter of fact, EPA's Office of Drinking Water has recently concluded the Class II Mid-Course Evaluation.

Section 1426 of the SDWA

Section 1426, "Regulation of State Programs," states that, 18 months after enactment of the 1986 SDWA amendments, the Administrator shall modify the regulations for Class I wells, including groundwater monitoring, to provide the earliest possible detection of fluid migration.

The Administrator shall issue a report to Congress by September of 1987. It shall include the following items of information:

- Class V (nonhazardous) well inventory, numbers, and categories;
- Primary contamination problems associated with these Class V these wells; and
- Recommendations for design, construction, and installation requirements that should be applied to protect USDW from contamination.

Section 1428 of the SDWA

Section 1428, "State Programs to Establish Wellhead Protection Areas," states that within 3 years of the 1986 SWDA amendments, States shall adopt and submit a State program to protect wellhead areas public supply wells). The States were to submit wellhead programs by June of 1989. In the program, States were required to:

- Specify the duties of State agencies, local government entities, and public water systems in developing and implementing wellhead protection;

- For each wellhead, identify the protection area. As used in this section, "wellhead area" means the surface and subsurface area;
- Identify within each area, all anthropogenic or man-related contaminants;
- Describe a program that protects the water supply within the wellhead protection area;
- Include contingency plans for alternate drinking water in the event contamination occurs; and
- Include a requirement that consideration be given to all potential sources of contaminants within the wellhead area of a new water well.

Each State must establish technical and citizen advisory committees to encourage public participation.

The Administrator may disapprove of a program if he deems it unsatisfactory in protecting public water systems.

- The State may, within 6 months after receipt of disapproval, submit a modified program based on the Administrator's comments.

Federal assistance must be received by the State within 3 years of inception of this Section 1428.

Each State should implement the program within 2 years of program submission. Status reports shall be submitted once every 2 years.

Any governmental branch having jurisdiction over a contaminant source is subject to and must comply with the established State provisions.

Section 1445 of the SDWA

Section 1445, "Records and Inspections," states that all persons who are suppliers of water or operators of injection wells subject to primary drinking water regulations must maintain records, make reports, and conduct monitoring.

Eighteen months after enactment of the 1986 SDWA amendments, the Administrator shall promulgate regulations requiring monitoring, by every public water system, of unregulated contaminants. These regulations shall include a list of unregulated contaminants, and criteria for addition or deletion from the list.

Monitoring results must be submitted to the primary enforcement authority.

Notification of the availability of the results shall be given to those served by the system and the Administrator.

The Administrator may waive the monitoring requirements for a system which has conducted a consistent program.

For public water systems serving less than 150, the system shall be in compliance if sampled in accordance with rules established by Administrator.

No entry of facilities in a State with primary enforcement responsibility may be made without notice first being given to the State by the Administrator.

Refusal of entry may result in a civil penalty not to exceed $25,000

Part of this section addresses the topic of confidentiality of information. The Administrator shall consider the applicant and give 30 days notice of an unsatisfactory showing before releasing information.

Information may be disclosed to other authorized representatives of the United States.

We will now discuss the Resource Conservation and Recovery Act.

RESOURCE CONSERVATION AND RECOVERY ACT (RCRA)

The Resource Conservation and Recovery Act of 1976 completely replaced the previous language set forth in the Solid Waste Disposal Act.

As defined, it is an act to provide technical and financial assistance for the development of management plans and facilities for the recovery of energy and other resources from discarded materials and for the safe disposal of discarded materials, and to regulate the management of hazardous waste.

SLIDE #6-8 The Resource Conservation and Recovery Act includes:

- Subtitle A
  - Section 1004 - Definitions
- Subtitle C
  - Section 3020 - Interim Control of Hazardous Waste Injection
  - Section 3003 - Standards Applicable to Transporters of Hazardous Waste
  - Section 3004 - Standards Applicable to Owners/Operators
  - Section 3007 - Access Entry
- Subtitle H
  - Section 8002 - Special Studies

Subtitle A - General Provisions

Section 1004 of Subtitle A is entitled, "Definitions". In simplest terms, a **solid waste** is any material that is discarded or is intended to be discarded. According to RCRA, solid wastes may be either solid, semi-solid, liquid, or contained gaseous material.

Specifically excluded are point source discharges subject to NPDES permits under the Clean Water Act.

Commercial products are not wastes unless and until they are discarded. Commercial products are regulated under other statutes such as FIFRA, TSCA, SARA, and OSHA.

The term **hazardous waste** means a solid waste, or combination of solid wastes which because of its quantity, concentration, or physical, chemical, or infectious characteristic may:

- Cause or significantly contribute to an increase in serious irreversible illness; or
- Pose a substantial present or potential hazard to human health when improperly handled.

EPA has also determined that produced water injected for enhanced recovery is not a waste for purposes of RCRA, Subtitle C or D, since produced water, as used in enhanced recovery, is beneficially recycled and is an integral part of some crude oil and natural gas production processes.

Subtitle C - Hazardous Waste Management

Management of hazardous waste falls under Subtitle C of RCRA. Subtitle C calls for the identification and listing of hazardous wastes. As listed in 40 CFR, Part 261.30, the regulations contain four lists of hazardous wastes:

- Hazardous wastes from non-specific sources;
- Hazardous wastes from specific sources;
- Commercial chemical products considered acutely hazardous when disposed of; and
- Commercial chemical products considered toxic wastes when disposed.

Listed hazardous wastes are assigned generic identification numbers. A solid waste is hazardous if it exhibits any of the characteristics in this subpart.

SLIDE #6-9

The characteristics of this subpart are:

- Ignitability;
- Corrosivity;
- Reactivity; and
- Toxicity.

RCRA regulations contain a rule that provides that the commingling of any **listed** hazardous waste with a nonhazardous wastes stream renders the entire mixture a hazardous waste. The intent of the rule is to prevent avoidance through dilution.

Section 3020 under Subtitle C is entitled, "Interim Control of Hazardous Waste Injection" and was added in 1984.

This section abolishes all hazardous waste injection (into or above USDWs) 6 months after enactment of the Hazardous and Solid Waste Amendments of 1984.

This shall not apply to the injection of contaminated ground water into the aquifer from which it was withdrawn if:

- Such injection is:
  - A response action taken under 104 or 106 of CERCLA; or
  - Part of corrective action required under this title.

In addition to enforcement under the provisions of this Act, the prohibitions established shall be enforceable under the SDWA.

Section 3003 under Subtitle C is entitled, "Standards Applicable to Transporters of Hazardous Waste" (established eighteen months after enactment).

The standards include:

- Recordkeeping, source, and delivery points;
- Proper labeling;
- Compliance with manifest system referred to in Section 3002; and
- Transportation to the facility designated on the manifest.

Regulations under this act should be consistent with the Hazardous Materials Transportation Act.

Section 3004 under Subtitle C is entitled, "Standards Applicable to the Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities."

The standards include:

- Maintaining records of treated, stored or, disposed hazardous waste;
- Satisfactory reporting, monitoring and inspection, and compliance with manifest system;
- Operating techniques and practices satisfactory to the Administrator;
- Location, design, and construction of facilities;
- Contingency plans;

- Maintenance of operation and qualification requirements; and
- Compliance with requirements of Section 3005 regarding permits.

Section 3007 under Subtitle C is entitled, "Access Entry." Representatives are authorized:

- To enter at reasonable times; and
- To inspect and obtain samples, providing a portion of the sample to the facility owner.

Any information shall be available to the public unless it would divulge information entitled to protection. Any person who divulges information entitled to protection is subject to fine or imprisonment ($5,000).

The State may make annual inspections of Federal facilities and make information available to the public.

The administrator shall annually inspect every permitted facility which is operated by a State or local government.

The Administrator, in cooperation with the States, shall compile an inventory of all wells which inject hazardous wastes.

Subtitle H - Research, Development, Demonstration, and Information

Section 8002(m) of Subtitle H mandates a study to be performed to determine the effects of drilling fluids, produced water, and other wastes associated with the production of crude oil, or natural gas and geothermal energy. The study was to be completed within 2 years of the enactment date of PL 96.482 (October 21, 1980). The Administrator was to prepare a summary of the findings, and submit a plan for research, development, and demonstration to the Committee on Environment and Public Works of the U.S. Senate, and the Committee of Interstate and Foreign Commerce of the U.S. House of Representatives. As a result of that mandate, EPA published the "Regulatory Determination for Oil and Gas and Geothermal Exploration, Development, and Production Wastes." The following lists are excerpted from the Federal Register notice of the determination, dated July 6, 1988.

EPA'S List of Exempt Exploration and Production Wastes

The following wastes are listed as exempt in EPA's Regulatory Determination submitted to Congress in June of 1988:

- Produced water;
- Drilling fluids;
- Drill cuttings;
- Rigwash;
- Drilling fluids and cuttings from offshore operations disposed of onshore;
- Well completion, treatment, and stimulation fluids;
- Basic sediment and water, and other tank bottoms from storage facilities that hold product and exempt waste;
- Accumulated materials such as hydrocarbons, solids, sand, and emulsion from production separators, fluid treating vessels, and production impoundments;
- Pit sludges and contaminated bottoms from storage or disposal of exempt wastes;
- Workover wastes;
- Gas plant dehydration wastes, including glycol-based compounds, glycol filters, filter media, backwash, and molecular sieves;
- Gas plant sweetening wastes for sulfur removal, including amine, amine filters, amine filter media, backwash, precipitated amine sludge, iron sponge, and hydrogen sulfide scrubber liquid and sludge;
- Cooling tower blowdown;
- Spent filters, filter media, and backwash (assuming the filter itself is not hazardous and the residue in it is from an exempt waste stream);

- Packing fluids;
- Produced sand;
- Pipe scale, hydrocarbon solids, hydrates, and other deposits removed from piping and equipment prior to transportation;
- Hydrocarbon-bearing soil;
- Pigging wastes from gathering lines;
- Wastes from subsurface gas storage and retrieval, except for the listed nonexempt wastes;
- Constituents removed from produced water before it is injected or otherwise disposed of;
- Liquid hydrocarbons removed from the production stream but not from oil refining;
- Gases removed from the production stream, such as hydrogen sulfide and carbon dioxide, and volatilized hydrocarbons;
- Materials ejected from a producing well during the process known as blowdown;
- Waste crude oil from primary field operations and production; and
- Light organics volatilized from exempt wastes in reserve pits, impoundments, or production equipment.

EPA's List of Nonexempt Exploration and Production Wastes

EPA's Regulatory Determination for Exploration and Production Wastes lists the following wastes as nonexempt. It appears that the EPA concluded that production equipment maintenance wastes, as well as transportation (pipeline and trucking) related wastes, are nonexempt. While the following wastes are nonexempt, they are not necessarily hazardous.

- Unused fracturing fluids or acids;
- Gas plant cooling tower cleaning wastes;
- Painting wastes;
- Oil and gas service company wastes, such as empty drums, drum rinsate, vacuum truck rinsate, sandblast media, painting wastes, spent solvents, spilled chemicals, and waste acids;
- Vacuum truck and drum rinsate from trucks and drums transporting or containing nonexempt waste;
- Refinery wastes;
- Liquid and solid wastes generated by crude oil and tank bottom reclaimers;
- Used equipment lubrication oils;
- Waste compressor oil, filters, and blowdown;
- Used hydraulic fluids;
- Waste solvents;
- Waste in transportation pipeline-related pits;

- Caustic or acid cleaners;
- Boiler cleaning wastes;
- Boiler refractory bricks;
- Incinerator ash;
- Laboratory wastes;
- Sanitary wastes;
- Pesticide wastes;
- Radioactive tracer wastes; and
- Drums, insulation, and miscellaneous solids.

Operators should consider testing nonexempt wastes whenever there is reason to believe they exhibit one of the hazardous waste characteristics.

There is no requirement for testing of a nonexempted waste to determine if it is hazardous; civil and criminal penalties may be imposed if the waste is not managed in a safe manner and according to regulations.

Additional Exempt Wastes

It should be noted that EPA's lists of exempt and nonexempt wastes are not all-inclusive and that determinations will need to be made on a number of other incidental wastes. In deciding which wastes were exempt, it appears that EPA focused on wastes necessary to conduct so-called "primary field operations" (including centralized facilities and gas plants). Using this approach, the following wastes, although not specifically listed as exempt, appear clearly exempt:

- Excess cement slurries and cement cuttings;
- Sulfur contaminated soil or sulfur waste from sulfur recovery units;
- Gas plant sweetening unit catalyst;
- Produced water contaminated soil;
- Wastes from the reclamation of tank bottoms and emulsions when generated at a production location;
- Production facility sweetening and dehydration wastes;
- Pigging wastes from producer operated gathering lines;
- Production line hydrotest/preserving fluids utilizing produced waster; and
- Iron sulfide.

Land Disposal Restrictions Program (Land Ban)

The Land Disposal Restrictions Program regulates the disposal of liquid **hazardous** wastes or free liquids associated with treatment residues of hazardous wastes, as well as non-liquid halogenated organic compounds.

Applicable regulations are found in 40 CFR, Parts 146 and 148, as well as Parts 268 and associated portions of 260 through 266.

State requirements for land disposal restrictions (UIC program) are found in 40 CFR, Parts 148.10 through 148.16.

The regulations prohibit land disposal in:

- Landfills;
- Surface impoundments;
- Waste piles;
- Injection wells;
- Land Treatment;
- Salt domes;
- Salt beds;
- Underground caves or mines; and
- Concrete vaults or bunkers.

Land disposal of restricted wastes can continue if:

- No migration petition (40 CFR, Part 148)
- Two year national capacity variance (40 CFR, Part 148)
- Case-by-case extension (40 CFR, Part 268.5)
- Exemption (40 CFR, Part 268.5)
- Contaminated soil or debris from CERCLA or RCRA clean-up (generally until 11/8/90)
- Small quantity generator
  - less than 100 kg/month of non-acute hazardous waste, or
  - less than 1 kg/month of acute hazardous waste
- Farmers disposing of pesticides in accordance with 262.51

The dilution of wastes as a substitution for treatment is prohibited (40 CFR, Parts 148.3 and 268.3).

Solvent wastes include:

- F001 through F005, except:
  - Chlorinated fluorocarbons
  - 1,1,2-trichloroethane
  - Benzene
  - 2-ethoxyethanol
  - 2-nitropropane
- The waste must be used as a solvent-cleaning agent, paint remover, degreaser, etc., where the substance is not chemically altered.
- The wastes are "restricted" above and below treatment standards.

Constituents on the California list include liquid hazardous wastes containing:

- Free cyanides $\geq$ 1000 mg/l;
- Corrosives with pH $\leq$ 2.0;
- PCBs $\geq$ 50 ppm; and
- Certain metals.

The list also includes hazardous wastes containing halogenated organic compounds (HOCs) in Part 268, Appendix III:

- Dilute wastewaters-primarily water and HOCs $\geq$ 1,000 mg/l, but < 10,000 mg/l;
- Other liquid HOCs $\geq$ 1,000 mg/l; and
- Nonliquid HOCs $\geq$ 1,000 mg/l.

Metals, as elements or compounds, include:

- Arsenic $\geq$ 500 mg/l
- Cadmium $\geq$ 100 mg/l
- Chromium VI $\geq$ 500 mg/l
- Lead $\geq$ 500 mg/l
- Mercury $\geq$ 20 mg/l
- Nickel $\geq$ 134 mg/l
- Selenium $\geq$ 100 mg/l
- Thallium $\geq$ 130 mg/l

Land Disposal Restrictions - First Third

- 157 high volume, high hazard wastes
- Treatment standards established for approximately 25% by August 8, 1988
- Treatment standards for "soft hammer" wastes, approximately 75% were not established

Soft Hammer Wastes

Disposal in a landfill or surface impoundment if:

- Facility is in compliance with technical requirements; and
- Prior to disposal, the generator must certify to the Regional Administrator that alternative treatment capacity is not available and that landfill or surface impoundment is the only available practical alternative.

Effective Dates Related to Injected Wastes

<u>Effective August 8, 1988</u>

40 CFR, Part 148.10:

- F001-F005 wastes, unless the solvent wastes is a solvent-water mixture or sludge containing less than 1% total F001-F005 constituents

Part 148.11:

- F020-F023 and F026-F028 wastes, unless the wastes have been treated to meet standards in 268.41; an exemption has been filed under 148.20 (no migration standard); and extension of the effective date under 148.4 or granted a treatability variance under 268.44

Part 148.12:

- Wastes listed in 268.32 containing PCBs $\geq$ 50 ppm of HOCs > 10,000 mg/kg

Effective August 8, 1990

Part 148.10:

- All spent F001-F005 solvent wastes containing <1% total F001-F005

- Same exceptions, extensions, variances as above

Part 148.12:

- Liquid hazardous waste including free liquids associated with any solid or sludge containing free cyanides ≥ 1,000 mg/l

- Liquid hazardous waste including free liquids associated with any solid or sludge containing the following metals (or elements) or compounds of these metals (or elements) at the following concentrations:

  - Arsenic ≥ 500 mg/l

  - Cadmium ≥ 100 mg/l

  - Chromium (VI) ≥ 500 mg/l

  - Lead ≥ 500 mg/l

  - Mercury ≥ 20 mg/l

  - Nickel ≥ 134 mg/l

  - Selenium ≥ 100 mg/l

  - Thallium ≥ 130 mg/l

- Liquid hazardous waste with pH ≤ 2

- Hazardous waste containing HOCs in total concentration > 1,000 mg/l, but < 10,000 mg/l

- Same exceptions, extensions, variances as above

Part 148.14:

- K049, K050, K052, K062, K071, K104

- Same extensions, exemptions, variances as above

Effective June 8, 1989

Part 148.14:

- F006 (Cyanide), F008, F009, F019
- K004(nw), K036(ww)
- P030, P039, P041, P063, P071, P089, P094, P097
- U221, U223

Part 148.15:

- F010, F011, F012, F024
- K027, K028, K029(nw), K038, K039, K040, K043, K095(nw), K096(nw), K113, K114, K115, K116
- P029, P040, P043, P044, P062, P074, P085, P098, P104, P106, P111
- U028, U058, U107, U235

Part 148.16:

- K002(nw), K003(nw), K005(nw), K006(nw), K007(nw), K023, K093, K094
- P013, P021, P099, P109, P121
- U069, U-87, U088, U102, U190

Effective Date August 8, 1990

Part 148.14:

- F007
- K011, K013, K014

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nw - nonwastewaters
ww - wastewaters

Effective Date June 8, 1991

Part 148.15:

- K009, K010

Generator Requirements

- Determine if waste is restricted (262.11(h) and 268.7(a)).

- If waste does not meet treatment standard, notification.

- If waste does meet treatment standards, notification and certification.

- May store wastes for up to 90 days for accumulation; if stored for more than 90 days, the facility must have interim status or a permit.

Treatment, Storage, and Disposal (TSD) Requirements

- General

  - Obtain detailed waste analysis (264.13 or 265.13).

  - Update waste analysis plan including: analyses to be performed (a)(1) and methods for analyses (b)(6).

  - For surface impoundments (b)(7), schedule for sampling, analysis and annual removal or residue.

Storage Requirements (268.50 (2))

- Container storage

  - Mark each drum/container identifying contents and the date accumulation begins.

- Tank storage

  - Mark each tank with contents and date accumulation begins, or keep the same information in the operating record.

- Transporter may store waste up to 10 days.

- TSD may store waste up to one year for accumulation purposes. Beyond 1 year, the facility must prove storage is for accumulation purposes.

Treatment Facilities (268.7(b))

- Keep a copy of generator notification/certification in operating record.

- Test treatment residues or extract at the frequency specified in waste analysis plan.

- Determine if restricted wastes have been treated to appropriate concentrations.

- If waste required further treatment, send notification with each shipment.

- If waste or residue meets the treatment standards, send notification and certification with each shipment.

Disposal Facility Requirements

- Keep generator notification/certification in operating record.

- Record quantities of waste disposed under an exemption.

- Test the waste or an extract to assure that wastes comply with treatment standards according to the frequency in the waste analysis plan.

Treatment, Recovery, or Storage Facility Requirements

- Must keep copies of the generators demonstration (if applicable) and certification in the operating record.

- Must certify (using text in 268.8(c)(1) that the waste has been treated in accordance with the generators demonstration.

- Must send a copy of the generators demonstration (if applicable), and certification under 268.8(a)(2) and certification under 268.8(c)(1) (if applicable) to the facility receiving the waste or treatment residues.

Disposal Facility Requirements

- Must ensure that the wastes prohibited under 258.33(f) are subject to a certification prior to disposal.

- Units receiving wastes must meet the minimum technological requirements of 268.5(h)(2).

Additional requirements for disposal in landfills or surface impoundments - 40 CFR, Part 268.8

Disposal in a landfill/surface impoundment may continue if the unit is in compliance with the requirements in 268.5(h)(2), provided that:

- Prior to disposal, the generator makes a good faith effort to contract with treatment/recovery facilities which provide the greatest environmental benefit.

- Generator submits a demonstration and certification that an attempt was made to meet the above requirement and the demonstration includes a list of the facilities contacted, names of contacts, addresses, telephone numbers, and contact dates.

If the generator determines that there is "no practically available" treatment:

- Indicate so in the demonstration and use the certification in 268.8(a)(2)(i). Submit the package to the Regional Administrator.

- Submit a copy of the demonstration and certification with the first shipment to the receiving facility.

- With each subsequent shipment, submit only the certification, as long as the conditions have not changed.

- Generator must retain a copy of the demonstration and certification (for each shipment) for at least 5 years, onsite.

- Record retension extended if enforcement action.

- Generator must immediately notify the Regional Administrator of any change in conditions which formed the basis of the certification.

If the generator determines that there is "practically available" treatment:

- Indicate so in the demonstration and use the certification in 268.8(a)(2)(ii). Submit the package to the Regional Administrator.

- Submit a copy of the demonstration and certification with the first shipment to the receiving facility.

- With each subsequent shipment, submit only the certification, as long as the conditions have not changed.

- Generator must retain a copy of the demonstration and certification (for each shipment) for at least 5 years, onsite.

- Record retension extended if enforcement action.

- Generator must immediately notify the Regional Administrator of any change in conditions which formed the basis of the certification.

Treatment, Recovery, or Storage Facility Requirements:

- Must keep copies of the generator's demonstration (if applicable) and certification in the operating record.
- Must certify (using text in 268.8(c)(1) that the waste has been treated in accordance with the generator's demonstration.
- Must send a copy of the generator's demonstration (if applicable), certification under 268(a)(2), and certification under 268.8(c)(1) (if applicable) to the facility receiving the waste or treatment residues.

Disposal Facility Requirements

- Must ensure that the wastes prohibited under 258.33(f) are subject to a certification prior to disposal.
- Units receiving wastes must meet the minimum technological requirements of 268.5(h)(2).

COMPREHENSIVE ENVIRONMENTAL RESPONSE, COMPENSATION, AND LIABILITY ACT (CERCLA)

It was felt that a Federal law was needed to protect U.S. citizens against the dangers posed by hazardous waste abandoned at sites throughout the nation, both the short-term threat that became all too apparent during emergencies and the long-term threat, often requiring years of cleanup action.

The Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) was the first major response to the problem on a national level. CERCLA had several key objectives:

- To develop a comprehensive program to set priorities for cleaning up the worst existing hazardous waste sites;
- To make responsible parties pay for those cleanups, wherever possible;
- To set up a $1.6 billion Hazardous Waste Trust Fund, popularly known as "Superfund," for the twofold purpose of performing remedial cleanups in cases where responsible parties could not be held accountable, and responding to emergency situations involving hazardous substances; and
- To advance scientific and technological capabilities in all aspects of hazardous waste management, treatment, and disposal.

Superfund was to be funded with taxes on crude oil and 42 different commercial chemicals. State governments were to pay 10 percent of the cost of Superfund work at privately owned sites and 50 percent at those that were publicly owned.

The United States seemed ill-prepared to deal with the problem of hazardous waste prior to the creation of Superfund.

In the Clean Water Act of 1972, Congress had provided for the regulation of hazardous waste discharged into all navigable waters of the United States. A $35 million trust fund (an ancestor of

Superfund) was set up to deal with problems stemming from such discharges. However, no provision was made to deal with damage to land resources resulting from contamination by hazardous waste.

CERCLA, commonly known as Superfund, became law in December of 1980. Superfund established a program to identify sites from which hazardous releases had occurred. This program was designed to assure that the releases are cleaned up by responsible parties or the government, to evaluate damages to natural resources, and to create a claims procedure for parties who have cleaned up sites or spent money to restore natural resources. Under CERCLA, releases of hazardous materials at levels above the reportable quantity must be reported to the National Response Center.

Under CERCLA, EPA has broad enforcement authority to require Potentially Responsible Parties (PRPs) to undertake cleanups (Section 106) or to recover costs incurred in conducting remedial actions from PRPs (Section 107).

Courts have interpreted the statute to be retroactive in its application, to provide for strict liability without regard to fault, and, in appropriate circumstances, to impose joint and several liability. CERCLA provides owners/ operators with a significant economic incentive to properly manage deposition of solid wastes at both on-site and off-site locations to avoid being involved in expensive cleanup activities.

For example, it would be financially unsound to **knowingly** allow hazardous waste to contaminate a nonhazardous exploration and production waste site making it a potential CERCLA site, and be named as a PRP by EPA. EPA has taken the position that non-petroleum "special wastes", although exempt from RCRA Subtitle C hazardous waste regulations, may nevertheless result in CERCLA liability if any of the constituents are "hazardous substances", as otherwise listed under CERCLA.

CERCLA provides for the exclusion of petroleum, including crude oil or any fraction thereof, from the definition of hazardous substance, pollutant, or contaminant. EPA has interpreted the petroleum exclusion to include, in their entirety, pure petroleum and pure petroleum fractions even though they contain substances that are otherwise listed as hazardous substances. Thus, EPA interprets the term "petroleum" to encompass crude oil, crude oil fractions, and refined products, such as gasoline. This includes any indigenous hazardous substances.

National Priorities List (NPL)

One important product of the 1972 Clean Water Act was the formation of a National Contingency Plan for dealing with emergencies involving hazardous waste. The plan has undergone many changes and is the guiding principle behind the implementation of Superfund.

The plan was originally published for the removal of oil and hazardous substances pursuant to Section 311 of the Clean Water Act in order to reflect and effectuate the responsibilities and powers created by the Act.

The revisions of PL499 (Oct. 17, 1986), found in Section 105 of CERCLA, include the National Hazardous Substance Response Plan which established procedures and standards for responding to releases of hazardous substances, pollutants, and contaminants.

The revisions established a list of national priorities among the known releases or threatened releases throughout the United States. The list is revised at least once annually.

OUTLINE OF REGULATIONS PERTINENT TO THE UIC PROGRAM

The instructor may find the following outline useful for review.

Federal Water Pollution Control Act (1972)/Clean Water Act (1977)

- Introduction
- Statement of Amendment
- Title III - Standards and Enforcement
  - Section 301 - Effluent Limitations
  - Section 304 - Information and Guidelines
  - Section 311 - Oil and Hazardous Substance Liability
- Title IV - Permits and Licenses
  - Section 402 - National Pollutant Discharge Elimination Systems

Safe Drinking Water Act (1974)

- Part C - Protection of Underground Sources of Drinking Water
  - Section 1421 - Regulation for State Programs
  - Section 1422 - State Primary Enforcement Responsibility
  - Section 1423 - Enforcement of Program
  - Section 1424 - Interim Regulation of Underground Injection
  - Section 1425 - Optional Demonstration by States Relating to Oil and Natural Gas
  - Section 1426 - Regulation of State Programs
  - Section 1427 - Sole Source Aquifer Demonstration Program
  - Section 1428 - State Program to Establish Wellhead Protection
  - Section 1445 - Records and Inspections
  - Section 1451 - Indian Tribes

40 CFR, Part 144 (1980) - Underground Injection Control Program

- Subpart A - General Provisions
  - Section 144.1 (a),(b),(e),(f)(1),(f)(2)
  - Section 144.3 - Definitions
  - Section 144.8 - Noncompliance
- Subpart B - General Requirements
  - Section 144.11
  - Section 144.12
  - Section 144.13
  - Section 144.14
- Subpart C - Authorization by Rule
  - Section 144.21
  - Section 144.22, .24
  - Section 144.25
  - Section 144.26
  - Section 144.28*
- Subpart D - Authorization by Permit
- Subpart E - Permit Conditions

40 CFR, Part 145 - State UIC Program Requirements

40 CFR, Part 146 - Underground Injection Control Program: Criteria and Standards

- Subpart A - General Provisions
  - Section 146.3 - Definitions
  - Section 146.8 - Mechanical Integrity Testing
  - Section 146.10 - Plugging and Abandonment

- Subpart B - Criteria and Standards Applicable to Class I Wells
  - Section 146.12 - Construction Requirements
  - Section 146.13 - Operating, Monitoring, and Reporting
- Subpart C - Criteria and Standard Applicable to Class II Wells
  - Section 146.22 - Construction
  - Section 146.23 - Operating, Monitoring, and Reporting
- Subpart D - Criteria and Standards Applicable to Class III Wells
  - Section 146.32 - Construction
  - Section 146.33 - Operating, Monitoring, and Reporting
- Subpart F - Criteria and Standards Applicable to Class V Wells

40 CFR, Part 147 - State Underground Injection Control Program

Resource Conservation and Recovery Act (1976)

- Introduction
- Section 1004 Definition
- Subtitle C
  - Section 3020 - Interim Control of Hazardous Waste Injection
  - Section 3003 - Standards Applicable to Transporters of of Hazardous Waste
  - Section 3004 - Standards Applicable to Owners/Operators
  - Section 3007 - Access Entry
- Subtitle D
  - Section 4001 - Objective of the Subtitle
  - Section 4002 - Federal Guidelines for Plans
  - Section 4003 - Requirements for Approval of Plans
  - Section 4007 - Approval of State Plan; Federal Assistance

- Section 4008 - Authorization of Federal Financial Assistance

- Section 4010 - Adequacy of Certain Guidelines and Criteria

• Subtitle H

  - Section 8002 - Special Studies

• EPA List of Exempt E&P Wastes

• EPA List of Nonexempt E&P Wastes

Toxic Substance Control Act

• Title I - Control of Toxic Substances

  - Section 2 - Findings

  - Section 3 - Definitions

  - Section 6 - Regulation of Hazardous Chemicals and Mixtures [(3) placarding]

  - Section 8 - Reporting and Retention of Information

  - Section 9 - Laws Administered by the Administration

  - Section 11 - Inspections and Subpoenas (Requirement for Written Notice)

Comprehensive Environmental Response, Compensation, and Liability Act

• Introduction

Federal Insecticide, Fungicide, Rodenticide Act

SECTION 7

UIC PROGRAM

This section contains material associated with the UIC program. Particular topics discussed include:

- Program Overview
- Well Classification System

DISCUSSION This section provides an overview of the EPA Underground Injection Control Program, commonly referred to as the UIC program. The purpose of the program will be discussed, as well as the classification system used to designate the various well types regulated under the program.

PROGRAM OVERVIEW

On December 14, 1974, Congress enacted the Safe Drinking Water Act to protect the public health and welfare of persons, and to protect existing and future underground sources of drinking water

SLIDE #7-1 (USDWs). In 1980, USEPA promulgated these regulations under 40 CFR, Parts 144 though 146.

The Act also mandated the development of a Federally approved Underground Injection Control (UIC) program for each State, Possession, and Territory. Approval of a particular program is based on a finding that the program meets minimum standards and technical requirements of SDWA Section 1422 or Section 1425 and the applicable provisions set forth in 40 CFR, Parts 144 through 146. States whose programs were submitted to and approved by USEPA are known are Primacy States. These States have primary enforcement responsibility for the regulation of injection wells in their States. In those instances where a State has opted not to submit a program for approval or where the submitted program does not meet the minimum standards and technical requirements, the program is promulgated and administered by USEPA. States with Federally administered programs are known as Direct Implementation (DI) States and are subject to the regulations set forth in 40 CFR, Parts 144 through 146.

Under 40 CFR, Section 144.3, a "well" is defined as a bored, drilled, or driven shaft, or dug hole, whose depth is greater than its largest surface dimension. "Well injection" is defined as the subsurface emplacement of fluids through a bored, drilled, or driven well; or through a dug well where the depth of the dug well is greater than its largest surface dimension.

SLIDE #7-2

An underground source of drinking water (USDW) is defined as:

- An aquifer which presently supplies a public water system; or
- Which contains sufficient water to supply a public water system; or
- Which contains less than 10,000 mg/l total dissolved solids; and
- Is not an exempted aquifer.

SLIDE #7-3 **WELL CLASSIFICATION SYSTEM**

The UIC regulations define and establish five classes of injection wells. These are listed on page 1-2 of the UIC Inspection Manual.

Class I wells receive hazardous and non-hazardous wastes from industrial and municipal generators; the wastes are injected below USDWs.

Class II wells include oil and gas enhanced recovery, salt water disposal, and hydrocarbon storage wells.

Class III wells include mineral extraction wells.

Class IV wells receive hazardous and radioactive wastes which are injected into or above USDWs.

Class V wells include all other wells not included in Classes I through IV.

Now we will review each well class in a little more detail. First, let's discuss Class I wells.

SLIDE #7-4 **Class I wells** are:

- Wells used by generators of hazardous waste or owners/operators of hazardous waste management facilities containing, within one quarter mile of the well bore, an underground source of drinking water; and
- Other industrial and municipal disposal wells which inject fluids beneath the lowermost formation containing, within one quarter mile of the well bore, an underground source of drinking water.

Bethlehem Steel, Dupont, and Parke-Davis are examples of companies that operate Class I wells at their facilities.

SLIDE #7-5 This slide illustrates the number of States which contain Class I wells. As you can see, there are quite a few states with Class I wells.

SHOW DUPONT VIDEO Now we will show you a video put together by Dupont for a Class I well they are constructing in Louisiana.

SLIDE #7-6 Now we will discuss Class II wells.

Class II wells are wells which inject fluids:

- Which are brought to the surface in connection with conventional oil or natural gas production and may be commingled with waste waters from gas plants which are an integral part of production operations, unless those waters are classified as a hazardous waste at the time of injection;

- For enhanced recovery of oil or natural gas; and

- For storage of hydrocarbons which are liquid at standard temperature and pressure.

SLIDE #7-7 This slide illustrates the number of States which contain Class II injection wells.

SLIDE #7-8 This is a typical Class II well. Class II injection wells can be constructed in a variety of ways. These various completion types can have a bearing on the inspections and types of MITs conducted in the field. Class II well completion types include:

SLIDE #7-9 • Conventional completion

SLIDE #7-10 • Packerless completion

SLIDE #7-11 • Slimhole completion

SLIDE #7-12 • Tubingless completion

SLIDE #7-13 • Dual completion

SLIDE #7-14 • Annular disposal well

SLIDE #7-15 THRU #7-18 Here are a few examples of actual Class II wells found in the field.

SHOW CALIFORNIA VIDEO We'd now like to show a short video put together by the California Division of Oil and Gas.

SLIDE #7-19 Now let's talk about Class III wells.

Class III wells are wells which inject for extraction of minerals, including:

- Mining of sulfur by the Frasch process;
- In-situ production of uranium or other metals; and
- Solution mining of salts or potash.

In-situ wells includes only in-situ production from ore bodies which have not been conventionally mined. Solution mining of conventional mines such as stopes leaching is included in Class V.

SLIDE #7-20 This slide illustrates the number of States in which Class III wells are operated.

SLIDE #7-21 This is a typical Class III salt or potash solution mining well. Salt solution mining wells can be operated as single wells or by the gallery system.

The decision on which type of field design to use is dependent on the type of salt formation.

SLIDE #7-22 Salt domes are mined by use of the single well field design. Wells are drilled deep into the salt dome where there are the fewest impurities. They inject fresh water, usually down the annulus, and produce saturated brine up the tubing.

SLIDE #7-23 The gallery method of salt solution mining is used in bedded salt formations. Bedded salt formations consist of salt layers too thin for single well brine production. The gallery method involves injecting into one well while producing from another well. The salt formation is fractured initially to allow flow between the wells. Fresh water is injected into one well and saturated brine is produced from the other well. Additional wells can be added to create a system of channels.

Salt solution mining wells are completed in many of the same ways as Class II wells.

They can be tested for mechanical integrity using the Standard Annular Pressure Test and by the use of the Radioactive Tracer Survey (RTS).

The MIT Workgroup is looking into approving the gallery test method. The gallery test involves pressuring up the entire well field system as one and approving the mechanical integrity of all the wells should it pass the test.

SLIDE #7-24 Another type of Class III well completion involves the in-situ leaching of minerals through injection.

Produced ground water is mixed with a leaching agent (such as ammonium carbonate or sodium carbonate for uranium mining) and injected into the mineral containing formation.

The mineral-laden fluid is produced out of the wells and the minerals are extracted out of the fluid.

Fluid is produced at a higher rate than it is injected in order to maintain the driving force in the reservoir.

SLIDE #7-25 Another type of Class III well is the Frasch Sulfur producing well.

SLIDE #7-26 The Frasch Well Operation involves injecting superheated water (330°F) into a sulfur bearing formation. This heats up the formation rock until the sulfur melts (240°F). Liquid sulfur is heavier than water so it flows down to the production perforations. Sulfur is then air lifted to the surface for distribution. Produced sulfur is 99.5% pure.

SLIDE #7-27 Class IV wells are banned.

Class IV wells consist of:

- Wells used by generators of hazardous or of radioactive waste, by owners or operators of hazardous waste management facilities, or by owners or operators of radioactive waste disposal sites to dispose of hazardous or radioactive waste into a formation which, within one quarter mile of the well, contains an underground source of drinking water;

- Wells used by generators of hazardous or of radioactive waste, by owners or operators of hazardous waste management facilities, or by owners or operators of radioactive waste disposal sites to dispose of hazardous or radioactive waste above a formation, which within one quarter mile of the well, contains an underground source of drinking water; and

Wells used by generators of hazardous waste or owners or operators of hazardous waste management facilities, to dispose of hazardous wastes which cannot be classified under Section 146.05(a)(1) or Section 146.05(d)(1) and (2), e.g., wells used to dispose of hazardous wastes into or above a formation which contains an aquifer which has been exempted pursuant to UIC Regulations (Section 146.04).

SLIDE #7-28 **Class V wells** are wells that are not included in Classes I through IV. Examples of Class V well types include:

- Drainage wells;
- Geothermal wells;
- Domestic wastewater disposal wells;
- Mineral and fossil fuel recovery wells;
- Industrial disposal wells; and
- Recharge wells.

SLIDE #7-29 This slide illustrates the States which contain Class V wells.

SLIDE #7-30 AND #7-31 These two slides illustrate how different types of Class V wells can potentially threaten groundwater sources.

SLIDE #7-32 THRU #7-35 Here is a list of the many types of Class V wells. There are 32 types of Class V wells. These include......

As you can see, the Class V injection well category is large and diverse. This is due to the broad definition of Class V wells.

Class V wells will be discussed in more detail in a later session.

As can be seen, there are many types of wells that inspectors may be seeing in the field. Inspectors need to be familiar with each type.

UIC INSPECTIONS

SECTION 8

UIC INSPECTIONS

This section contains material associated with UIC inspections. Particular topics discussed include:

- Inspections and the SDWA
- Role of the Inspector
- Inspector Responsibilities
- Typical Observations to Make During Inspections
- Actual Inspection Cases

DISCUSSION

UIC inspections are a vital part of maintaining operator compliance with regulations.

As inspectors, you are asked to maintain oversight of injection well operators and inform EPA or State agencies when regulations are not being followed.

In this session, we will be discussing the role of the inspector in the UIC program and the importance of inspection activities.

We will also be addressing how inspections should be conducted and the proper documentation involved.

READ TOP OF PAGE 2-1

INSPECTIONS AND THE SDWA

Let's look at Section 2 in the UIC Inspection Manual. You can follow along as I read the "Overview of the SDWA and Amendments" at the top of the page.

ROLE OF THE INSPECTOR

Inspectors play a major role in the Agency's compliance and enforcement program. Without inspectors, there would be no enforcement cases, for inspectors are the ones who collect the information upon which enforcement cases are based.

The inspector's work must meet the highest standards in order to achieve ultimate success in an enforcement action.

An inspector's failure to adequately substantiate what he or she saw may mean that EPA cannot take the case to court and win a large penalty, instead settling for a lesser action which does not send a strong signal to the regulated community.

Inspectors are generally involved in virtually every aspect of the compliance and enforcement program, which includes:

- Selecting specific facilities to inspect;
- Determining the scope and objectives of the inspection;
- Coordinating with appropriate legal, technical, and program staff;
- Evaluating the need for a warrant and developing the information required to support an application if needed;
- Assessing whether a violation exists and collecting evidence;
- Collecting the necessary information and writing the report that will serve as the basis for the Agency's decision regarding an enforcement action;
- Collecting additional evidence if needed to support an enforcement case;
- Participating in (or supporting) settlement negotiations;
- Serving as a government witness in enforcement hearings or trials; and

- Checking to make sure that a facility has taken the steps required by the enforcement action to return to compliance.

SLIDE #8-1 **INSPECTOR RESPONSIBILITIES**

The basic responsibilities of inspectors can be grouped into the following general categories:

- Official Representative - The inspector represents EPA and may be the only Agency official ever seen by a plant manager. This requires tact, a professional attitude, and diplomacy.

- Fact-finder - The inspector assesses whether the facility is in compliance with regulations. This requires extensive knowledge of the regulations and skill in obtaining information and following up leads to identify the less obvious violations.

- Enforcement Case Developer - The inspector collects and preserves evidence of noncompliance. Since the inspection is usually the primary basis for the enforcement case, good documentation is essential. The inspector is often a key witness.

- Enforcement Presence - The inspector creates a visible presence of government interest in the regulatory status of facilities; the potential for being inspected creates an incentive for compliance with regulations.

- Technical Educator - The inspector serves as a source of regulatory information and may provide technical assistance to facility managers by directing them to sources of technical information.

- Technical Authority - Inspectors may be required to help the Agency interpret regulatory requirements and technical data, and assess the adequacy of control measures environmental impacts.

When preparing to conduct an inspection, the inspector needs to consider the potential ramifications of his or her findings during the inspection.

SLIDE #8-2 AND READ SECTION 3:1

Turn to Section 3 in the UIC Inspection Manual entitled, "Techniques for Efficient Inspections." I'll be reading from Section 3:1, "Legal Responsibilities..."

Legal Framework for Conducting Facility Inspections:

- Presentation of proper credentials
- Presentation of required notices and receipts
- Proper handling of necessary warrants when facility entry is denied
- Handling of confidential information
- Proper handling of samples (chain of custody) and photographs

SLIDE #8-3

This slide illustrates a Notice-of-Inspection form.

SLIDE #8-4

Section 1445 of the SDWA is printed on the back side of the form.

As mentioned earlier, Section 1445 of the SDWA provides authority for inspectors to enter upon and inspect any facility under the jurisdiction of the UIC program.

Inspectors should be familiar with the general investigative techniques and procedures to ensure accurate, concise, and legally defensible inspections.

SLIDE #8-5

This slide depicts an outline of inspector responsibilities. The outline may be found on page 3-3 of the Inspection Manual. Please follow along as we read through the outline.

Pre-Inspection Preparation

The inspector should:

- Establish the purpose and scope of the inspection;
- Review background information and Agency records;
- Develop a plan for the inspection;

READ SECTION 3:4

  - Refer to page 3-7, Section 3:4 on Inspection Plan Development.

    Please flip back to page 3-3 and we'll continue our review of the outline of the inspector's responsibilities.

- Prepare documents and equipment; this includes filling out the Notice-of-Inspection form and making sure that gauges are in working order; and
- Review the inspection schedule, coordinating with the lab if samples are to be collected.

Entry

The inspector should:

- Present official credentials; and
- Manage denial of entry, if necessary. Facility access and denial procedures will be discussed in the next section.

READ SECTION 3:9

Opening Conference

The inspector should:

- Discuss inspection objectives and scope; and
- Establish a working relationship with facility officials.

  You may want to follow along as we read Section 3:9 on page 3-11.

Facility Inspection

The inspector should:

- Review facility records;
- Inspect monitoring equipment and operations;
- Collect samples (if necessary); and
- Document inspection activities.

Let's turn to Section 3:10 and read the first paragraph.

SLIDE #8-6

The inspection report should be:

- Accurate;
- Relevant;
- Comprehensive;
- Coordinated;
- Objective;

- Clear; and
- Neat and legible.

Section 3:22 provides detailed guidelines for writing inspection reports.

Closing Conference

The inspector should:

- Collect missing or additional information;
- Clarify questions with facility officials; and
- Prepare necessary receipts.

READ SECTION 3:11

Turn to Section 3:11, page 3-16 and follow along as I read.

Follow-Up

- A follow-up letter should be prepared to summarize the inspection results.
- All information should be submitted to the correct personnel, keeping your record book and copies of all data.

SLIDE #8-7

KINDS OF INSPECTIONS

There are several different kinds of inspections:

- Emergency inspections
- Preoperational inspections
- Mechanical integrity tests
- Compliance verification
- Plugging and abandonment verification
- Class IV closure verification
- General maintenance inspections
- Citizen complaint inspections

Let's turn to pages 2-17 through 2-20 of your text for a review of each type.

READ EACH SECTION

Emergency, compliance, and citizen complaint inspections are discussed on page 2-17.

Preoperational inspections are discussed on page 2-18.

Mechanical integrity test inspections are discussed on page 2-18.

Plugging and abandonment inspections are described on page 2-19.

Closure of Class IV wells is discussed on page 2-19.

General maintenance inspection are described on page 2-19.

TYPICAL OBSERVATIONS TO MAKE DURING INSPECTIONS

The following provides a list of items to note during an inspection of Class I, II, or III wells:

- Examine the wellhead area, noting:
  - Presence of meter
  - Evidence of surface discharge
  - Evidence of recent workover
  - Physical signs of injection activity
  - Gauges present and pressures
- Inspect the injection plant, noting:
  - Evidence of surface discharge
  - Capability of handling spills
  - Injection pump, plunger size - can establish capability to inject
  - Automatic switches (murphy switches)
  - Water tank capacity

- Chart recorders
- Sample locations
- Gauges present and pressures

ACTUAL INSPECTION CASES

INVOLVE TRAINEES These are slides of actual Class II inspections conducted in the States of Montana and Tennessee.

SLIDE #8-8 This is a typical workover rig. It consists of a truck-mounted telescoping derrick with diesel-powered drumworks. It is capable of pulling two joints of tubing at a time. You may see this type of rig on location during inspections.

SLIDE #8-9 This is a picture of a drilling rig. As inspectors, you may visit a rig such as this during the initial construction of an injection well.

SLIDE #8-10 This is a picture of a high-tech enhanced recovery injection well located in Montana. Note that the piping is stainless steel. Pressure gauges are located on the tubing and annulus. Shut-off valves are located on both the tubing string and the injection line. Note the sample tap, volume meter (blue), and adjustable choke (gold) on the injection line. The workover workstring is in the left foreground of the picture. The building will be rolled back over the injection well after testing is completed.

SLIDE #8-11 This is also an enhanced recovery injection well. Note the double valves on the injection tubing and a check valve (red) on the injection line to prevent backflow. The hose running from the top of the tubing and from the annulus is connected to pressure sensors in the chart recorder on the wall. The chart recorder monitors injection pressure and annulus pressure. An electronic meter on the injection line monitors the volume of fluid injected.

SLIDE #8-12 This is another injection well. Note the gauge on the injection line, the check valve (red), and the Halliburton volume meter on the injection line (white shape to rear of photo). There is evidence of leakage on the injection line. Note the metal grate over the cellar in the wellhouse. Always check the cellar for evidence of leakage (standing water/oil).

SLIDE #8-13 This is a picture of a well discovered by an inspector in Tennessee. It is a possible gas injection well. Note the lack of seal on the casing. Anything could be dumped into the well between the tubing and casing. Any ideas about what this well could be? As inspectors, you may run across abnormally constructed wells.

SLIDE #8-14 This is a casing injection well. The injection fluid is pumped directly into the casing without use of tubing and packer. Note the evidence of spills.

SLIDE #8-15 When conducting inspections, it is a good idea to note the reading on the volume meter. This is a volume flow meter on the injection line of an injection well. If the well is injecting, you can monitor the meter reading over a time interval and calculate the injection rate. A meter reading is also useful when taken on wells that are supposed to be shut in. If you take a meter reading one week, and happen to return at a later date and the meter reading is different, the operator has been using the well.

SLIDE #8-16 This is another example of a flow meter. In this picture, you can also see a sample tap on the injection line (red handle), a bull plug on top of the well, and a gate valve on the tubing.

SLIDE #8-17 This is a picture of a logging truck that is rigged up on an injection well. The logging tool is lowered by wireline into the well to log the areas of interest. On the right side of the workover rig is a trailer-mounted circulating pump and 55 barrel tank.

SLIDE #8-18 This is a picture of a logging tool being prepared to run into a well. Note that the pit located next to the well is used for catching wellbore fluids. Also note the wellhead on the ground behind the well.

SLIDE #8-19 This slide illustrates an injection well workover. In the foreground of the slide is a stack of 2 3/8" fiberglass tubing. The large silver piece of equipment on the well is a hydraulic blowout preventer. The equipment being lowered to the ground is a stripper head. It is used so that the tubing can be moved in and out of the well while the well is being circulated clean.

SLIDE #8-20 This is a picture of a Baker AD-1 tension set packer. Many of the injection wells you will encounter use a packer similar to this one.

SLIDE #8-21 This is an injection plant for a waterflood in Montana. The pump in the foreground is a quintuplex pump for the injection fluid. These injection plants are normally quite noisy and precautions should be taken to avoid hearing damage.

SLIDE #8-22 Remember the high-tech injection well that was previously shown. This is the injection plant that supplies the water. This is a state-of-the-art injection plant. Stainless steel flow lines are used throughout the plant to avoid any corrosion from the brine. In the background are two 25 horsepower booster pumps. These supply the injection pressure. The water storage tank is located in the background of the photo (blue tank through archway). Note the barrels of chemicals. Chemicals are added to the injection fluid for various reasons (i.e., the prevention of scale buildup).

SLIDE #8-23 This is another example of an injection plant for a large waterflood. Shown is a multistage centrifugal pump powered by a 1750 HP electric motor. The blue panel at the back of the plant is the computer control panel.

SLIDE #8-24 This is a pump for a small injection project. Shown is an electric motor driving a triplex pump. The red cylinder in the foreground is a vibration dampener. A vibration dampener is used to smooth out the pulses of water leaving the triplex pump.

SLIDE #8-25 This is the more common way you will see injection pumps in older fields. This is a triplex pump that injects into a salt water disposal well.

SLIDE #8-26 This is a manifold system for injection. Each line leads to an individual well. The injection rate and volume are monitored at this manifold. Note the adjustable chokes and electronic rate/volume meters.

SECTION 9

FACILITY ACCESS

This section contains material associated with facility access. Particular topics discussed include:

- Statutory Considerations
- Constitutional Considerations
- Case Studies
- Denial of Entry

The Region may wish to have members of Regional counsel present to lead the discussion pertaining to facility access of injection operations.

DISCUSSION We have a memorandum prepared by Mr. Jim Ellerbe, Office of Regional counsel in Region VIII, for use in that Region. The memorandum has been placed in the insert of the handout notebook. Please pull it out at this time.

READ SUBJECT OF MEMORANDUM "This memorandum is to provide you with some of the legal considerations that EPA's inspectors should be aware of in the field. The scope of this memo is limited to inspection procedures in UIC direct implementation States[1], particularly the State of Montana. As such, the goal is to provide general legal advice that applies to the typical inspection situation in that rural State, and not to handle every exception and nuance that may come up in actual inspections...."

READ SECTION 3:8 With this in mind, let's read Section 3:8 on page 3-8 of the UIC Inspection Manual.

DISCUSSION

Upon entry to a facility, the UIC inspector must show his/her credentials. Credentials:

- May include the inspector's signature, physical description, and photograph;
- Mention proprietary issues and/or confidentiality; and
- Should always be carried with the inspector when in the field to perform inspections in the event that the owner/operator of the facility requests them.

Inspector credentials are not typically requested by Class II operators who are usually familiar with UIC inspections. Operators of Class V facilities, however, are more likely to request credentials due to their relative unfamiliarity with the UIC program.

The Notice-of-Inspection (NOI) form (shown earlier) should also be carried to each UIC inspection. The form should be completed even if the operator is not available to sign it. Arrangements can be made to send it to the operator subsequent to the inspection. The back side of the Notice-of-Inspection form contains Section 1445 of the SDWA, which brings us back to the memorandum prepared by Mr. Ellerbe of Region VIII.

READ FROM MEMORANDUM

"The legal considerations that will be discussed fall into two categories: Statutory (Safe Drinking Water Act Section 1445) and Constitutional (Fourth Amendment) Considerations."

STATUTORY CONSIDERATIONS

According to Section 1445 of the SDWA, the following conditions of entry should be followed when possible:

- Present credentials;
- Provide Notice-of-Inspection form; and
- Inspect the facility "at reasonable times" (i.e., business hours).

Exceptions to these conditions may be made when:

- The operator is not present. In such a case, the Notice-of-Inspection form can be left at the facility subsequent to the inspection.
- EPA has reason to believe that a noncompliant operation is occurring; In such cases, EPA can use the two inspector system (i.e. one inspector with the operator, while the other inspector is simultaneously at the injection facility). Circumstances may dictate the most reasonable action to take.

CONSTITUTIONAL CONSIDERATIONS

The Fourth Amendment limits search and seizures based on:

- Expectation of privacy; and
- Probable cause.

CASE STUDIES

Marshal v. Barlow established that:

- The Fourth Amendment covers commercial premises; and that

- Probable cause in the criminal law sense is not required. An inspector can get a warrant on the basis of a general administrative plan for enforcement.

Applicability to UIC inspectors:

- Where the operator has taken steps to ensure "expectation of privacy", the inspector needs:

  - Operator consent; and

  - A warrant.

- The inspector should always attempt to conduct the inspection with the operator's consent.

Air Pollution Variance Board of Colorado vs. Western Alfalfa Corporation allowed warrantless search on the basis of "open field" exception to the Fourth Amendment.

Ways in which warrantless entry might be permissible:

- "Closely regulated business" exception based on the rationale that by engaging in these kinds of businesses, one gives up one's expectation of privacy; and

- "Open fields" doctrine.

Applicability to UIC inspectors:

- Inspections may be performed in the operator's absence, on an unmanned, unsecured injection facility.
- If the operator does not consent to the inspection, the inspector should leave immediately and return with a warrant.

DENIAL OF ENTRY TO THE FACILITY

The facility owner may withdraw his consent to the inspection at any time. The inspection is valid to the extent to which it has progressed **before** consent was withdrawn. Thus, observations by the inspector, including samples and photographs obtained **before** consent was withdrawn, would be admissible in any subsequent enforcement action.

Denial of entry into the facility requires certain procedural steps that should be undertaken by the inspector to ensure that proper legal guidelines are followed.

First, upon arrival at the facility, the inspector should clearly identify himself as an EPA UIC inspector and present the proper credentials and notice of inspection to the facility owner or agent in charge.

The establishment owner may complain about allowing an inspector to enter or otherwise express his displeasure with EPA or the Federal government. However, as long as he allows the inspector to enter, the entry is voluntary and consensual. On the other hand, if the inspector gains entry in a coercive manner (either in a verbal or physical sense), the entry would not be consensual.

If entry is not granted, ask why. Tactfully probe the reason for the denial to see if obstacles (such as misunderstandings) can be resolved. If resolution is beyond the authority of the inspector, he or she may suggest that the facility officials seek advice from their attorneys on clarification of the scope of EPA's inspection authority under the Safe Drinking Water Act.

If entry is still denied, the inspector should leave the premises immediately and telephone the designated Regional Enforcement Attorney as soon as possible for further instructions. The Regional Enforcement Attorney should contact the U.S. Attorney's Office for the district in which the establishment desired to be inspected is located and explain to the appropriate Assistant United States Attorney the need for a warrant to conduct the particular inspection. The Regional Attorney should arrange for the United States Attorney to meet with the inspector as soon as possible. The inspector should bring a copy of the appropriate draft warrant and affidavits.

All observations pertaining to the denial are to be carefully noted in the field notebook. Include facility name and exact address, name and title of person(s) approached, authority of person(s) who refused entry, time of denial, reason for denial, facility appearance, any reasonable suspicions that refusal was based on a desire to cover up regulatory violations, etc. All such information will be important should a warrant be sought.

In the event that a warrant becomes necessary, the inspector should be aware of what information is required to obtain a warrant. There are several general rules for securing warrants. Three documents have to be drafted:

- An application for a warrant;
- An accompanying affidavit; and
- The warrant.

Each document should be captioned with the District Court of jurisdiction, the title of the action, and the title of the particular document.

The application for a warrant should generally identify the statutes and regulations under which the Agency is seeking the warrant, and should clearly identify the site or establishment desired to be inspected (including, if possible, the owner and/or operator of the sire). The application can be a one or two page document if all of the factual background for seeking the warrant is stated in the affidavit, and the application so states. The application should be signed by the U.S. Attorney or by his Assistant U.S. Attorney.

The affidavits in support of the warrant application are crucial documents. Each affidavit should consist of consecutively numbered paragraphs, which describe all of the facts that support warrant issuance. If the warrant is sought in the absence of probable cause, it should recite or incorporate the neutral administrative scheme which is the basis for inspecting the particular establishment. Each affidavit should be signed by someone with personal knowledge of all the facts stated. In cases where entry has been denied, the person would most likely be the inspector who has denied entry. Note that an affidavit is a sworn statement that must either be notarized or personally sworn to before the magistrate or judge.

MAY 17 1989

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION VIII
999 18th STREET - SUITE 500
DENVER, COLORADO 80202-2405

April 12, 1989

Ref: 8RC

MEMORANDUM

TO: Laura Clemmens, Chief
UIC Program and Enforcement Section

Tom Pike, Chief
UIC Implementation Section

FROM: Jim Ellerbe Jim
Office of Regional Counsel

SUBJECT: UIC Inspections

This memorandum is to provide you with some of the legal considerations that EPA's inspectors should be aware of in the field. The scope of this memo is limited to inspection procedures in UIC direct implementation States[1], particularly the State of Montana. As such, the goal is to provide general legal advice that applies to the typical inspection situation in that rural State, and not to handle every exception and nuance that may come up in actual inspections. The legal considerations that will be discussed fall into two categories: Statutory (Safe Drinking Water Act Section 1445) and Constitutional (Fourth Amendment) considerations.

Statutory Considerations

Section 1445 of the Safe Drinking Water Act provides as follows:

> ... the Administrator, or representatives of the Administrator duly designated by him, **upon presenting appropriate credentials and a written notice** to any ... person subject to ... an applicable underground injection control program ... is authorized to enter any establishment, facility, or other property of such ... person in order to determine whether such ... person has acted or is acting in compliance with this title, including for this purpose, inspection, at reasonable times, of records, files, papers, processes, controls, and facilities ....

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[1] Statutory considerations in delegated States vary somewhat; <u>see</u> SDWA Section 1445(b)(2). Constitutional considerations in delegated States are unaffected.

This section is interpreted to allow any inspector who is either (1) an EPA employee, or (2) working for EPA on a contractual basis to come onto an oil and gas lease, approach the wellhead of an injection well, and make any observations necessary to determine UIC compliance. This would include looking at gauges and physically touching the wellhead apparatus (for example, to fit the inspector's gauge onto the wellhead to record current injection pressure) **as long as the inspector's activities on the lease are necessary in order to determine compliance.** The inspector will not be committing a trespass under State common law if he is on private property under the authority of SDWA Section 1445.

Section 1445 imposes two important conditions on the inspector's right of entry. The two conditions are that the inspector (1) present to the operator the inspector's credentials and (2) provide the operator written notice of the inspection. These procedures should be followed, if possible, as a matter of routine just as the inspection begins; if the operator is present, there should be no problem with them. The problem arises, however, when the operator is not present at the time of inspection. In such a case, there is nobody to present the credentials and give the written notice to. This should not stop the inspector from making the inspection, however; it is enough to notify the operator after the inspection has taken place, either by (1) leaving a notice of inspection at the wellhead, or (2) mailing the notice to the operator. Another procedure that is acceptable is to have one EPA employee present the written notice at the operator's office at the same time another EPA employees is inspecting the well[2]. It should be emphasized that the credentials and notice procedures should not be interpreted to preclude surprise inspections or to require the operator's presence on site during the inspection.

A third condition on the inspector's right of entry is that the inspection take place "at reasonable times." Ordinarily this means normal business hours (e.g. Monday through Friday between 8:00 a.m. and 5:00 p.m.), but there is an important exception when EPA has reason to believe that non-compliant operation is occurring during other than normal business hours. In law, as elsewhere, what is "reasonable" depends on the circumstances.

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[2] For further guidance on the written notice condition, the reader is referred to an August 24, 1987 EPA Memorandum from Michael B. Cook to James S. Kutzman entitled "UIC Inspection Notice Requirements."

Constitutional Considerations

The Fourth Amendment to the Constitution reads as follows:

> The right of the people to be secure in their persons, houses, papers, and effects, against unreasonable searches and seizures, shall not be violated, and no Warrants shall issue, but upon probable cause, supported by Oath or affirmation, and particularly describing the place to be searched, and the persons or things to be seized.

The Fourth Amendment is a limit on the search and seizure (arrest) powers of the Government, the purpose of which is to prevent the Government from harassing or intimidating citizens by conducting intrusive searches (or arrests) without good reason. Most Fourth Amendment law has developed in the criminal law context, but the Fourth Amendment affects agencies with civil regulatory programs as well. In general (there are exceptions), the Fourth Amendment prevents the Government from searching areas in which a person has an "expectation of privacy" without a search warrant. To obtain a search warrant, the Government must present to a court some kind of factual basis that would lead one to suspect that a crime has been committed ("probable cause"). The search warrant then allows the Government to conduct a search at a particular time and place.

With respect to Government agencies enforcing civil regulatory programs, such as the UIC program, the leading case is Marshall v. Barlow's[3]. This case involved an OSHA inspector who attempted to enter the nonpublic area of Barlow's commercial premises (an electrical and plumbing business) without a search warrant. For his authority to inspect, the OSHA inspector was relying on Section 8 of the Occupational Safety and Health Act, which allows OSHA inspectors to inspect any facility covered by the Act, and does not mention the need for a search warrant. (The language of OSHA Section 8 is very similar to that of Section 1445 of the Safe Drinking Water Act.) When the case got to the U.S. Supreme Court, the Court held that (1) the Fourth Amendment covers commercial premises as well as private residences, (2) OSHA Section 8 does not allow warrantless inspections; rather, the Fourth Amendment imposes an **independent** requirement for a warrant regardless of OSHA's statutory authority to conduct inspections, and (3) to obtain a warrant, "probable cause" in the criminal law sense is not required. It will be enough for the Government to show that "... a specific business has been chosen for an OSHA search on the basis of a

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[3] For further guidance on the effect of the Barlow's decision, see OECM Guidance #GM-5, "Conduct of Inspections After the Barlow's Decision," April 11, 1979.

general administrative plan for the enforcement of the Act derived from neutral sources." In other words, the Government can get a warrant in this context merely by showing that it is someone's turn to be inspected in a plan that treats everybody in the regulated community equally.

How does Marshall v. Barlow's apply to the UIC inspector? First, if the inspector needs to enter an operator's business offices or other area where the operator has taken steps to ensure an "expectation of privacy" (for example, a manned and fenced injection facility), the inspector will need to have either (1) the operator's consent, or (2) a warrant. SDWA Section 1445 is not enough, by itself, to get the inspector past an operator who does not consent to entry[4]. Second, if the inspector is acting under a neutral inspection plan, the procedure for obtaining a warrant should be straightforward. The major inconvenience is that, in most cases, the inspector should attempt to make the inspection with the operator's consent before going to court for a warrant and returning to the inspection site with the warrant in hand[5].

With respect to UIC inspections in the State of Montana, the inspector is more likely to encounter an unguarded and unmanned injection facility miles from the nearest town than he is to encounter a guarded facility. Typically there is no fence or any other obstacle to complete access to the facility. Absent the operator's consent, does the inspector need a warrant to come onto the lease and inspect? Although there is no caselaw interpreting the Fourth Amendment in the context of searches of rural injection wells, there are persuasive reasons to believe that a warrant is not required in this instance.

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[4] SDWA 1445(c) provides for a civil penalty of up to $25,000 for failure to allow EPA representatives to conduct inspections authorized by SDWA 1445(b). Established case law holds that persons who have exercised their Fourth Amendment rights by refusing to consent to warrantless inspections may not be prosecuted under this kind of provision. In fact, if an inspector obtains consent to inspect by threatening prosecution, there is a serious risk that a court might later find that consent was coerced, the search was unconstitutional, and evidence gained thereby is inadmissible.

[5] In Montana, making two trips to the site with a stop in federal court can obviously be a significant burden. Under certain circumstances, the Government can obtain an "ex parte" warrant before the first attempt to inspect, but the Government must be prepared to show the court why a simple request for the operator's consent is likely to be unproductive.

The key to whether a warrant is required or not is the degree to which the operator has a legitimate "expectation of privacy" in the injection operations/facilities that the inspector wishes to search. As courts use the term, "expectation of privacy" is not something a person either has or he doesn't have; courts recognize the expectation of privacy in varying degrees, and afford persons with a diminished expectation of privacy a diminished degree of protection under the Fourth Amendment.

With respect to public areas and unsecured private property, warrantless searches are permissible under the "open fields" doctrine because here the courts recognize only a diminished expectation of privacy or no such expectation at all. So, for example, in the case of Air Pollution Variance Board of Colorado v. Western Alfalfa Corporation, a State inspector entered the outdoor premises of the company to make a visual opacity test of plumes of smoke emitted from chimneys. He was on the company's property but not in an area from which the public was excluded, and he was observing plumes of smoke, which anyone near the plant could see. The court allowed the warrantless search in this instance because the search was within the "open fields" exception to the warrant requirement of the Fourth Amendment.

The "open fields" doctrine is one way in which a warrantless search of an injection well might be permissible. Another justification for a warrantless search of an injection well might be the "closely regulated business" exception to the Fourth Amendment's warrant requirement. The United States Supreme Court is allowing more and more warrantless searches on the commercial premises of closely regulated businesses (for example, the liquor industry, firearm dealers, stone quarry mining, automobile salvage yards, etc.) on the rationale that by choosing to engage in these businesses and accept a federal license the businessman gives up some of his expectation of privacy. This has never been used in the context of oil and gas regulation or environmental regulation, but the Supreme Court has shown a tendency to find one exception after another to the Fourth Amendment's protections in the last few years.

The bottom line for UIC inspectors is that if an injection facility is unmanned and unsecured, the inspector can go onto the lease without a search warrant. If the operator's employee is there telling the inspector that he doesn't consent to the inspection, the inspector should leave immediately and return with a warrant. The same principle applies to unmanned secure facilities with fences and locks; it's preferable to get a warrant than to jump fences, break locks, etc.

SECTION 10

FIELD SAFETY

This section contains material associated with general field safety. Particular topics discussed include:

- Personal Protective Equipment
- Other General Considerations for Personal Safety
- Drilling and Workover Safety
- Safety During Routine Inspections
- Safety During Mechanical Integrity Testing
- Sampling
- Initial Hazard Assessment
- Levels of Personal Protection
- Decontamination

DISCUSSION

Much of the material presented on inspector field safety may be found in Section 5 of the UIC Inspection Manual.

First of all, we can reduce the potential for accidents through education. The 40-hour Occupational Health and Safety course is a comprehensive safety training program.

How many have taken that training course? NOTE: Get a show of hands.

Those that have taken the OSHA course know that it covers items such as the handling of hazardous wastes, air monitoring and instrumentation, personal protective equipment, principles of decontamination and safety, and site planning and organization.

This discussion will deal in part with some of the subjects covered in that course, which may be useful to UIC inspectors.

A couple basic points need to be made:

- The dangers encountered by UIC inspectors are few.
- Increased awareness is achieved through experience.
- Good safety habits can be developed to reduce on-site risks.

PERSONAL PROTECTIVE EQUIPMENT

The use of personal protective equipment is often a choice.

Hard hats and steel toed boots are a requirement for Class II inspections. Boots should be worn during <u>any</u> inspection. The national standards for each are quoted in the UIC Inspection Manual.

It is easy to disregard these requirements and not wear them unless specifically required by operator. Safety begins with the development of good habits.

READ

Let's read part of Section 5:1 of the UIC Inspection Manual. We'll start at the top of page 5-2 and read the section, entitled "General Protective Equipment."

REFER CLASS TO PAGE 5-3

Eye protection is not typically required during inspections of Class II or Class V facilities.

Brines encountered at production facilities are not apt to cause vision damage except in unlikely situations.

Most Class I operators require eye protection and a hard hat upon entering the facility.

It may be desirable to utilize eye protection while conducting certain Class V activities, most specifically during sampling efforts.

Most Class V inspection situations require very little personal protective equipment.

Class V sampling situations, on the other hand, may require the most personal protection of all inspection situations.

Hazard assessment may necessitate the need for all of the previously mentioned equipment in addition to:

- Gloves;
- Chemical resistant suit; and
- Breathing apparatus.

READ SECTION 5:3

Let's read Section 5:3 of the UIC Inspection Manual. This section may be found on pages 5-4 and 5-5.

OTHER GENERAL CONSIDERATIONS FOR PERSONAL SAFETY

The UIC inspector will encounter different types of hazards depending on the type of inspection being conducted.

SLIDE #10-1 We will look at the hazards involved with the following inspection activities and provide safety tips for each:

- Drilling and workover operations;
- Routine inspections;
- Mechanical integrity testing; and
- Sampling.

We will be reviewing Section 5:6 of the UIC Inspection Manual, starting on page 5-6.

DRILLING AND WORKOVER SAFETY

The inspector's greatest potential for exposure to accidents is during workover operations. Equipment is generally under pressure and heavy tools are used during workover operations. Safety is often sacrificed for the sake of speed.

SLIDE #10-2 The following rules should be applied when involved with workover operations:

- Always park outside guidewires.
- Always wear steel toed shoes/boots and hard hat.
- Evaluate dangers upon arrival. Identify the specific operation and potential hazards.
- Know what's occurring overhead. It is very important to be aware of what is happening overhead. Activity overhead may be the most life threatening of all situations.
- Being attentive at the site is a necessity. Be aware of what others are doing around you.
- Do not smoke.

SLIDE #10-3 AND #10-4

Occasionally, inspectors are asked to witness well construction during drilling operations. Follow the same rules as previously mentioned when approaching the drilling operation:

- Know the hazards;
- Wear hard hat and boots; and
- Do not smoke.

Now, let's look at Section 5:7 on page 5-7.....

SAFETY DURING ROUTINE INSPECTIONS

The following considerations apply to safety during routine inspections.

Be careful about entering enclosed facilities. Accumulation of H_2S, if present in high concentrations, can be lethal. Most facilities are well marked by warning signs. The ventilation of the facility is also an important factor to consider upon entry.

SLIDE #10-5

Casing heads with bull plugs in each port should not be tampered with. This constitutes an automatic inspection alert and should be considered a failure. Any tampering under these circumstances should <u>not</u> be suggested or condoned by the inspectors present.

When performing inspections, "shabby" equipment is often encountered. Gauges and valves may have weakened threads resulting from corrosion. Tampering without absolute isolation is not advised. Faulty valves may not isolate the gauge for safe removal. Treat every valve encountered as if it does not properly contain pressure. A threaded fitting which requires a lot of force to turn may be a tale-tell sign that it is under pressure. Once the connection has been broken, wiggle the fitting in an attempt to bleed pressure off of it.

Exercise caution in opening and closing valves. It is not a good idea to open or close a valve suddenly. Pressure surges could induce failure in old equipment. Inspection reports require the inspector to record tubing/casing annulus pressure. This is often accomplished by opening the casing valve to verify that no pressure exists.

Difficulty in opening a valve may indicate the existence of substantial pressure.

Breaking connections which are difficult to break can result in injury if carelessly handled. Always position a wrench in a position to push down instead of pulling up with the back.

SAFETY DURING MECHANICAL INTEGRITY TESTING

Safety during pressure tests can be accomplished by following a few basic rules:

- Think before you act.
- If there is any uncertainty, communicate with co-workers.
- Make an attempt to be aware of the position and action of co-workers.

People do boneheaded things. The most competent of individuals can make mistakes.

SLIDE #10-6 Chicsem lines are often used on trucks to pressurize.

Never strike any portion of a line that is under pressure. If a leak is detected during a test, bleed pressure back to zero and make the adjustments; then repressurize, following the same procedure for leaking fittings.

One needs to acquire a respect for pressure. A couple of hundred pounds of pressure can be lethal in the wrong circumstance.

As the story goes, an inspector pulled up to an injection well to perform a routine inspection. Arriving with the pumper, he pulled to the side of the well and began organizing his paperwork. In the mean time, the pumper had begun to remove the bull plug from a wellhead with plugs on both ports of the wellhead. One turn with a 24" pipe wrench sent the plug like a projectile around 80 yards into the field. The 24" wrench landed about 10 yards away.

This illustrates a few of the points which we are attempting to make, particularly to be aware of the actions of others and to respect pressure.

The story also illustrates the importance of safe practices with regard to vehicle location. Each location has anchors at four points around the wellhead. Prudent inspectors will practice parking outside of these anchors. Some degree of thought, in any case, should be given to the vehicle location.

SAMPLING (FROM RCRA MANUAL)

Hazardous waste sampling is not a common practice for UIC inspectors; however, exposure to potentially harmful constituents can occur during sampling or inspections of Class I and Class V facilities.

The purpose of the following information is to provide some insight into the manner by which harmful substances may enter the human body.

SLIDE #10-7 The four basic routes of entry include:

- Inhalation;
- Skin absorption;
- Ingestion; and
- Eye contact.

Inhalation - breathing a gas, vapor, mist or dust. This route of entry is the most common accidental form of exposure and is most likely to cause systematic illness. The inhalation hazards depend on a number of factors, such as:

- Chance that the chemical will leak into the air;
- The concentration present;
- The volatility at ambient;
- Length of exposure; and
- Physical properties such as particle size of the mist, fumes, or dust.

The body may be affected in two distinct ways:

- Effects on the lining of the air passages; and
- Absorption from lungs into the blood stream.

The following precautions can be taken. First, the Self-Contained Breathing Apparatus (SCBA) or appropriate respirator should be used. Respirator selection should be based on assessment of the hazard. Secondly, avoid prolonged time periods in poorly ventilated areas.

Skin absorption - Skin exposure can result in skin irritation. Certain chemicals have the capacity to penetrate unbroken skin, and enter the blood stream.

Although no clothing is absolutely impermeable to chemical penetration, certain clothing types provide adequate protection and should be selected based on the assessment of the particular situation.

The following precautions should be taken when inspecting sites which may contain materials which are hazardous by skin contact:

- Assure that all skin areas which may be contacted are protected during site work.
- When taking samples, wipe all the residue off of containers after filling with sample.
- After completing the inspection, use proper procedures for removing contaminated clothing while still on site.
- Gloves, rags, and other disposable items should be bagged for proper disposal.

Ingestion - Toxic amounts of hazardous waste may be carried to the mouth by hand when drinking, eating, or smoking. These activities must never occur during or immediately following inspections until decontamination procedures have been completed. Decontamination procedures will be discussed later in this section.

Eye contact - The eyes can be harmed by chemicals in solid, liquid, or vapor form.

The following precautions should be taken to avoid eye injury:

- Wear safety glasses or face shield.
- Avoid rubbing eyes during inspection or sampling activities.
- Do not wear contact lenses in areas where hazardous materials may be encountered.

INITIAL HAZARD ASSESSMENT

In order to determine whether to enter a potentially hazardous field site and to determine the appropriate level of protection, the nature and extent of the hazard must be assessed. A site-specific health and safety plan should be developed based on the assessment. In developing the health and safety plan, the following steps must be taken:

- Review all evidence of potential contaminants. A check list of potential contaminants may be found on page 15 of "Standard Operating Procedures for Injectate and Sediment Sampling at Class V facilities." This document is located in the Class V Addendum. Material Safety Data Sheets (MSDS) and other information collected during in-depth facility inspections can be used to identify potential contaminants on the list.
- Review all available toxicological information regarding types of hazardous materials handled.

- Choose protective clothing according to the types and levels of waste material handled at the facility, potential for exposure to substances in air, splashes of liquids, and other direct contact.

LEVELS OF PERSONAL PROTECTION

SLIDE #10-8 **Level A** is the highest level of skin and respiratory protection. Level A protection is characterized by:

- Supplied air respirator;
- Totally encapsulated suit;
- Gloves; and
- Boots and boot covers.

SLIDE #10-9 **Level B** provides only the highest respiratory protection level. This level can be used when exposure to unprotected areas of skin is unlikely. Level B protection is characterized by:

- Supplied air respirator; and
- Chemical resistant clothing, such as
  - Splash suit;
  - Gloves (inner and outer);
  - Boot;
  - Boot covers; and
  - Hard hat.

If conditions require Levels A or B, delegate entry to the facility to a trained emergency response team.

The level of respiratory protection can be selected as a function of the percentage of oxygen (19.5%) present in the working atmosphere, threshold limit values (TLV), levels immediately dangerous to life or health (IDLH), and Permissible Exposure Levels.

SLIDE #10-10 **Level C** can be used when respiratory protection can be afforded by air purifying respirators and exposure to unprotected areas of the skin is unlikely. Level C protection is characterized by:

- Air purifying respirator; and
- Chemical resistant clothing, such as
  - Splash suit;
  - Gloves (inner and outer);
  - Boots;
  - Boot covers; and
  - Hard hat.

SLIDE #10-11 **Level D** can be used when no respiratory protection is necessary and there is little or no possibility of contact with the contaminants. Level D protection is characterized by:

- Splash suit;
- Gloves;
- Boots;
- Safety glasses; and
- Hard hat.

DECONTAMINATION

Decontamination is defined as the process of removing or neutralizing contaminants that have accumulated on personnel and/or equipment.

To ensure personal safety, the inspector should verify that a decontamination plan has been developed and set up before any activities are performed, regardless of the simplicity of the site.

SLIDE #10-12 The decontamination plan should:

- Determine the location of decontamination stations;
- Determine the decontamination equipment needed;
- Determine appropriate decontamination methods; and
- Establish methods of disposing of equipment and clothing, if necessary.

Many factors affect the selection of a decontamination method. From a health and safety standpoint, two key questions must be addressed:

- Is the decontamination method effective for the specific substances present?
- Does the method itself pose any health and safety hazards?

Decontamination methods may:

- Be incompatible with the hazardous substances being removed;
- Be incompatible with the clothing or equipment being decontaminated; and
- Pose a direct health hazard.

The chemical and physical compatibility of the decontamination solutions or other decontamination materials must be determined before they are used.

Any method that permeates, degrades, damages or otherwise impairs the safe functioning of the Personal Protective Equipment (PPE) is incompatible and should not be used.

An effective decontamination method is desirable not only for the sake of safety, but serves as a method of quality control for the samples taken.

Quality control measures and decontamination methods will be covered in the sampling presentation which will be given later in the course.

SECTION 11

MECHANICAL INTEGRITY TESTING

This section contains material associated with mechanical integrity testing. Particular topics discussed include:

- Well Construction Types
- Newly Constructed Wells
- Mechanical Integrity Test Methods

DISCUSSION

Mechanical integrity testing can be a simple process if the inspector is aware of all potential problems that can appear during a test. Before an inspector travels to conduct an MIT, they must first prepare for the test.

The inspector will need to be aware of how the well is constructed. The well construction can often dictate the type of testing procedure that is going to be used on the well. Each EPA Region determines the type of MIT which is acceptable for a particular well construction type.

Once the well construction is known and the type of test method is determined, the inspector should prepare himself/herself for any problems that can occur while the test is being conducted.

WELL CONSTRUCTION TYPES

To get started, we will be discussing some of the types of well constructions you may see while in the field and how each well type is tested for mechanical integrity. We will then discuss each test method in more detail.

An injection well should be constructed in a manner that ensures that USDWs are protected.

SLIDE #11-1 Let's first discuss an ideal well construction. The first step involves boring the surface hole to emplace the surface casing. The surface hole is normally drilled through the lowermost USDW and into a shale, or clay confining zone.

SLIDE #11-2 Surface casing is then run into the well and should be cemented to the surface.

SLIDE #11-3 After letting the cement cure, drilling is initiated again to drill to the target depth. In this example, drilling was stopped at the top of the injection zone.

SLIDE #11-4 After reaching the target depth, casing is run into the well and should then be cemented to surface.

SLIDE #11-5 In this example, the well was drilled through the injection zone and underreamed to enlarge the hole size. This could be done for 2 reasons:

- To enlarge the surface area of the hole to minimize problems with the clogging formation; or
- To emplace a gravel pack.

SLIDE #11-6 In this well, a gravel pack and screen assembly were installed.

SLIDE #11-7 Tubing and packer can then be run in the hole for injection purposes.

SLIDE #11-8 This slide illustrates a conventionally completed well which contains casing, tubing, and packer.

As you know, not all wells are completed this way or contain this much cement.

SLIDE #11-9 Many injection wells in this country are completed in unconventional manners. These **unconventional** completion types include:

- Packerless;
- Slimhole;
- Tubingless;
  - Sometimes called "casing injectors"
- Dual; and
- Annular disposal.

SLIDE #11-10 A **packerless completion** contains an injection tubing string in a long string of casing, but does not contain an injection packer. Packerless completions are sometimes implemented for Class I hazardous disposal wells due to the extremely high cost associated with the special packers and/or seal bore assemblies required for these systems. Injection wells with packerless completions often require standard annular pressure tests to initially demonstrate mechanical integrity. Routine monitoring is subsequently required to ensure that mechanical integrity is maintained.

The Ada pressure test, a variation of the standard pressure test, is also used to demonstrate mechanical integrity on packerless wells. The radioactive tracer survey may also be used for mechanical integrity demonstration.

SLIDE #11-11 **Slimhole completions** are commonly referred to as those completions which contain only a small tubular string which is cemented to the surface. Wells constructed in this manner generally pose a more serious threat than conventional completions due to the fact that the only tubular string in the well acts as the injection conduit. The tubing and the primary cement are the only barriers acting to prevent fluid movement into USDWs. The internal mechanical integrity of a slimhole completion can be tested through the use of a retrievable bridge plug. The bridge plug is run into the well and set above the injection perforations. Once set, the bridge plug isolates the tubing string so that it can be pressurized and tested. Upon completion of the pressure test, the bridge plug is retrieved from the well. Radioactive tracer surveys (RTS) are accepted in many States to demonstrate internal mechanical integrity in slimhole completions. The test is considered successful if results show that all injection fluid is exiting the well through the injection perforations.

The Water-in-Annulus test is approved for use as a MI test in certain areas of EPA Regions II and III.

SLIDE #11-12 **Tubingless completions** do not contain an inner tubing string for injection; they inject directly through casing set to or through the injection zone. Tubingless completions may or may not contain surface casing; therefore, the number of USDW protective barriers can very. Injection wells of this construction type can be tested similarly to slimhole completions. A retrievable bridge plug can be run on wireline and set above the perforations. The bridge plug can then be removed after testing. Another method commonly used to test the integrity of tubingless completions entails the temporary use of a work string and packer. The work string and packer are run into the well, the packer is set, and the standard annular pressure test is performed.

The radioactive tracer survey can also be used to demonstrate MI.

The Water-in-Annulus Test is approved for use in specific cases in areas of EPA Regions II and III.

SLIDE #11-13 A **dual completion** is a single well that produces and/or injects from/into two separate formations at the same time. Each zone is segregated by running either: (1) two tubing strings with packers inside the single string of production casing; or (2) one tubing string with a packer run through one zone while the other is produced or injected through the annulus. Wells which dispose of fluids below the production interval are generally tested for mechanical integrity by resetting the packer above the production zone perforations and performing the standard annular pressure test.

A dual completion test is approved by EPA for use on dual completion wells in the States of Montana, Wyoming, Kansas, Nebraska, Michigan, and the Osage Mineral Reserve.

The Ada pressure test and RTS are also used on dual completion wells.

SLIDE #11-14 AND #11-15 **Annular disposal wells** are those wells which inject fluids through any annulus of an injection or production well. Many of these wells inject between the surface casing and the long string casing.

Because the annulus is perforated, it is not possible to use the standard annular pressure test on these wells.

The State of Ohio has developed two procedures for testing annular disposal wells. Both methods are based on the Ada pressure test principle of monitoring fluid levels in the annulus.

NEWLY CONSTRUCTED WELLS

In some cases, inspectors will be asked to verify the construction of new injection wells. This includes being on site while wells are being cased and cemented; therefore, inspectors should be familiar with the cementing practices involved.

READ CHECKLIST

In Section 4:17 of the UIC Inspection Manual (page 4-18) there is a section on witnessing a primary cementing job. Section 4:18 includes a checklist that can be used to verify the cementing job.

SLIDE #11-16

Mechanical Integrity Testing

Mechanical Integrity Testing is covered in Section 4:23, which begins on page 4-23 of the Inspection Manual. Follow along as I read the first paragraph.

READ FIRST PARAGRAPH

SLIDE #11-17 MIT requirements must meet 2 criteria:

- There must be no significant leaks in the casing, tubing, or packer (internal MI); and
- There must be no significant fluid movement into a USDW through vertical channels adjacent to the well bore (external MI).

READ SECTION 4:45 Please follow along as I read Section 4:25 on "Internal Mechanical Integrity."

SLIDE #11-18 There are several things that need to be considered when deciding which mechanical integrity test to use on a given well. They are:

- Type of Completion;
- Depth of Well;
- Injection Interval;
- Inside Diameter of Casing and Tubing;
- Pipe Wall Thickness; and
- Type of Packer.

SLIDE #11-19 **INTERNAL MECHANICAL INTEGRITY TEST METHODS**

There are several tests available for use, in demonstrating internal MI. These tests include:

- Standard Annular Pressure Test;
- Water-in-Annulus Test;
- Annular Pressure Monitoring;
- Injection Rate vs. Injection Pressure Monitoring;
- Dual Completion Test;

- Ada Pressure Test; and
- Radioactive Tracer Survey.

We'll now talk about each test method separately.

Standard Annular Pressure Test

The standard annular pressure test is the most widely used method to determine internal mechanical integrity.

The test requirements vary for each EPA Region and Primacy State. In Regions 4 and 5, the test usually requires that a pressure of 300 psi be held for 30 minutes, with 3% change in pressure allowed.

When conducting the test, it is important to make sure that there is at least a 100 psi differential between the injection tubing pressure and the annulus pressure. This is needed to ensure that the test pressure is greater than the formation pressure at all depths.

SLIDE #11-20 AND #11-21

On page 4-27 of the Inspection Manual, there is an equation which can be used to make sure that the test pressure is greater than the hydrostatic head in the tubing at all depths.

After you determine the pressure required for the test, you need to consider the type of packer in the well.

Next, you need to make sure the annulus is full of fluid. The operator needs to be informed to fill the annulus a day or two ahead to ensure that all the air that got trapped in the fluid has worked its way out. In addition, the fluid will expand as it is heated by the formation.

After you have filled the annulus, you can then pressure it up.

In the field, pressurizing the annulus can be achieved through different methods. The use of a pump truck or hot oiler is common. When this equipment is used, the water used to fill the backside (annulus) is fresh water, and it is pumped through a hose connected to the water tank on the truck. Some trucks are equipped with continuous pressure reading charts, which can then become a permanent record of the test. The advantages of using this equipment are that: (1) the fluid used for the test is non-contaminating; and (2) if a strip chart recording of the pressure is taken, it supports and validates non-witnessed tests. The disadvantages of using a pump truck are that: (1) it is expensive to rent the equipment; and (2) weather conditions prohibit moving the equipment onto a location more often than other pressuring methods. An average truck will rent for around $75/hour, with an 8-hour minimum charge. The size and weight of the equipment make it difficult to move on muddy roads, through snow drifts, across flooded areas, etc.

Another common method of pressurizing the backside is achieved through use of the injection line connected to the tubing. A jumper hose is run from the injection line to the annulus, and the valves are shut-off when the test pressure is reached. The advantages of pressuring with a jumper hose are that: (1) it requires only an inexpensive hose and valves; and (2) the pumper can hook up unassisted, which reduces labor costs to the operator. The possible disadvantages are that: (1) on wells injecting at low pressure, the injection line may not provide sufficient testing pressure; and (2) the fluid used for the test is the injection fluid.

Weather delays are infrequent when pressurizing with a jumper hose. Inspectors have tested wells after wading through hip-deep mud and water, after climbing up steep hills which are inaccessible to equipment, and after riding on three-wheeled all-terrain vehicles to get to locations where the roads have long since been overgrown.

A third method used for pressuring up the backside is through the use of a hand pump. When using the hand pump, the casing is usually filled from the injection line first. The hand pump is connected with a hose to a 5-gallon bucket on one end and the casing valve on the other end. The pump is used to apply pressure to the casing, and then the valve is shut-in for the test. A hand pump is often used on wells in which the injection pressure is too low to achieve testing pressure. This pressurization method may also be used on wells where there is concern regarding the use of injection fluids for the test (e.g., an external fluid source is used).

Look for signs of surface leakage at the wellhead. If there is air in the top of the wellhead, it might leak. The leak may stop when the fluid reaches it.

After pressuring up, allow the well to settle for about 5 minutes. This allows the pressure exerted by the fluid to stabilize. Record the time and pressure at the start of the test. If a well is going to fail the standard annular pressure test, it will generally fail during the first 5 minutes of the test.

SLIDE #11-22 AND #11-23

These two slides illustrate the types of forms the Regions use to record test data.

An example test procedure would include recording the pressure about every 5 minutes during the beginning of the test, then about every 10 minutes thereafter. After 30 minutes, a final pressure reading should be taken. If the well did not lose or gain 3% of the initial test pressure, it passed.

Many times the well will be on the borderline of pass/fail. This requires the inspector to make a judgment call. For instance, if there is a small leak in the casing head (around the tubing), many times the inspector can give the benefit of the doubt and pass the well.

After the test, have the operator bleed the pressurized fluid from the well and into a bucket. Depending on the depth of the packer, the fluid return for a 3,000 ft well should be 2 or 3 gallons. This helps determine approximately how deep the packer is set.

Tests can be run either while the well is injecting or shut-in -- you just need to be sure that there is a pressure differential between the annulus and the tubing.

This series of slides demonstrates the steps involved in conducting a standard annular pressure test.

SLIDE #11-24 When the inspector arrives at the well site, he or she needs to fill out the Notice-of-Inspection form.

SLIDE #11-25 After you have filled out the Notice-of-Inspection form, have the operator read the form, both front and back, and sign the form, acknowledging that he/she knew you were on site conducting the MIT.

SLIDE #11-26 After you have completed that paperwork, have the operator hook the pump truck up to the annulus. It is a good idea to have the hammer union nearest the well tightened with a pipe wrench. Then you can disconnect the pipe after pressurizing the well without hurting your gauge.

SLIDE #11-27 Have the pump truck operator fill the annulus with water slowly until it runs out the other side of the wellhead. Then attach your gauge. This allows for little air to be trapped in the wellhead.

SLIDE #11-28 This slide illustrates the packing around the tubing being tightened. Many times when you first pressurize the well, it will leak around the tubing. This will often seal the leak. Make sure your gauge is not on the well when it is being hammered tight.

SLIDE #11-29 After getting everything tight, install your gauge on the wellhead. Then pressurize the annulus.

SLIDE #11-30 The pressure test usually lasts 30 minutes. Try to take readings every 10 minutes. In this picture, you can see how well someone planned where to drill. The large rock to the right of the well was only part of a much larger buried rock.

SLIDE #11-31 After the test, bleed the fluid back into a 5-gallon bucket. This will help you determine the approximate depth of the packer. Be careful to avoid splashing water on yourself.

SLIDE #11-32 This shows the amount of fluid returned from this well. 5 1/2" casing, 2 7/8" tubing, approximately 2500' deep will give you 2 1/2 to 3 gallons of fluid return.

SLIDE #11-33 After the test, fill in the rest of the MIT form, have the operator sign it, and give the operator his copy of the form.

Water-in-Annulus Test

Another type of internal mechanical integrity test is the Water-in-Annulus test, discussed on page 4-49 of the Inspection Manual.

The Water-in-Annulus test is being conducted with approval (final approval granted 6/12/89) from EPA Headquarters for use in the Bradford area encompassing portions of New York and Pennsylvania. The procedure was originally conceived of and designed to accommodate the well constructions in the Appalachians which precluded the use of long string casing. After a study of the geological formations exposed in the uncased portion of the hole (Dewan, 1979), the test was conditionally approved to be run as follows:

1. Shut-in the well and bleed off the tubing pressure.
2. Fill the annulus to the surface with water.
3. Wait 1 hour.
4. Measure the drop in the fluid level.
5. Resume injection into the well and allow pressure stabilization (usually a few minutes).
6. Re-fill the annulus to the surface with water, as necessary.
7. Wait 1 hour.
8. Measure the drop in the fluid level.

A well is considered to have demonstrated mechanical integrity if the fluid level falls no more than 10 feet during the test, and if the rate of falling is the same during both portions of the test. If a well does not pass, it is classified as an inconclusive test, unless the water level rises during the injection portions of the test (obvious tubing and/or packer leak).

- When conducting the WIA test, you need to make sure that the annulus is filled with water. If the conductor pipe annulus is filled, there is no way to detect a leak.
- Make sure that pressure is bled off for the first part of the test.

Annular Pressure Monitoring

Another type of internal mechanical integrity test used by operators is annular pressure monitoring (APM). APM can be considered a continuous pressure test of the casing/tubing annulus in wells using a pressurized annulus. Not all wells using APM have a pressurized annulus. The practice involves the continuous monitoring of the pressure within the closed tubing/casing annulus of an injection well in an attempt to continuously confirm the well's internal mechanical integrity. Class I hazardous waste injection wells are required to continuously monitor annular pressure. Such monitoring requires very sophisticated (usually computer controlled) indicators, records, control valves, and alarms.

Annular pressure monitoring, when utilized on Class II injection wells, is not as sophisticated at it is when utilized on Class I wells. For Class II wells, the annular pressure is rarely monitored continuously with chart recorders; rather, manual readings of the annular pressure are taken daily, weekly, or monthly. Requirements for Class I wells mandate that a positive pressure differential exist between the annular fluid and injection fluid over the entire length of the tubing. However, annular pressure requirements for Class II wells vary among States. Some States require significant pressure while others have no pressure requirements at all (allow an annular pressure of zero).

- When inspecting wells in a field that use annular pressure monitoring, the annulus pressure needs to be recorded for each well visited.

- The inspector should look for evidence of surface flow.

- Most operators in Michigan and Indiana which use APM do not maintain a pressurized annulus.

Injection Pressure vs. Injection Rate Monitoring

Another type of monitoring allowed for mechanical integrity testing is Injection Pressure vs. Injection Rate (IPIR) Monitoring.

This monitoring method consists of an evaluation of monitoring records showing the absence of significant changes in the relationship between injection pressure and injection flow rate for the following types of Class II enhanced recovery wells:

- Existing wells completed without a packer provided that a pressure test has been performed; and
- Existing wells constructed without long string casing, but with surface casing which terminates at the base of the fresh water.

Injection pressure/injection rate monitoring is based on the fact that, while injecting, the ratio of injection pressure to injection rate remains somewhat constant over short periods of time (months). Any significant variations in either rate or pressure can be interpreted as abnormal, and may indicate a potential failure in mechanical integrity.

The reliability of injection pressure/injection rate monitoring, like the annular pressure monitoring method, depends upon the normal injection pressure fluctuations of the well. If significant fluctuations are common, mechanical integrity failures may not be detected.

- When inspecting wells that use IPIR, it is critical to obtain pressure and rate readings over a period of time.
- Most wells using IPIR monitoring are required to have chart recorders installed on each well. Inspectors should check these chart recorders to look for any discrepancies.

SLIDE #11-34 **Dual Completion Test**

This test is also called the liquid level monitoring test. The wells are completed with two strings of tubing, with a packer run on the long string to isolate the well bore. In these wells, injection occurs through the long string of tubing, while oil is produced through the short string.

The **proposed** MIT consists of monitoring the fluid level open to the production interval to ensure that the level is always below the base of USDWs. Fluid levels would be taken of the producing interval both during operating and static conditions. Fluid levels would then be measured on a regular basis to ensure that the fluid level showed no significant variances. Should a leak occur in the injection tubing, it would be identified immediately through the corresponding rise in the producing fluid level. The major safeguard to this method, though, is that if a tubing leak were to occur in the injection string, then the oil production would "water out" immediately. The operator would notice the drop in oil production and the corresponding rise in water production within 24 hours. During this 24-hour period, the fluid level in the producing interval probably would not approach the base of the USDWs, since the pump would be drawing down the head to some extent.

- When inspecting these wells, inspectors should contact the operator in the field and have him accompany the inspector to shoot fluid levels on the wells.
- The inspector should also look at the production records of wells using this method. This can identify problem wells.
- Pressure tests are required on these wells at each workover.

Ada Pressure Test

The Ada pressure test, or nitrogen test, was developed to provide a means of determining mechanical integrity in wells with open perforations above the packer. Well constructions which might use this testing method include:

- Dual completion wells without a packer above the top perforations; and
- Wells with a cemented annulus.

READ

SLIDE #11-35 Ada Pressure Test Requirements

SLIDE #11-35 Ada Pressure Test Procedures

SLIDE #11-36 Ada Pressure Test Results

Radioactive Tracer Survey

The radioactive tracer survey gained final approval for use in mechanical integrity testing on September 18, 1987.

It is approved for use in determining leaks in tubing and packer, and is approved to determine lack of fluid movement through vertical channels adjacent to the wellbore above the injection zone.

Radioactive tracer surveys will be discussed in the cased hole logging section which will be presented later.

As you can see, there are many things to consider when conducting mechanical integrity tests.

The construction of the well needs to be checked. The well construction dictates the type of test being administered.

Once an inspector knows the type of well construction and the test method to use, he/she can gather the information necessary to prepare for the test. It is to the inspector's advantage to prepare for the test and consider any potential problems that could arise during the testing procedure.

SLIDE #11-38 **EXTERNAL MECHANICAL INTEGRITY TEST METHODS**

Once you have determined the internal mechanical integrity of the casing, tubing, and packer, the external MI must also be determined. The methods available to demonstrate external MI are:

- Cement records;
- Noise log;
- Temperature log;
- Radioactive Tracer Survey (conditional); and
- Oxygen Activation Log (interim approval).

As field inspectors, you will be called upon to witness logging operations performed on injection wells. Well logging will be discussed in a subsequent section.

CASED HOLE LOGGING

SECTION 12

CASED HOLE LOGGING

Presentation of this section will be made through individual discussion of each slide contained within the section. The slides represent a general outline of the subject matter. Discussion should be promoted to encompass any points not covered on the slides.

This section includes discussion of the following subjects:

- Wireline Logging of Injection Wells
- Well Logging Methods and Their Uses

The tests previously discussed satisfy the requirements of Part I of the definition of mechanical integrity (i.e., no leaks in the tubing, casing or packer).

Determination of Part II of MI is achieved through the use of wireline logs.

SLIDE #12-1 **WIRELINE LOGGING OF INJECTION WELLS**

SLIDE #12-2 Injection Well Logging Necessary To:

- Determine lithology (open hole logs)
- Define effective injection interval
- Demonstrate mechanical integrity (MI)
    - Internal (casing, tubing, packer leaks)
    - External (flow behind casing)
    - Most logging witnessed by inspectors conducted for mechanical integrity testing

SLIDE #12-3 Primary Components of a Logging System (Guyod and Shane, 1969):

- Downhole sensor (tool)
- Wireline cable
- Powered winch
- Calibrated sheave
    - Line measurement
    - Weight indicator
- Prime power unit
- Surface control and recording systems

SLIDE #12-4 Mechanical Surface Equipment Required for Logging:

- Wireline truck
- Bottom sheave
- Top sheave
- Mast
- Lubricator (for pressure control)

SLIDE #12-5 Basic Inspector Responsibilities When Witnessing Logging Operation:

- Be familiar with procedure and well before arriving on location
- Ensure that procedure is followed to the extent possible
- Defer all but the most elementary interpretation until back in the office
- Obtain expert opinion when necessary

SLIDE #12-6 **WELL LOGGING METHODS AND THEIR USES**

SLIDE #12-7 MIT Logging Can Determine:

- Presence or absence of casing leaks
- Quality of cement bonding
- Channeling of fluids behind casing
- Rate and direction of fluid flow
- Casing condition
- Tubing integrity

SLIDE #12-8 **Temperature Surveys**

SLIDE #12-9 Temperature Survey Purpose:

- Locate cement tops after primary cementing
- Fluid migration determination
  - Casing shoe behind pipe
  - Tubing, casing, packer leaks
- Flow (volumetric) profiling (rare)
- Identification of intervals producing gas (expanding gas = cooling)

SLIDE #12-10 Temperature Survey Operation Principle:

- Downhole temperature governed by geothermal gradient
- Injection of fluid with large temperature difference
- Zones (or leaks) that take injected fluids will return to natural temperature at a slower rate

SLIDE #12-11 Temperature Survey Procedure:

- Let well stand idle at least 24 hours
- Run base log to determine geothermal gradient
- Ensure injection fluid temperature is significantly different than bottom-hole temperature
- Start injection, and log hole while injecting (optional)
- Shut in after predetermined volume is injected
- Log hole at 0, 1, 2, and 4 hours after shut in

SLIDE #12-12 **Radioactive Tracer Surveys (RTS)**

SLIDE #12-13 Radioactive Tracer Survey Purpose:

- Flow (volumetric) profiling
- Fluid migration determination
  - Casing shoe behind pipe
  - Casing, tubing, packer leaks

SLIDE #12-14 RTS Principle Of Operation:

- Use radioactive iodine (1/2 life = 8 days)
- Eject tracer at surface or downhole
- Follow tracer as it travels downhole
- Use gamma ray tool as detector
- Migration of tracer into other than injection zone is detected through tubing and/or casing

SLIDE #12-15 Factors Affecting Gamma-Ray Measurement:

- Radioactive (hot) formations
- Injection rate
- Ejector/detector configuration
- Pipe scale

SLIDE #12-16 RTS Equipment:

- Radioactive material ejector (surface or downhole)
- 2 or more gamma ray detectors
- Configuration of ejector/detectors varies depending on objective
- Tool diameter as small as 1 1/2 inches
- Recommend with spinner tool

SLIDE #12-17 RTS Procedure:

- Load tracer at surface
- Run in tubing or casing
- Run base log while injecting
- Eject tracer at or near surface
- Follow tracer to injection zone checking for tubing or casing leaks

- Log vicinity of casing shoe and/or packer for potential migration
- Check flow profile with spinner
- Run with casing collar locator

SLIDE #12-18 **Oxygen Activation Log (OA Log)**

SLIDE #12-19 Oxygen Activation Log Purpose:

- To determine the presence of fluid flow behind casing
- Measures:
  - Flow Direction
  - Linear Flow Velocity
  - Volumetric Flow Rate
  - Radial distance of flow from tool

SLIDE #12-20 OA Log Principle of Operation:

- Similar to RTS
- Tracer is created within the flowing water behind the casing
  - Water behind pipe bombarded with energetic neutrons
  - Radioactive nitrogen isotope (1/2 life = 7 seconds) formed when neutrons react with oxygen in water
- Emitted gamma-rays detected by two detectors at different distances

SLIDE #12-21 OA Log Limitations:

- Depth of investigation (about 12 inches)
- Fluid composition - must contain oxygen
- Fluid velocity

SLIDE #12-22 OA Log Equipment:

- Neutron source
- Neutron shield
- 2 gamma ray detectors above source to detect upward migration
- Tool size = 1 3/4-3 5/8 inches x 34-26 feet
- Computer analysis at surface

SLIDE #12-23 OA Log Procedure:

- Run log during normal injection
- Calibrate OA instrument in test barrel at surface
- Run base gamma-ray log
- Log at 10 foot stations (5 minutes at each) starting below perforations (no flow condition)
  - Three 5 minute readings at each station
  - Repeat 10 feet up hole

SLIDE #12-24 **Noise Logs**

SLIDE #12-25 Noise Log Purpose:

- To "hear" fluid flow occurring inside or outside the well tubulars
  - Behind casing channels
  - Tubing and/or casing leaks

SLIDE #12-26 Noise Log Principle of Operation:

- Fluid turbulence (flow) causes noise
- Different kinds of flow create different frequencies of noise
- Noise is measured at different frequency cuts
  - <200 Hz
  - <600 Hz
  - <1000 Hz

    <2000 Hz
- Type of flow discerned by its typical frequency

SLIDE #12-27 Noise Log Equipment:

- Transducer that converts sound to electrical signal
- Depends on metal to metal contact (no centralizers)
- Frequency separating network
- Typical size = 1 3/4 inches x 3 1/2 feet

SLIDE #12-28 Factors Affecting Noise Log:

- Well construction material
- Surface noise (noise log not reliable at <1000 feet)
- Fluid in casing (liquid vs. gas)
- Tool contact with casing

SLIDE #12-29 Noise Log Procedure:

- Pull tubing if necessary
- Run base log while well is shut in (readings at 20-50 foot intervals for 1-2 minutes at each)
- Start injection to initiate flow if necessary
- Run noise log (readings at same points as base logs)
- Ensure tool stops moving at each station
- Readings at 10 foot intervals within zones of interest

SLIDE #12-30 **Cement Bond Logs (CBL)**

SLIDE #12-31 Cement Bond Log Purpose To Infer:

- Quality of cement bond to casing
- Quality of cement bond to formation
- Presence of channel in primary cement
- Top of cement

SLIDE #12-32 CBL Limitations:

- Cannot find leaks
- Cannot determine fluid movement
- Sensitive to microannulus
- Many parameters affect reading and interpretation (fast formations, etc.)
- Logging tools are not standardized

SLIDE #12-33 CBL Principle of Operation:

- Pulsed sound energy (sonic)
- Travels thru casing, cement, and formations at different velocities
- Sound energy from transmitter
- Received by receiver after traveling thru casing, cement, formation

SLIDE #12-34 Diagram showing Tool and Principles of Operation (CBL/VDL)

SLIDE #12-35 Factors Affecting Signal Amplitude (Georhart, 1982):

- Magnitude of original sound pulse
- Internal diameter of casing
- Type of fluid in well
- Thickness of casing wall
- Amount of cement bonded to casing
- Compressive strength of cement
- Fast formations

SLIDE #12-36 CBL Equipment:

- Sonic transmitter
- 1 or 2 receivers
- Transmitter - receiver spacing = 3-7 feet
- Longer spacing for VDL
- Tool size = 1 1/8-3 5/8 inches x 10-22 feet
- Signals received at regular intervals called a gate
- Gate can be fixed or floating depending on interpretation needs

SLIDE #12-37 CBL/VDL Procedure:

- Remove tubing
- Ensure tool is centralized
- Log at different pressures to find microannulus
- Log only in liquid-filled casing
- Run with casing locator and gamma ray

SLIDE #12-38 This slide illustrates a:

- Receiver signal
- Transit time measurement
- Typical cement bond log

SLIDE #12-39 Variable Density Log (VDL)

SLIDE #12-40 **Cement Evaluation Tool (CET)**

SLIDE #12-41 Cement Evaluation Tool Purpose:

- Same as CBL/VDL, only more advanced principle
- Investigate cement radially
- Measure casing diameter, casing roundness, and tool eccentering

SLIDE #12-42 CET Principle of Operation:

- Ultra sonic energy makes casing resonate
- Rate of dampening is measured
- 9 transducers allow radial investigation

SLIDE #12-43 Diagram showing Principle of Operation

SLIDE #12-44 Factors Affecting Measurement:

- Type of fluid in well
- Thickness of casing wall
- Amount of cement bonded to casing
- Compressive strength of cement

SLIDE #12-45 CET Equipment:

- 8 transducers in helical pattern
- 1 transducer measures fluid sound velocity
- Tool size = 3 3/8-4 inches

SLIDE #12-46 Diagram of Tool

SLIDE #12-47 CET Procedure:

- Remove tubing
- Ensure tool is centralized
- Log only in liquid-filled casing
- Run with casing collar locator and gamma ray

SLIDE #12-48 CET Advantages:

- Radial cement evaluation
- Cement channel identification
- Immune to microannulus
- Not affected by fast formations

SLIDE #12-49 Comparison of CBL/VDL and CET Log Presentations

SLIDE #12-45 General Logging Procedures:

- Know planned procedure and well construction/ history prior to arrival on location
- Pre-logging meeting
- In the truck
  - Weight indicator
  - Casing collar locator
  - Depth indicator
  - Logging speeds
- Ask questions!

PLUGGING AND ABANDON.

SECTION 13

PLUGGING AND ABANDONMENT

Presentation of this section will be made through individual discussion of each slide contained within the section. It should be noted that this presentation is a synopsis of the section presented in the handout notebook. This section has been based on the content of the Technical Assistance Document entitled, "Cementing for the Plugging and Abandonment of Injection Wells."

The instructor may find that a review of the cementing guidance would be beneficial prior to presenting the section.

Call the attendees' attention to page 4-57 and Section 4:34 "Plugging and Abandonment" of the handout notebook. NOTE: Additional information in Appendix D, G, and H.

This section includes discussion of the following subjects:

- Basic Considerations
- Plugging Materials
- Cement Plug Placement
- Plugging Job Execution

SLIDE #13-1 Plugging and Abandonment

SLIDE #13-2 Plugging and Abandonment For Environmental Concerns:

- Prohibit movement into or between USDWs
- Unplugged or improperly plugged wellbore is potential migration conduit
- Documented cases of USDW contamination via abandoned wells
- Successful abandonment = one or more cement plugs through selected intervals
- Operational concerns, also

SLIDE #13-3 **BASIC CONSIDERATIONS FOR PLUGGING JOB DESIGN:**

- Geology
- Mechanical condition of well
- Equipment availability and expense

SLIDE #13-4 Define Geology:

- USDWs
- Potential producing zones
- Lost circulation zones

SLIDE #13-5 Ascertain mechanical condition of well:

- Casing integrity
- Cement integrity
- Junk in hole
- Stuck tubing
- Collapsed casing
- Remedial action necessary?

SLIDE #13-6 Equipment Availability and Expense:

- Workover rig
- Access to location
- Fishing tools
- Cutting and milling tools
- Service companies
- Wellbore fluids
- All part of plan

SLIDE #13-7 Halliburton (or similar) Book provides:

- Tubular specifications
- Hole and tubular capacity
- Annular volumes
- Cement slurry volumes
- Cement setting properties
- Invaluable in plugging and abandonment

SLIDE #13-8 **PLUGGING MATERIALS:**

- Wellbore fluid system
- Cement slurry
- Mechanical plugs

SLIDE #13-9 Wellbore fluid system:

- Clean hole
- Static well condition
- Uniform throughout well bore
- Necessary environmental for successful cement plug setting and placement
- Stabilizing material between plugs

SLIDE #13-10 Wellbore Fluid System Properties:

- Sufficient weight
- Ability to remain in place over long period of time
- Chemical and physical stability for unlimited period of time
- Recommended fluid would contain:
  - Water
  - Clay
  - Gel
  - Lost circulation material

SLIDE #13-11 Cement Slurry:

- Compressive strength
- Density
- Setting time
- Additives
- Recommended properties:
  - Sealing to prevent fluid movement
  - Good bonding characteristics
  - Durability
  - Long life

SLIDE #13-12 Cement Mixing Procedures:

- Proper mixing important
  - Proper proportions
  - Predictable properties
- Mixing water from purest available source (potable water recommended, clear water suitable)

- Pretest slurry
- Mixing Methods:
  - Jet
  - Recirculating
  - Batch
  - Bulk

SLIDE #13-13 **CEMENT PLUG PLACEMENT**

SLIDE #13-14 Plug Placement Methods:

- Balance method
- Cement retainer method
- Two-plug method
- Dump bailer method

SLIDE #13-15 Placing Multiple Plugs:

- Most jobs require multiple plugs
- Each plug should set before next plug is placed (8-24 hours)
- Should tag to verify
- Recirculate plugging fluid (well back to static conditions)
- Repeat procedure

SLIDE #13-16 Tools and Materials to Assist in Plug Placement:

- Scratchers
- Centralizers
- Chemical washes
- Spacers to prevent contamination

SLIDE #13-17 **PLUGGING JOB EXECUTION**

SLIDE #13-18 Major Plugging Activities:

- Well preparation:
  - Inspection of well conditions
  - Removal of tubulars and equipment
  - Remedial operations (fishing, milling, cementing, etc.)
  - Establishment of static equilibrium
- Well plugging:
  - Placing mechanical plugs
  - Placing cement plugs
  - Testing of cement plugs

SLIDE #13-19 Inspection of Well Conditions:

- Well records/files
- Size, grade, depths of tubulars
- Primary cementing program
- Condition of cement and tubulars
- Perforations/open hole
- Downhole equipment
- Formation pressure

SLIDE #13-20 Removal of Well Equipment:

- Requires workover rig
- First step
- Tubing almost always removed
- Some packers not retrievable

- Cutting uncemented casing:
  - Jet
  - Chemical
  - Mechanical
  - Explosive
- Pulling casing
- Fishing

SLIDE #13-21 Remedial Operations:

- Well cleanout
- Casing repair
- Plug-back operations

SLIDE #13-22 Establishment of Static Well Conditions:

- Very important
- Prevents cement contamination
- Proper weight (well control)
- Circulate at least one wellbore volume

SLIDE #13-23 Plug Types and Location:

- Mechanical plugs:
  - Just above injection zone
  - Above unretreivable equipment
  - Bridge plugs
  - Sand or cement on top
- Cement plugs:
  - Above lowermost production or injection zone
  - Through each fresh water strata

- Across casing stubs
- At the surface

SLIDE #13-24 Diagram of Well Plugging - Well with Insufficient Casing

SLIDE #13-25 Diagram of Well Plugging - Cased and Cemented Well with Removable Packer

SLIDE #13-26 Diagram of Well Plugging - Partially Cased, Partially Cemented with Non-removable Packer

SLIDE #13-27 Placement and Setting of Cement Plugs:

- Requires careful planning
- Contamination should be avoided
- Most effective if:
  - Static equilibrium established
  - Spacer fluid utilized
  - Surfaces of casing and borehole clean before placement
- Allow adequate time to set

SLIDE #13-28 Testing Cement Plugs:

- No simple method
- Wait on cement (WOC) 8-24 hours
- Tagging
- Testing recommended for:
  - Plugs critical to pressure control or USDW protection
  - Questionable plugs

SLIDE #13-29 Sample Procedure and Calculations:

- See page 5-18 of "Cementing for the Plugging and Abandonment of Injection Wells"

SLIDE #13-30 Guidelines to Ensure Cement Plug Quality (Smith, 1987):

- Circulate hole sufficiently
- Ensure well in static equilibrium
- Place plugs across competent formations for maximum bonding
- Precede cement with flush or spacer
- Use low water ratio cement (API Class A, C, G, or H)
- Minimize contamination
- Carefully calculate cement, water, and displacement volumes
- Place plug with care (move pipe slowly)

CLASS V INSPECTIONS

SECTION 14

INSPECTIONS OF CLASS V INJECTION WELLS

This section contains material associated with Class V inspections. Particular topics discussed include:

- Types of Inspections
- Preparing for Class V Inspections
- Conducting Class V Inspections
- Activities Subsequent to Inspections
- Class V Well Types/Inspection Tips

DISCUSSION

The Class V injection well grouping is large and diverse. This is due to the broad definition of Class V wells. If a well does not fit one of the first four classes of injection wells and meets the definition of an injection well, it is considered a Class V well.

Class V injection wells can be divided into two general types of wells based on construction. "Low-tech" wells:

- Have simple casing designs and wellhead equipment; and
- Inject into shallow formations by gravity flow or low volume pumps.

In contrast, "high-tech" wells typically:

- Have multiple casing strings;
- Have sophisticated wellhead equipment to control and measure pressure and volume of injected fluid; and
- Inject high volumes into deep formations.

Generally, Class V injection is into or above USDWs. Certain special Class V facilities are known to inject fluids below USDWs. Potential for contamination to USDWs varies and is dependent upon where injection occurs relative to USDWs, well construction, design and operation, injectate quality, and injection volumes.

SLIDE #14-1 This is a theoretical view of various sources of contamination and transport of contamination in the subsurface.

SLIDE #14-2 This is a diagram showing the relationship between an injection well and an abandoned well which does not flow to the surface.

SLIDE #14-3 This is a diagram showing the relationship between an injection well and a flowing abandoned well.

According to inventory figures reported in the 1987 Report to Congress, there are approximately 170,000 Class V injection wells in the United States, its territories, and possessions.

It must be emphasized that the reported inventory figures are considered to be very conservative. The inventory collection is an on-going process, and figures are subject to change frequently and dramatically.

SLIDE #14-4 This shows the total number of Class V wells by State (as reported in the Report to Congress, 1987). Note that States reporting the greatest number of wells generally are those States with the most active inventory programs.

SLIDE #14-5 This shows the total number of Class V wells by Region (as reported in the Report to Congress, 1987). Note that Regions reporting the greatest number of wells generally are those Regions with the most active inventory programs.

TYPES OF INSPECTIONS

Several types of injection well inspections can be conducted, depending on the Agency's objectives:

- Enforcement;
- Routine;
- Witness mechanical integrity testing;
- Witness plugging and abandonment;
- Reconnaissance; and
- Assessment-level.

The primary types of inspections conducted at Class V facilities have historically included:

- Reconnaissance-level inspections (basic information gathering);
- Verification-level (verify information given in State or local permit applications);
- Assessment-level (gather information necessary to assess groundwater contamination potential); and
- Enforcement-level (gather information necessary to prove Class IV hazardous waste injection or Class V endangerment).

Reconnaissance-Level Inspections

The simplest type of inspection is the reconnaissance-level inspection. Very few details about the injection operation are recorded at this type of investigation. These inspections are conducted when the purpose is to find out "what's out there."

Verification-Level Inspections

An intermediate level of data are collected at verification-level inspections. This type of investigation is possible when the injection facility is operating under a permit (e.g. State agency permit) and considerable data is on file with the facility permit application. Similar to routine Class II well inspections, the inspector should review the facility permit application information prior to inspecting the facility. The main intent of this type of inspection would then be to verify the previously submitted information and look for compliance with permit specifications.

Assessment and Enforcement-Level Inspections

Both assessment and enforcement-level inspections involve the collection, verification, or generation of extensive information about the Class V facilities being inspected. Assessment-level inspections are conducted when nothing is known about a certain well type or facility, and the impact of the well's or well type's discharges on groundwater quality must be determined. Enforcement-level inspections are conducted when a facility is suspected of injecting hazardous waste (Class IV enforcement) or when a well may present endangerment to USDW (although hazardous waste is not injected). Injectate sampling and analyses may be necessary to determine the impact of such injection practices on groundwater quality. Site investigations at this level, and especially those which include sampling, must be well prepared and coordinated in advance. Sample and safety plans must be prepared, and legal counsel may need to be consulted.

PREPARING FOR CLASS V INSPECTIONS

The inspector should perform numerous activities prior to conducting Class V inspections:

- The inspector should review all 32 Class V injection well types. Wells are classified according to the injectate.

- The inspector should review example facility files to become familiar with the various types of businesses/industries and Class V disposal well systems. It is important to note the types and extent of information collected during actual inspections. The inspector will be expected to write an inspection summary report similar to those included in the files.

- The inspector should review the "Guide for Conducting Inspections of Class V Wells." The inspector will be expected to cover all points included in the list. This document may be found in the pocket of the Class V Addendum.

- Prior to each facility inspection, an inspection file should be prepared. The file should include:

  - Notice-of-Inspection form;

  - Blank Inspection Summary Report form; and

  - Any other information pertinent to the inspection (such as telephone correspondence records, etc.).

- The inspector should purchase necessary maps and film.

CONDUCTING INSPECTIONS

The following lists several tips to assist the inspector in conducting an efficient, thorough inspection:

- Immediately upon entry to a site, the inspector should provide the facility representative with a brief explanation of the UIC program and the Class V program. The inspector should inform the representative that he/she is interested in Class V wells which may be located on site (including waste disposal systems, storm water drainage wells, etc.). The inspector's EPA credentials should be presented and the Notice-of-Inspection form should be signed by the facility representative.

- Each point identified in the document, "Guide for Conducting Inspections of Class V Wells" should be answered or addressed at every facility and recorded in the field notebook. The inspector should request any necessary documentation (i.e., Material Safety Data Sheets, plumbing blueprints, etc.). The "Guidelines and Procedures for Field Book Use" should be reviewed by the inspector.

Both documents are included in the pocket of the Class V Addendum. Please pull them out so we can review them.

- A site map should be obtained or sketched indicating the location of all Class V systems, fluid discharge points, plumbing, etc. Hazardous waste storage areas, waste oil tanks, and any other possible sources of contamination should also be plotted on the site map. The site map may be sketched in the field book for convenience. The most accurate site map will be based upon visual observation by the inspector.

- After obtaining as much verbal information as possible, the inspector should ask the facility representative to direct him/her to the Class V systems and entry points to these systems. The inspector should make note of all drains to the system, potential contaminants, and access points (for sampling). The inspector also should note where hazardous chemicals are stored in order to be certain that no Class V wells are susceptible to drainage and/or spills from chemical storage areas. This information should be sketched on the site map.

- The inspector should photograph all Class V wells, systems, and/or access points, or note why photos were not taken. A description of each photo should be recorded in the field notebook with the film roll number and frame number denoted.

- Upon completion of the inspection, note any requested information to be provided by mail (e.g. MSDS, site blueprints) on the Notice-of-Inspection form. Detach the pink copy and leave it with the facility representative.

- Any time an inspector is unable to conduct an inspection when scheduled (if inspections have been scheduled), the facility must be called as soon as possible for rescheduling, or to confirm that the inspection has been cancelled.

ACTIVITIES SUBSEQUENT TO INSPECTIONS

The following activities should be performed subsequent to inspections:

- The inspector should complete the Inspection Summary Report form <u>immediately</u> following each inspection. All Inspection Summary Report forms should be filled out in ink, neatly printed or typed.

- Field notes should be reviewed for clarity and completeness. For each facility, the inspector should note the number and types of Class V wells in the field notebook.

- All film should be developed, and photos should be labeled, documented, and inserted into appropriate plastic photo holders.

- An inspection summary report (1 to 3 pages) should be written and typed for each facility inspected. Each report summarizes all activities conducted during the inspection; describes the site history, Class V systems identified, and waste disposal practices; describes hydrogeology (as completely as possible using information provided); and makes recommendations regarding follow-up investigations.

- The inspector should review each file to ensure that the following documents are included:

  - Copy of field notes;

  - Completed Inspection Summary Report form;

  - Labeled photos;

  - Signed Notice-of-Inspection form (2 copies);

  - Typed summary report; and

  - Any maps, MSDS, manifests, etc. collected during the inspection.

CLASS V WELL TYPES/INSPECTION TIPS

Agricultural Drainage Wells (5F1)

SLIDE #14-6 Agricultural drainage wells receive irrigation tailwaters, other field drainage, and animal yard, feedlot, or dairy runoff. Most of these wells are used by farmers to provide adequate drainage of surface runoff and subsurface flow so the crop root zone can be well aerated, allowing optimum crop growth.

SLIDE #14-7 This slide illustrates the number of agricultural drainage wells by State (as reported in the 1987 Report to Congress).

SLIDE #14-8 This slide presents a schematic of an agricultural drainage well. Note that this well is injecting direct flow from the surface and flow from the subsurface through a perforated collection drain pipe. The injection zone is fractured limestone with solution channels.

- Well Construction, Operation, and Siting
  - Shallow well completions dominate.
  - Wells may be designed to receive surface and/or subsurface drainage.
  - Large capacity wells drain 80 to 640 acres while small capacity wells drain less than 80 acres. Casing diameters range from 3 to 8 inches for small capacity wells to 9 to 24 inches for large capacity wells.

- Large capacity wells generally have screened or inverted inlets, settling ponds, and surface seals. Small capacity wells may not have these features.

- Agricultural drainage wells inject into or above USDWs.

- Systems are susceptible to corrosion, incrustation, and plugging.

- These wells are usually sited in areas with low soil permeabilities, shallow water tables, and insufficient natural surface drainage.

• Injected Fluids

  - Fluid constituents vary depending upon differing farm practices and soil types.

  - Potential agricultural contaminants include nutrients, pesticides, organics, salts, metals, and pathogens.

SLIDE #14-9 This slide illustrates an agricultural drainage well showing three sources of flow:

• Direct flow from the surface;

• Flow from the surface with minimal infiltration prior to injection; and

• Subsurface flow.

SLIDE #14-10 This is a diagram of a subsurface flow collection system. This system consists of perforated collection pipes which flow to the agricultural drainage well. The drainage well is located centrally.

SLIDE #14-11 This illustrates the surface expression of an agricultural drainage well. Note that a portion of the screen over the injection well inlet is missing. The purpose of this screen is to prevent debris, which may cause clogging, from entering the well.

SLIDE #14-12 This is an agricultural drainage well located in a sump with a concrete cover. Flow from the subsurface is diverted to this well through a perforated-pipe collection system (as previously illustrated).

SLIDE #14-13 This slide illustrates the surface expression of an agricultural drainage well. This well is sited at a low point to allow direct injection of surface flow.

- Well-Type Specific Questions/Inspection Tips
  - Does the agricultural drainage well receive surface and/or subsurface drainage (subsurface drainage is collected by a buried tile field)?
  - How deep are the supply wells, if present?
  - What kind of nutrients and pesticides are used, and what are the application rates?
  - Do surface drainage waters flow over land which could contribute high levels of microbial contaminants (e.g., feed lots, barnyards, dairies, etc.)?
  - Has the drainage well ever been used for direct disposal of wastes (such as pesticide rinsate, etc.)?

- Are septic systems or cesspools used? If yes, continue to ask questions for septic systems and cesspools since effluent from these wells could enter a nearby agricultural drainage well.

- Peculiarities/Potential Problems
  - Finding an inspection contact may be difficult, if not impossible.
  - Getting information from the inspection contact may be difficult. Because these wells are often shallow, owners/operators may not consider them "real wells".
  - These wells are also known as dry wells, pits, sumps, drains, and other local "pet" names.
  - Construction and operation details along with other specific information may not be readily available.

Storm Water Drainage Wells (5D2)

Storm water drainage wells receive storm water runoff from paved areas, including parking lots, streets, residential subdivisions, building roofs, highways, etc.

SLIDE #14-14 This slide illustrates the number of storm water drainage wells by State (as reported in the Report to Congress, 1987).

- Well Construction, Operation, and Siting
  - Wells are usually simply constructed and are relatively shallow.
  - Most wells have large diameter settling basins or other "treatment" devices above or attached to the well bore or casing. Casing may or may not be used; sometimes the well bore is filled with rocks or other filter material.

- Wells are sited in topographically low spots in areas that do not drain well or within facility or property boundaries if ordinances require retention of storm water on site.

- Wells often inject above USDWs and less frequently into USDWs.

• Injected Fluids

  - Fluid may contain herbicides, pesticides, fertilizers, deicing salts, asphaltic sediments, gasoline, grease and oil, tar and residues from roofs and paving, rubber particulates, liquid wastes and industrial solvents, heavy metals, and coliform bacteria.

SLIDE #14-15 This slide illustrates some typical storm water drainage well designs. The next four slides show the detail for each example.

SLIDE #14-16 Construction features of a typical storm water drainage well.

SLIDE #14-17 Construction features of a typical storm water drainage well.

SLIDE #14-18 Construction features of a typical storm water drainage well.

SLIDE #14-19 Construction features of a typical storm water drainage well.

SLIDE #14-20 This slide illustrates pre-cast perforated concrete dry well "rings." Perforations allow seepage of storm water to the subsurface.

SLIDE #14-21 This shows a storm water drainage well accepting flow from a nearby catch basin, which is plumbed to the well through the subsurface.

SLIDE #14-22 This is a storm water drainage well which has been utilized by the public for garbage disposal.

SLIDE #14-23 This is a large-diameter storm water drainage well sited within a municipal storm water retention basin. Surface runoff from city streets is diverted to this basin for injection.

SLIDE #14-24 This is a storm water drainage well located near a municipal water supply well. A well house is shown in the background of this photograph. Construction features of both wells would be of interest in this situation in order to establish the vertical separation distance between the injection well and the production zone of the water supply well. Depth of the annular seal in the supply well would be of interest, since injected fluid from the storm water drainage well may flow horizontally to an open annulus in the water supply well, allowing possible contamination of the water supply.

SLIDE #14-25 This illustrates a storm water drainage well maintenance crew utilizing a vacuum truck to clean a drainage well in a residential area. This must be done when the wells become clogged with silt, which leads to poor infiltration and flooding problems.

- Well-Type Specific Questions/Inspection Tips
  - Are storm water drainage wells utilized?
  - Note location of wells (with respect to sources of contamination such as chemical storage and handling areas), note condition of wells, figure apparent drainage area and land use, measure well depth (or depth to backfill).
  - Is the measured depth equivalent to the total depth of the well, or is the well backfilled with rock or gravel below casing?
  - Look for inflow or outflow pipes and associated settling chambers (catch basins) or wells hooked up in series (overflow); look for evidence of illicit disposal or disposal of materials other than storm water.
  - Have any spills or leaks flowed to the storm water drainage wells?
  - Is there a spill containment/contingency plan? What is done with the debris collected after cleaning/maintaining the wells?
- Peculiarities/Potential Problems
  - Finding an inspection contact may be difficult. Getting information from the inspection contact may also be difficult.

- Shallow wells like these may not be considered "real wells" and are also known as dry wells, pits, sumps, and drains. Construction and operation details and other specific information may not be readily available.

- If you don't already know that this is a storm water drainage well, it may look just like a storm sewer from the surface.

- Look for inflow/outflow pipes and riser pipes (top of injection casing) in the settling chamber under the grate or manhole cover and nearby connected chambers.

- Access to the well may require special grate or lid removal tools; these can usually be obtained from the city maintenance division.

Industrial Drainage Wells (5D4)

Industrial drainage wells include wells located in industrial areas which primarily receive storm water runoff but are susceptible to spills, leaks, or other chemical discharges.

SLIDE #14-26 This illustrates the number of industrial drainage wells by State (as reported in the Report to Congress, 1987).

- Well Construction, Operation, and Siting
  - Similar to storm water drainage well construction

- Injected Fluids
  - Constituents found in 5D4 wells are similar to those which may be found in 5D2 wells.
  - Heavy metals such as lead, iron, and manganese, and organic compounds may be found in industrial drainage wells.

SLIDE #14-27 This is a picture of an industrial drainage well located at a service station.

SLIDE #14-28 This is an industrial drainage well located near a chemical storage area.

SLIDE #14-29 This is an industrial drainage well located in a loading dock adjacent to a storage tank.

SLIDE #14-30 This industrial drainage well is located adjacent to barrels of fuel, oil, and waste chemicals.

- Well-Type Specific Questions/Inspection Tips
  - Same as for 5D2 wells
- Peculiarities/Potential Problems
  - Same as for 5D2 wells

Improved Sinkholes (5D3)

Improved sinkholes receive storm water runoff from developments located in karst topographic areas. These "wells" may also receive other fluids such as sewage and industrial wastes, in which case, these wells should be reclassified to the appropriate well type (such as 5W9 raw sewage waste disposal wells).

SLIDE #14-31 This slide illustrates the number of improved sinkholes by State (as reported in the Report to Congress, 1987).

- Well Construction, Operating, and Siting
  - Sinkholes can be improved in a number of ways, such as placing a pipe or casing down into the sinkhole throat or paving a cement pad to improve drainage or injection.
  - Many sinkholes have a grate or screen at the opening to prevent rapid clogging and must be routinely maintained to prevent total clogging.
  - Concentrated usage of some sinkholes has caused flooding or rapid caving in other sinkholes which are connected by large fracture solution networks to the improved sinkholes.
  - Improved sinkholes inject directly into or above USDWs.
- Injected Fluids
  - Improved sinkholes may receive runoff from paved areas containing lead and petroleum products from automobiles, pesticides from horticulture and lawn care, nitrates from fertilizers, fecal material from wild and domestic animals, and normal fallout from air pollutants.

- These wells may also receive other fluids such as sewage or industrial wastes, in which case, these wells should be reclassified.

- Carbonate aquifers, in which sinkholes occur, provide little, if any, filtration or other means of attenuating contaminants.

SLIDE #14-32 This slide illustrates a sinkhole development near improved sinkholes.

- Well-Type Specific Questions/Inspection Tips

  - What has been done to improve the sinkhole(s) (e.g., put pipe in sinkhole throat, installed grate to restrain debris, etc.)?

  - What fluids are disposed in the sinkhole?

  - Are there any interconnected sinkholes in the area (other sinkholes may back up and flood due to this sinkhole's improvements)?

  - Has there been any rapid development of other sinkholes or further development of this sinkhole since it has been improved?

  - Are any nearby surface water bodies connected to the sinkhole or sinkhole system?

- Peculiarities/Potential Problems

  - The Agency has not defined precisely what constitutes an improved sinkhole. The inspector should be aware of this, but should still maintain keen observation for intentional discharge of fluids into sinkholes. Hopefully, this gray area will be better defined as more site-specific data is gathered and reported.

- The owner or operator may not consider the improved sinkhole to be a well and, thus, without direct questioning, may not provide useful information.

Special Drainage Wells (5G30)

Special drainage wells are used for disposing of water from sources other than direct precipitation. Examples of this well type include landslide control drainage wells; potable water tank overflow drainage wells; swimming pool drainage wells; lake level control drainage wells; and municipal and construction dewatering drainage wells.

- Well Construction, Operation, and Siting
  - Most wells are shallow, injecting into or above shallow USDWs.
  - Construction varies with purpose and siting. Casing and screens are often used.
- Injected Fluids
  - Constituents in injected fluids are highly variable depending on the system design.
  - For landslide control wells, ground water is usually the fluid drained. For swimming pool wells, the fluids may contain lithium hypochlorite, calcium hypochlorite, sodium bicarbonate, chlorine, bromine, iodine, cyanuric acid, aluminum sulfate, algaecides, fungicides, and muriatic acid.

SLIDE #14-33 This is a one example of special drainage wells. These landslide control drainage wells are utilized to lower the water table in order to prevent a landslide on the highway.

SLIDE #14-34 This is another example of special drainage wells. This is a typical swimming pool drainage well in Dade County, Florida.

- Well-Type Specific Questions/Inspection Tips
  - Specific questions are difficult to list due to the variable nature of this well type.
  - During inspections, the inspector must initially determine the use of wells, type and volume of injected fluids, and construction details of wells to correctly subcategorize the well (see examples of well types listed above).
- Peculiarities/Potential Problems
  - The inventory database for these wells is very limited at present and needs to be developed further. Because of this, inspection tips other than routine procedures are limited. The inspector should use common sense and intuition.
  - Use and location of these wells will not generally be obvious or often talked about.
  - Swimming pool owners may not know whether their pool drains to the sewer system or a well.

Geothermal Reinjection Wells

Electric Power Reinjection Wells (5A5)

Electric power reinjection wells reinject spent geothermal fluids which were used to generate electric power.

- Well Construction, Operation, and Siting
  - Wells typically have surface and conductor casing strings cemented in place.
  - Injection zones are usually deep and are geothermal reservoirs or margins of such reservoirs.
  - Wellhead equipment is sophisticated. Designs are location and project specific. Production wells may be converted to injection wells; construction is similar.
  - Wells are maintained regularly. 5A5 wells are monitored constantly or regularly by operators.
  - Wells inject below or into USDWs. Many geothermal reservoirs are USDWs, but may naturally exceed some Drinking Water Regulation standards.
- Injected Fluids
  - At vapor dominated resources, fluids may contain heavy metals (arsenic, boron selenium), sulfates, and dissolved solids.
  - At hot water dominated resources, fluids may contain heavy metals (arsenic, boron, selenium), chlorides, dissolved solids, and have an acidic pH.

SLIDE #14-35 This slide illustrates construction features of a geothermal injection well associated with electrical power generation.

SLIDE #14-36 This is a wellhead of a geothermal reinjection well associated with electrical power generation.

- Well-Type Specific Questions/Inspection Tips
  - What type of electric power generation process is used at this facility (e.g., binary method, dry steam, or dual flash system)?
  - Could a synopsis of the operation be provided, especially with regard to the injection facilities and what changes the geothermal fluids are subject to before injection?
  - Is injection into the same geothermal reservoir as production?
- Peculiarities/Potential Problems
  - Many operators (and State regulatory agencies holding records) will claim confidentiality of information, especially geologic data.
  - Most injection wells are regulated, along with rest of the facility, under State programs or the BLM (federal leases). Regulation and information required by permits will vary from agency to agency (so will cooperation).
  - A considerable amount of data and information should generally be available for 5A5 wells, where they exist.

Direct Heat Reinjection Wells (5A6)

Direct heat reinjection wells reinject geothermal fluids used to provide heat for large buildings or developments; they can be deep or shallow wells.

- Well Construction, Operation, and Siting
  - Same as 5A5 wells

- Injected Fluids

  - Same as 5A5 wells; and

  - Fluids may contain arsenic, boron, fluoride, dissolved solids, sulfates, and chloride.

SLIDE #14-37 This is a wellhead for a typical geothermal reinjection well associated with domestic direct space heating operations.

SLIDE #14-38 This slide shows the construction features for a typical domestic direct space heating reinjection well.

- Well-Type Specific Questions/Inspection Tips

  - Does the direct heat system use downhole or surface heat exchangers?

  - Is the geothermal fluid piped to a central facility or to many buildings/facilities?

  - Is information available on analyses of geothermal fluids, etc?

- Peculiarities/Potential Problems

  - Some direct heat facilities are considered by the State to be utilities.

  - Regulation of these wells varies from State to State and may be dependent on volumes of heat-spent fluid injected.

  - Where these wells are actively regulated (e.g., permitted), a large information database should exist.

Heat Pump/Air Conditioning Return Flow Wells (5A7)

Heat pump/air conditioning return flow wells reinject ground water used to heat or cool a building in a heat pump or air conditioning system.

- Well Construction, Operation, and Siting
  - These wells are generally shallow and are completed in the same aquifer as the production well. Average depth is 200 feet and ranges from 19 to 930 feet according to inventory data.
  - Construction varies across the nation. Casing and cement are often used for surface seals, and sometimes injection tubing is used to prevent aerating injected fluids.
- Injected Fluids
  - Fluids are primarily thermally altered ground water with additives designed to inhibit scaling, corrosion, and incrustation (used when ground water is high in metals and salts, or has a high of low pH).

SLIDE #14-39 This shows the construction features for a typical shallow heat pump/air conditioning return flow well.

SLIDE #14-40 This slide illustrates the construction features for a typical shallow heat pump/air conditioning return flow well.

- Well-Type Specific Questions/Inspection Tips
  - Does the ground-water pump utilize an open-loop system or a closed-loop system? [Note that some heat pump systems are installed with subsurface

closed-loop circulation systems. Injection wells are not utilized with systems such as this, since water is recirculated.]

- Does the system have an injection well for fluid discharge (as opposed to surface discharge or drain tile systems)?

- Are additives used in the system?

- Is injection into the same formation as withdrawal?

• Peculiarities/Potential Problems

  - Closed-loop, earth-coupled heat pumps are not injection wells. The closed-loop exchanger is filled just one time with water or some other fluid which is continuously circulated in the buried vertical loop.

  - Many States may have well construction standards such as requiring surface grouting around both production and injection wells.

  - Water may be injected into a zone other than the supply zone.

Aquaculture Return Flow or Discharge Wells (5A8)

Aquaculture return flow or disposal wells reinject ground water or geothermal fluids used to support aquaculture. Non-geothermal fluids are also included in this category (e.g., marine aquariums in Hawaii use relatively cool ocean water which is injected into wells for disposal).

• Well Construction, Operation, and Siting

  - Most wells are shallow and are of relatively simple design with only surface casing in place. Cement may or may not be used.

- Wells must be maintained regularly to prevent total clogging.

- Lightweight steel or PVC casing is often used and a perforated casing or liner may be used opposite the injection zone.

- Most wells inject into or beyond USDWs along the coast in Hawaii.

• Injected Fluids

  - Aquaculture wastewater in Hawaii is composed of salt or brackish water with added nutrients, bacteriological growth, perished animals, and animal detritus.

  - Effluent may contain nitrates, nitrites, ammonia, high BOD, and orthophosphate.

SLIDE #14-41 This slide illustrates the construction features for a typical aquacultural return flow well.

SLIDE #14-42 This is a aquacultural operation in Hawaii.

• Well-Type Specific Questions/Inspections Tips

  - What is the source of water used in the aquaculture operation?

  - Is the water system a continuous once-through system or is the water recycled several times before disposal?

  - What is the specific disposal method (via injection wells, surface disposal, or sewer system)?

  - Are additives used in the aquarium water and, if so, what is used, how much, etc.?

• Peculiarities/Potential Problems

  - Commercial aquaculture facility owners may be leery of inspectors and may think you are a competitor trying to find out his operational secrets (this has happened before).

- Surface water disposal is much easier than injection because the wastewater can easily clog the injection well and/or formation.

- In the absence of surface water, aquaculture wastewater may be injected to the subsurface or percolated in ponds.

- The only inventoried 5A8 wells are located in Hawaii where the injection zones are extremely permeable.

Domestic Wastewater Disposal Wells

Raw Sewage Waste Disposal Wells (5W9) and Cesspools (5W10)

Raw sewage waste disposal wells receive raw sewage wastes from pumping trucks or other vehicles which collect such wastes from single or multiple sources. Abandoned mines, lava tubes, and/or cavern systems which receive raw sewage, raw sewage wastes, or sludges are included.

Cesspools include multiple-family dwelling, community, or regional cesspools, or other devices that receive wastes and which have an open bottom and sometimes have perforated sides. To be regulated under the Class V program, USEPA has specified that cesspools must serve more than 20 persons per day if receiving solely sanitary wastes.

SLIDE #14-43 This shows the number of untreated sewage waste disposal wells by State (as reported in the Report to Congress, 1987).

SLIDE #14-44 This shows the number of cesspools by State (as reported in the Report to Congress, 1987).

- Well Construction, Operation, and Siting
  - For 5W9 wells, construction may simply include access to a lava tube, cavern, abandoned mine, etc. Wells may be covered by a manhole cover.
  - For 5W10 wells, precast concrete rings or cesspool blocks are often used. Wells are typically very shallow. Wells may require periodic maintenance.
  - These wells inject above or directly into USDWs.
- Injected Fluids
  - Raw sewage wastes are generally poor quality and include high fixed volatiles, BOD, COD, TOC, nitrogen (organic and ammonia), chloride, alkalinity, and oil and grease.
  - Pathogens are a major health concern in raw sewage wastes.

SLIDE #14-45 This slide presents a sectional view of a cesspool.

- Well Types Specific Questions/Inspection Tips
  - See Septic Systems
- Peculiarities/Potential Problems
  - See Septic Systems

Septic Systems (5W11, 5W31, 5W32)

Septic systems - undifferentiated disposal methods (5W11) inject the waste or effluent from a multiple-family dwelling, business establishment, community, or regional establishment septic tank via an undetermined disposal method. To be regulated under the Class V program, these wells must serve more than 20 person per day if they receive solely sanitary wastes.

Septic systems - well disposal method (5W31) inject the waste or effluent from a multiple-family dwelling, business establishment, community, or regional establishment septic tank through a well. Examples of wells include actual wells, seepage pits, cavitettes, etc. To be regulated under the Class V program, these wells must serve more than 20 persons per day if they receive solely sanitary wastes.

Septic systems - drainfield disposal method (5W32) inject the waste or effluent from a multiple-family dwelling, business establishment, community, or regional establishment septic tank into a drainfield. Examples of drainfields include drain or tile lines and trenches. To be regulated under the Class V program, these wells must serve more than 20 persons per day if they receive solely sanitary wastes.

SLIDE #14-46 This slide illustrates the number of undifferentiated septic systems (5W11) by State (as reported in the Report to Congress, 1987).

SLIDE #14-47 This slide shows the number of septic systems with wells (5W31) by State (as reported in the Report to Congress, 1987).

SLIDE #14-48 This illustrates the number of septic systems with drainfields (5W32) by State (as reported in the Report to Congress, 1987).

- Well Construction, Operation, and Siting
  - Septic tanks consist of a baffled tank specially designed for primary treatment of sewage wastewater.
  - Septic tanks may discharge to a variety of subsurface disposal devices such as simple dry or drainage wells, cesspools, or seepage pits.
  - These types of wells are often crude, not having casing or surface seals.
  - Septic tanks may also discharge to tile or leach lines, commonly referred to as drainfields, or to trenches.
  - These wells inject above or directly into USDWs.
  - Periodic maintenance is required for properly designed systems. Improperly designed systems often fail and discharge wastes to the surface.
- Injected Fluids
  - Fluids vary with the type of system used.
  - Typical septic tank effluent contains 99.9 percent water (by weight) and .03 percent suspended solids (including nitrates, chlorides, sulfates, sodium, calcium, and fecal coliform and other pathogens).

SLIDE #14-49 This is a cross-sectional view of a conventional septic tank.

SLIDE #14-50 This is a cross-sectional view of a seepage pit associated with a septic tank (5W31).

SLIDE #14-51 This is a cross-sectional view of a drainfield associated with a septic tank (5W32).

SLIDE #14-52 Drainfields may be constructed in absorption mounds when natural conditions do not allow for adequate drainage or treatment.

- Well-Type Specific Questions/Inspection Tips
  - How are sewage wastes disposed? [If a septic system is used, ascertain what kind of disposal system is used (e.g., drainfield, cavitette, etc.).]
  - Is the septic tank or cesspool pumped out periodically?
  - Who pumps out the facility, and where do the pumped wastes go?
  - Are any chemicals used to "treat" the septic system?
  - Does the system receive any wastes other than sanitary wastes? [Find out all sources of waste, e.g., lab drains, floor drains, toilets, etc.]
  - Have there been any problems with the system?
  - What is the capacity of the system?
- Peculiarities/Potential Problems
  - Many owners may not have a clue as to what kind of sewage disposal system they have, and any records may have "disappeared."

- Sewage waste disposal wells may receive wastes other than sanitary wastes, especially at industrial or commercial facilities. Owner/operators may be hesitant to tell you about this or may even lie about it (this has happened).

- Access to the wells may be difficult or impossible without exhuming the systems.

- Sampling to detect wastes other than sanitary wastes may be difficult because of construction features.

- If cesspools or septic systems are exhumed for sampling, dangerous levels of gases such as methane or hydrogen sulfide may be present.

Sewage Treatment Plant Effluent Disposal Wells (5W12)

Domestic wastewater (sewage) treatment plant effluent disposal wells dispose of treated sewage or domestic effluent from various types of plants, ranging from small package plants to large municipal sewage treatment plants. Treatment is usually of secondary quality and sometimes is capable of producing highly treated tertiary effluent.

SLIDE #14-53 This slide illustrates the number of domestic wastewater treatment plant effluent disposal wells by State (as reported in the Report to Congress, 1987).

- Well Construction, Operation, and Siting

  - These wells are specially designed and sited to meet the hydrogeologic and operational considerations.

- Most wells have multiple casings cemented in place.

- Injection fluids or ground water are often monitored.

- Most wells inject directly into USDWs although some inject above them.

• Injected Fluids

  - The injected fluids, after secondary or tertiary treatment, are believed to be generally compatible with receiving formation waters; however, the fluids may contain high nitrates and pathogenic contaminants if improperly treated.

SLIDE #14-54 This is a construction diagram of a wastewater treatment plant disposal well and associated monitoring well.

SLIDE #14-55 This is a diagram of a wastewater, treatment, and disposal facility in Teton County, Wyoming.

SLIDE #14-56 This is a wastewater treatment plant in Hawaii.

SLIDE #14-57 This injection well accepts effluent from a wastewater treatment plant in Hawaii.

• Well-Type Specific Questions/Inspection Tips

  - Please describe the plant's treatment process and operation. [Try to get a tour of the plant as the contact describes the processes.]

  - What level of treatment is provided and does the plant consistently achieve this treatment level?

  - Are effluent analyses available?

  - Have any problems occurred injecting this volume?

- Peculiarities/Potential Problems

  - Sewage treatment plant (STP) effluent disposal wells may serve a secondary purpose of recharging depleted aquifers or acting as a hydraulic barrier to salt water intrusion. In some cases, disposal may be the secondary purpose and recharge may be the primary purpose.

  - Sewage treatment plants generally experience periods where treatment processes are not adequate to treat wastes as designed.

  - Many such injection facilities may hold monitoring data on the injectate and possibly on the groundwater quality; these data should be obtained if possible.

  - Some STP disposal wells need periodic maintenance (e.g., acidizing wells). Maintenance records and descriptions should be noted.

Mineral and Fossil Fuel Recovery Related Wells

Mining, Sand, or Other Backfill Wells (5X13)

Mining, sand, or other backfill wells are used to inject a mixture of fluid and sand, mill tailings, and other solids into mined-out portions of subsurface mines including radioactive mining wastes. Also included are special wells used to control mine fires and acid mine drainage wells.

- Well Construction, Operation, and Siting

  - Backfill wells are usually simply constructed.

  - Conductor casing may or may not be used; cement is sometimes used to seat the casing firmly in the well bore.

- Sometimes abandoned mine shafts are used as injection wells. By definition, backfill wells are sited in mined-out areas. Wells may be used for only a few days at some sites if the void space is entirely filled. Other wells may be used for several months.

- These wells often inject into or above USDWs, though at some sites, injection may be below or beyond USDWs.

- Injected Fluids

  - Fluids are injected as either hydraulic or pneumatic slurries.

  - The solid portion of the slurries may be sand, gravel, cement, mill tailings or refuse, or fly ash.

  - Slurry waters may be acid mine water or ore extraction process wastewater.

SLIDE #14-58 This illustrates the construction features of typical mine backfill well.

SLIDE #14-59 This presents scenarios for potential groundwater contamination resulting from mine backfill injection wells.

- Well-Type Specific Questions/Inspection Tips

  - What is the composition of materials injected? How are the wells plugged and abandoned?

  - Does the State mining, minerals, or energy department permit the wells, perhaps as part of an overall mining project permit? [Obtain permit application data, or note type of information and where it is available for review.]

- Peculiarities/Potential Problems

  - Some backfill wells have a very short lifetime (2 to 3 days).

  - Backfill wells can be used for subsidence control, mining waste disposal, acid mine drainage, and mine fire control.

Solution Mining Wells (5X14)

Solution mining wells are used for in-situ solution mining in conventional mines, such as stopes leaching (these wells are non-Class III wells).

- Well Construction, Operation, and Siting

  - Plastic piping is used for casing in most cases, although light-weight steel casing is sometimes used.

  - Diameters range from 2 to 8 inches and injection well depths range from about 200 feet to more than 1,000 feet, depending on the depth of the ore body.

  - The annular space is generally cemented from depth to surface.

  - Injection is by gravity flow.

  - Siting is project specific, but is primarily situated to enhance mineral recovery.

  - Injection is usually in areas where USDW occurrence is rare or USDWs are of poor quality.

- Injected Fluids

  - Injected fluids are typically weak acid solutions (sulfuric and hydrochloric), ammonium carbonate, sodium carbonate/bicarbonate, or ferric cyanide.

SLIDE #14-60 This illustrates the construction features of a proposed large-diameter, high-volume solution mining injection well. Note annular cement to total depth of the borehole.

SLIDE #14-61 This is a block diagram of solution-mining operations illustrating application and collection of leaching fluid.

SLIDE #14-62 This is a conventionally-mined area in Arizona, now being solution mined for copper.

- Well-Type Specific Questions/Inspection Tips
  - What minerals are being produced and what is the lixiviant used in the mining process?
  - What zones are being mined? How many wells are used to inject lixiviant?
  - Are analyses of injected fluid available?
  - What percent of fluids are recovered (e.g., 90%)?
  - Are there any aquifers in the mining vicinity, and is there a groundwater monitoring network? If so, are analyses available?
- Peculiarities/Potential Problems
  - Solution mining operations may use both Class III and V injection wells. Class V wells are those used in previously mined areas (by conventional methods) or pilot-scale experimental projects.
  - Solution mining operations typically use many hundreds of injection wells. Often, these operations will recover over 100% of fluids injected, which indicates the mine is acting as a groundwater sump.

- Operators generally know exactly what they are injecting (part of the process) and will reuse the lixiviant until it is totally spent.

- Lixiviant chemistry will vary with the mineral product to be mined, but is typically a very acidic or basic solution.

In-Situ Fossil Fuel Recovery Wells (5X15)

In-situ fossil fuel recovery wells are used for in-situ recovery of coal, lignite, oil shale, or tar sands.

- Well Construction, Operation, and Siting

  - In-situ fossil fuel recovery related wells are specially designed to withstand high variations in temperature and pressure.

  - In addition to high temperatures and possible melting, the well materials (casing, cement, wellhead and surface valves) are subjected to sulfidation and oxidation from combustion, thermal expansion and contraction forces, and cement shrinking and parting due to overburden drying or volatilization. Subsidence is also likely.

  - Carbon or high strength stainless steel is used for casing.

  - Injection may be above, into, or below USDWs.

- Injected Fluids

  - For underground coal gasification, air, oxygen, steam, water, or igniting agents such as ammonium nitrate fuel oil may be injected.

  - For in-situ oil shale retorts, injected fluids include air, oxygen, steam, water, sand, explosives, or igniting agents (generally propane).

- The purpose in both cases is to initiate and maintain combustion.

- Combustion products include polynuclear aromatics, cyanides, nitrites, and phenols.

SLIDE #14-63 This is a cross sectional view of an in-situ coal gasification process utilizing an injection well (right) and a production well (left).

- Well-Type Specific Questions/Inspection Tips

  - What energy-related product is the operation producing, and by what method is it produced? [If the operation is confidential or patent-pending status, ask for at least a brief overview. Items to note are: 1) what is produced; 2) what is injected; 3) how many wells over what three-dimensional area are used; 4) what is left in the burn zone; 5) whether the project has a ground-water monitoring network in place; 6) whether the project (as a whole) is permitted or regulated by some federal or state agency; and 7) what was required for a permit application (should review permit material).]

- Peculiarities/Potential Problems

  - Very few, if any, of these types of projects are currently operating, due to the economic situation.

  - Other federal agencies, such as the Department of Energy (DOE) or Bureau of Land Management (BLM) may be more involved in regulating projects such as these; however, these agencies probably are regulating the entire project and not just the injection well part of the project.

Spent Brine Return Flow Wells (5X16)

Spent brine return flow wells are used to reinject spent brine into the same formation from which it was withdrawn after extraction of halogens or their salts.

- Well Construction, Operation, and Siting
  - These wells are constructed and operated like Class II salt water disposal wells.
  - Siting is dependent upon location of the halogen deposit.
  - Injection is below USDWs and is typically greater than 5,000 feet below land surface.
  - Mechanical integrity tests used for Class II wells would be appropriate for spent brine return flow wells.
- Injected Fluid
  - Injected fluids are limited to brines from which halogens or their salts have been extracted.
  - There is a potential for illicit addition of other undefined constituents into the waste stream.

SLIDE #14-64 This slide illustrates the construction features of a spent brine return flow well.

- Well-Type Specific Questions/Inspection Tips
  - Which halogens or salts are being extracted?
  - Is injection into the same horizon from which production is occurring? [Examine production volumes and injection volumes. Be wary of high injection volumes which would indicate other fluids (e.g., process wastewater) may be injected in the spent brine stream.]

- Peculiarities/Potential Problems

  - These wells are very similar in construction and operation to Class II wells and most are permitted by State agencies.

  - Some States regulate 5X16 wells as either Class I, II, or III wells and require permits for operation. In such a case, permit application records should be reviewed before inspection, and the inspection should be verification or routine level.

  - Some Arkansas 5X16 operators have been discovered to dispose of other process wastewater along with the spent-brine, a practice which, according to USEPA HQ, is illegal.

  - Casing, tubing, and other construction features are susceptible to corrosion from the brines disposed.

Oil Field Production Waste Disposal Wells

Air Scrubber (5X17) and Water Softener (5X18) Waste Disposal Wells

Air scrubber waste disposal wells inject wastes from air scrubbers used to remove sulfur from crude oil which is burned in steam generation for thermal oil recovery projects. If injection is used directly for enhanced recovery and not just for disposal, it is a Class II well.

Water softener regeneration brine disposal wells inject regeneration wastes from water softeners which are used to improve the quality of brines used for enhanced oil recovery. If injection is used directly for enhanced recovery and not just disposal, it is a Class II well. All air scrubber waste disposal wells and water softener regeneration brine disposal wells inventoried to date are Class II wells.

- Well Construction, Operation, and Siting
  - All wells in California are located within or adjacent to currently active oil fields.
  - Some wells were drilled solely for injection purposes, but must have been converted from poor or marginal production wells to injectors. As such, construction designs are consistent with standard oil production or Class II injection well design.
  - Injection is almost always into an oil producing zone although some facilities inject into non-oil bearing USDWs.
- Injected Fluids
  - For air scrubber wastes, injected fluids may have high TDS, nitrates, sulfates, and chlorides. These scrubber wastes are commingled with excess produced water and water softener regeneration brine wastes.
  - For water softener wastes, injected fluids may have high TDS, calcium, and chlorides, and often have high nitrates. These wastes may be commingled with excess produced water.

SLIDE #14-65 This slide shows the construction features of an air scrubber waste disposal well.

SLIDE #14-66 This slide depicts the construction features for a water softener regeneration brine disposal well.

- Well-Type Specific Questions/Inspection Tips

  - For air scrubber wells, what are the approximate relative percentages of scrubber liquor, regeneration brine, and produced water that are commingled for injection?

  - Are injectate analyses available?

  - Similarly, for regeneration brine disposal wells, what are the approximate relative percentages of regeneration brine and produced water?

  - Is cogeneration a part of the overall operation? If so, what processes are involved? (This is important primarily for inventory purposes.)

  - Is the system fired by crude oil or natural gas? (This will aid in determining air scrubber waste constituent types and concentrations.)

  - Is the injection zone hydrocarbon productive? (This may be important for future aquifer exemptions.) What is the cation exchange medium used in the water softener, and how often is it replaced?

  - Is there a plot available showing origins and holding facilities for all wastes that are commingled prior to injection?

- Peculiarities/Potential Problems

  - Waste streams will be commingled either at the wellhead or at a central storage facility. This is important to note if waste stream sampling is anticipated. If wastes are commingled at a central holding tank, sampling can be conducted under low pressure conditions. However, if commingling occurs at the wellhead, accurate characterization of the waste stream will require sampling at the wellhead. This may involve the use of high pressure wellhead sampling equipment.

- One strategy behind injection of these wastes may be for enhanced oil recovery purposes, which would make such injection Class II.

- It is important to identify the operator's intentions so that differentiation between Class II and V disposal practices can be made.

Industrial, Commercial, and Utility Disposal Wells

Cooling Water Return Flow Wells (5A19)

Cooling water return flow wells are used to inject water which was used in a cooling process, including open-loop, closed-loop, and contact systems. These wells are classified separately from heat pump or air conditioning return flow systems.

- Well Construction, Operation, and Siting

  - Well construction varies greatly throughout the nation.

  - Most wells are relatively shallow, often less than 600 feet deep.

  - Wells may be cased to depth, cased at the surface, or open hole for the entire depth.

  - Wells are often completed in the source aquifer, and injection is usually into or above USDWs.

  - Cooling water systems are often closed, meaning the ground water used in cooling does not become exposed to the air at any point between withdrawal and reinjection.

- Open systems expose ground water to the air at some point before injection.

- Contact systems run ground water used for cooling directly over the product to cool it.

• Injected Fluids

  - Injectate quality is dependent upon the type of system, type of additives, and temperature of water.

  - Open pipe and contact systems may expose ground water to accidental introduction of surface contaminants or unauthorized disposal of wastes.

SLIDE #14-67 This illustrates the proper concentration of annular space in the cooling water return flow well. Note that the well construction allows injection into the deeper aquifer (often utilized for water production) while preventing migration of water from the shallow contaminated aquifer.

• Well-Type Specific Questions/Inspection Tips

  - What products are manufactured at this facility?

  - What processes are employed to make the products?

  - What wastes are generated from each process? How are wastes disposed?

  - Which processes require the use of cooling water?

  - Are any of the waste streams commingled with the spent cooling water?

  - What type of cooling water system is used (e.g., contact, open-loop, or closed-loop)?

  - What is the source of supply water?

- Are any chemical additives used?

- Is there a scale problem and, if so, how is it removed? [Inspect the entire cooling system and return flow well(s). Look for any pipes which do not originate from the cooling system but lead to the circulation system or return flow well, and ask for the source of each pipe. Ask to see all waste handling/storage areas.]

- Does the facility have a spill containment/ contingency plan?.

• Peculiarities/Potential Problems

  - Wastes other than spent cooling water may be injected along with cooling water.

  - If a contact system or open-loop system is used, there is a possibility that contaminants may enter the spent cooling water.

  - The type of system and its integrity should be checked during inspection.

  - Water may be injected into a zone other than the supply zone.

Industrial Process Water and Waste Disposal Wells (5W20)

Industrial process water and waste disposal wells are used to dispose of a wide variety of wastes and wastewaters from industrial, commercial, or utility processes. Industries include refineries, chemical plants, smelters, pharmaceutical plants, laundromats and dry cleaners, tanneries, laboratories, electric power generation plants, car washes, and electroplating industries.

SLIDE #14-68 This slide illustrates the number of industrial process waste disposal wells by State (as reported in the Report to Congress, 1987).

- Well Construction, Operation, and Siting
  - Well construction varies greatly, ranging from simple dry wells with no casing and rock filled well bores to sophisticated relatively deep wells with multiple strings of casing cemented in place.
  - Wells are usually sited on facility property and injection is into or above USDWs.
  - Some periodic maintenance is required for most wells.
  - Some industrial wells have operators which control injection operations.
- Injected Fluids
  - Potentially, any waste fluid produced by various industries, utilities, and commercial ventures can be injected by Class V industrial disposal wells.
  - Fluids may have high total dissolved solids, alkalinity, chloride, phosphate, sulfate, and may include spent solvents or other organic compounds.

SLIDE #14-69 This is a homemade treatment system (solids removal) discharging to a floor drain. This floor drain discharges to a 300 by 600-foot drainfield.

SLIDE #14-70 This is a floor drain located in a paint mixing area. This floor drain discharges to a 300 by 600 foot drainfield.

SLIDE #14-71 This industrial waste disposal well accepts several sources of effluent from discharge piping.

- Well-Type Specific Questions/Inspection Tips

  - What products are made or what services are provided? What processes are employed to make the products?

  - What wastes are generated from each process? How are these wastes disposed?

  - May I see the waste storage/handling areas?

  - Is there a spill containment/ contingency plan?

  - Are there any floor drains in the process areas or waste handling/storage areas?

  - Are any wastes, other than sanitary wastes, discharged into the sewage disposal system (e.g. lab chemicals, etc.)?

  - Are any wastes discharged into, or could any waste potentially enter, storm water runoff drainage wells?

  - Is equipment (such as trucks, heavy machinery, etc.) washed at the facility? If so, what types of cleaners are used, and how is the rinsate disposed?

  - Are any storm water drainage wells susceptible to injection of rinsate?

  - Is there an aquifer remediation project on site? If so, does it utilize injection/ recharge wells as part of the system?

  - Is a cooling water system used? If so, is the spent cooling water injected?

  - Is there a groundwater or vadose zone monitoring system on site? If so, is any monitoring data available?

- Is any waste discharged to pits, wells, or leach lines?

- Are any injectate analyses available?

• Peculiarities/Potential Problems

  - Many owner/operators will be hesitant to provide such information on their waste disposal wells.

  - Many industries mix their waste streams.

  - Many industries use dual purpose wells (e.g., sewage waste disposal or storm water runoff wells).

  - Some of these wells may actually be Class IV hazardous waste disposal wells. Appropriate sampling and analysis is required to determine if Class IV waste disposal is practiced.

  - Keen observation is warranted at all industrial site inspections. This is especially important for facilities where the inspection contact is hesitant to provide information.

Motor Vehicle Service Station Waste Disposal Wells (5X28)

Motor vehicle service station waste disposal wells receive wastes from repair bay drains and floor drains at gasoline stations, garages, automobile dealers, motorpool divisions, car washes, etc.

SLIDE #14-72 This shows the number of motor vehicle waste disposal wells by State (as reported in the Report to Congress, 1987).

• Well Construction, Operation, and Siting

  - Wells are usually constructed very simply and may be similar to cesspools or dry/drainage wells.

- Wells are usually very shallow and injection is above or into USDWs.

- Specific construction features will vary from site to site.

- Some pretreatment may be provided by oil-water separators, catch basins, or grease traps if installed and maintained properly.

- Wells are sited on facility property.

• Injected Fluids

  - Injected fluids can contain waste oil, antifreeze, floor washings (including detergents, organic and inorganic sediment), and other petroleum products.

  - Waste oils may contain heavy metals such as lead, chromium, and cadmium.

SLIDE #14-73 This is a catch basin detail for a facility in New York. This catch basin discharges to a dry well. Note that the inlet drain pipe for this particular catch basin is designed in a manner which does not allow separation of the floating phase. As a result, oil is discharged to the injection well. (Many catch basins have an inverted pipe which penetrates the oil layer, allowing injection of the aqueous phase below.)

SLIDE #14-74 This slide illustrates the detail of a disposal well at a service station in New York. Note the inlet drain pipe from the catch basin (illustrated in the previous slide).

SLIDE #14-75 This is a photograph of a motor vehicle waste disposal well at a service station. Note the floating, oily scum within the well.

- Well-Type Specific Questions/Inspection Tips

  - Does the facility have a recycling/reuse or waste management system in place? If so, please describe.

  - How are the repair bay wastes managed or disposed?

  - Is an oil/water separator, or other grease trap device used to remove oils before disposal of wastes into the injection well?

  - What type of injection well is used (e.g., dry well, septic system, cesspool, drainage well, etc.)?

  - Are there any plumbing plans for the disposal system? If so, obtain the plans.

  - Does the facility have a car wash? If so, how is the car wash effluent disposed and what cleaners are used? Is the station area hosed down? If so, where does the floor/lot drainage water go?

  - How many cars are serviced daily? Specifically name all wastes and describe the associated disposal practice. [Observe setting and determine if any other wastes can be or have been injected into the on-site disposal well(s).]

- Peculiarities/Potential Problems

  - Many gasoline station and garage owners may not have knowledge or records on their disposal systems.

  - Intensive detailed questioning may provide some answers which were not easily answered before.

- Many facilities may use dual purpose wells (e.g., cesspools, septic systems, and storm runoff drainage wells).

- The inspector may have to check city records to determine if the station is sewered or not. This may be a tedious task.

- Some wastes injected by such facilities may be Class IV hazardous wastes. All sampling and analysis must be carefully undertaken, especially if enforcement actions are anticipated.

Recharge Wells

Aquifer Recharge Wells (5R21)

Aquifer recharge wells are used to recharge depleted aquifers and may inject fluids from a variety of sources such as lakes, streams, domestic wastewater treatment plants, other aquifers, etc.

SLIDE #14-76 This slide depicts the number of aquifer recharge wells by State (as reported in the Report to Congress, 1987).

- Well Construction, Operation, and Siting

  - Many recharge wells are specially designed and sited to accomplish recharge objectives and are under control of an operator.

  - Wells may have one or more casing strings cemented in place and some wells may use injection tubing.

  - Wells inject directly into USDWs in most cases, but some facilities may inject above aquifers.

- Some wells may serve a dual or secondary purpose such as sewage effluent disposal, water production, or drainage of surface water or ground water.

- Injected Fluids

  - Injected fluids are dependent on the water source.

  - Water quality changes which can take place in injected fluids or in the mixing zone between injected and aquifer fluids include adsorption, ion exchange, precipitation and dissolution, chemical oxidation, biological nitrification, aerobic or anaerobic degradation, mechanical dispersion, and filtration.

SLIDE #14-77 This shows the construction features of an aquifer recharge well in California.

Saline Water Intrusion Barrier Wells (5B22)

Saline water intrusion barrier wells are used to inject water into fresh water aquifers to prevent intrusion of salt water into the fresh water aquifers.

- Well Construction, Operation, and Siting

  - Most wells are sophisticated and have multiple casing strings cemented in place.

  - Wells are usually sited in lines parallel to coast lines to form a hydraulic barrier against salt water intrusion.

  - Wells inject directly into USDWs under control of an operator.

- Injected Fluids

  - A large variety of fluids are used in salt water barrier projects, much like aquifer recharge wells. Fluids are site-specific.

SLIDE #14-78 This illustrates construction features of saline water intrusion barrier wells. These wells are operated in California. Note that the well on the right is constructed to allow injection into the upper and lower aquifer.

SLIDE #14-79 This is a saline water intrusion barrier operation utilizing injection wells to form a fresh-water ridge acting as a sea-water barrier.

Subsidence Control Wells (5S23)

Subsidence control wells are used to inject fluids into a non-oil or gas-producing zone to reduce or eliminate subsidence associated with overdraft of fresh water.

- Well Construction, Operating, and Siting
  - Well construction is similar to aquifer recharge and subsidence control wells.
  - Wells are sited to stop or improve subsidence due to overdraft of ground water on a site-specific basis.
- Injected Fluids
  - A variety of injected fluids may be used and are site specific. See the section on aquifer recharge wells since potential fluids are similar.

SLIDE #14-80 This is an injection well utilized for subsidence control in the Wilmington Oil Field, Long Beach, California. This slide is for illustration of subsidence control utilizing injection wells - the injection well shown is injecting into an oil bearing zone, and therefore is not considered a Class V injection well. This is a Class II injection well which serves to prevent subsidence and enhance oil recovery.

SLIDE #14-81 These are injection wells utilized to prevent subsidence in a previously-mined area. This slide is for illustration of subsidence control utilizing injection wells - the injection wells shown are classified as Class V mine backfill wells (type 5X13).

SLIDE #14-82 These are areas of land subsidence resulting from ground-water withdrawal.

- Well-Type Specific Questions/Inspection Tips
  - What is the source and quality of injected fluids?
  - Do these wells serve a secondary purpose such as sewage treatment plant effluent disposal?
  - Which aquifer is being recharged?
  - What is the injection zone?
  - Please present an overview of the recharge project including specific details on the injection portion of the project.

- Is there a groundwater monitoring and/or injectate monitoring system on site? If so, would a review of the periodic/ continuous analyses be possible?

- Is this project regulated by a local or State agency?

• Peculiarities/Potential Problems

  - Define the purpose of the injection project (e.g., recharge, salt water barrier, or subsidence control).

  - Determine any secondary uses of system.

  - Many of these projects are under jurisdiction of a local or State agency. This is primarily due to the fact that most such projects inject directly into USDWs.

  - Some of these projects may be operated irresponsibly with regard to injectate water quality.

Miscellaneous Wells

Radioactive Waste Disposal Wells (5N24)

Radioactive waste disposal wells include all non-Class IV radioactive waste disposal wells. Class IV wells inject radioactive wastes into or above USDWs and Class V wells inject radioactive wastes below all USDWs.

SLIDE #14-83 This slide illustrates the number of radioactive wastes disposal wells by State (as reported in the Report to Congress, 1987). Note that any well utilized by a generator of radioactive waste to inject radioactive waste into or above USDWs is defined as a Class IV well in 40 CFR.

- Well Construction, Operation, and Siting

  - No details are available on the construction of these wells.

  - Wells are generally sited on federal property such as DOE, NRC, DOD facilities and arsenals.

  - Inventory data are notably lacking for these wells.

- Injected Fluids

  - A variety of radioactive materials may be injected including Beryllium 7, Tritium, Strontium 90, Cesium 137, Potassium 40, Cobalt 60, beta particles, Plutonium, Americium, Uranium, and radionuclides.

SLIDE #14-84 This is a radioactive waste disposal well in the western United States.

- Well-Type Specific Questions/Inspection Tips

  - What specifically is injected and what is the fluid quality and quantity?

  - Please delineate all aquifers (USDWs) nearby with respect to the injection zone (to determine if this is a Class IV or V well).

- Peculiarities/Potential Problems

  - Very little is currently known about 5N24 wells.

  - Any 5N24 site inspection should be conducted only after careful planning and coordination with USEPA and the facility owner/operator or other representative.

  - Although USEPA's motive would be to obtain all site-specific assessment level information, the health and safety of field inspectors is paramount. Coordination with other regulatory agencies such as DOE and NRC is crucial.

Experimental Technology Wells (5X25)

Experimental technology wells include wells used in experimental or unproven technologies such as pilot-scale in-situ solution mining wells, secondary water production, tracer studies, thermal storage, and a number of projects already named as utilizing Class V wells (such as oil shale retorting, aquifer remediation, and underground coal gasification).

- Well Construction, Operation, and Siting
  - Well construction, operation, and siting vary greatly from site to site.
  - Wells may inject into, above, or below USDWs.
- Injected Fluids
  - Due to the diversity of experimental technology wells, a wide variety of fluids may be injected including: highly acidic or basic lixiviants for solution mining; domestic wastewater effluent containing high total suspended solids, fecal coliform, ammonia, BOD, pH; and air for secondary recovery of water from unsaturated zones.

SLIDE #14-85 This slide depicts some examples of projects utilizing injection wells associated with experimental technology.

- Well-Type Specific Questions/Inspection Tips
  - Please explain the project and the specific usage of injection wells.
  - What type and quality of fluids are injected?

- Does the facility have a groundwater or injectate quality monitoring system on site?

- Peculiarities/Potential Problems

  - This is an unlimited, diverse class of injection wells which require specific questioning to determine use and purpose, threat to groundwater quality, etc.

  - If the wells are associated with in-situ solution mining, aquifer remediation, underground coal gasification, or in-situ oil shale/tar sands retorting, proceed with reviewing tips presented for these well types, respectively.

  - Some owner/operators may consider these associated technologies as experimental.

  - Very little is known about other experimental technologies using injection wells; thus, assessment level inspections are warranted.

Aquifer Remediation Related Wells (5X26)

Aquifer remediation related wells include wells used to prevent, control, or remediate aquifer pollution, including but not limited to Superfund sites. These wells also include wells used for the disposal of treated ground water. Some wells serve secondary purposes such as aquifer recharge.

SLIDE #14-86 This slide illustrates the number of aquifer remediation wells by State (as reported in the Report to Congress, 1987).

- Well Construction, Operation, and Siting
  - Well construction, operation, and siting are site-specific and vary widely.
  - Many wells have one or more casing strings cemented in place.
  - Wells are specially designed to aid in aquifer remediation and may be an active or passive component of the remediation project.
  - Siting is also site-specific.
  - Most wells are under control of a designated operator and may be regulated by a federal, State, or local agency.
  - Most wells inject into or above USDWs.
- Injected Fluids
  - Injected fluids are dependent upon the hydrogeologic regimen, parameters of the contamination plume, and design of the remediation program.
  - For aquifer remediation projects at refineries, typical injectate constituents may include oil and grease, phenols, toluene, benzene, lead, and iron.

SLIDE #14-87 This shows construction features of a product recovery well used to recover free-floating product during aquifer remediation. The lower production string produces water and causes a cone of depression, while the upper production string produces free floating product which flows down the depression cone to the well.

SLIDE #14-88 This is an aquifer remediation injection well utilized to return coproduced water to the aquifer from which it was produced.

SLIDE #14-89 This is a schematic of flow lines illustrating hydraulic containment of a contamination plume utilizing production wells and injection wells.

SLIDE #14-90 This is a well screen with centralizers ready for installation. This screen may be utilized in production or injection wells.

- Well-Type Specific Questions/Inspection Tips
  - What contaminants are being recovered by the remediation system?
  - Please detail the remediation system specifics.
  - Are any treatments used before the recovered ground water is reinjected? If so, please detail.
  - What is the source, quality, and quantity of injected fluids?
  - Is there a groundwater or injectate monitoring system on site?
  - May I review the system reports and periodic analyses?
  - How effective has the system been to date?
  - Is the project under regulatory authority of any federal, State, or local agency? If so, please detail. [A tour of the system and each component, complete with explanation, is in order.]

- Peculiarities/Potential Problems

  - Each system is site-specific. Inspection questions should be developed for each facility to compensate for site-specific conditions.

  - Any federal, local, or State regulatory agency overseeing the remediation system should be identified during site investigations.

  - Depending on the site and the stage of remediation in place, it may not be practical or necessary to treat recovered ground water before injection. This is true for facilities where hydrocarbon contamination is being remediated; at such sites, the "free hydrocarbon" (source) is first removed before further groundwater treatment can effectively be conducted.

Abandoned Drinking Water Wells Used for Waste Disposal (5X19)

Abandoned drinking water wells used for waste disposal include any abandoned drinking water wells used or converted for waste disposal.

- Well Construction, Operation, and Siting

  - Many States have improperly abandoned drinking water wells and some of these wells may have been converted or may be used for waste disposal.

  - Well construction is usually identical to or deteriorated from standard drinking water well construction.

  - Injection is directly into USDWs.

  - Land owners may maintain or "operate" such wells.

- Injected Fluids

  - Abandoned drinking water wells used for waste disposal could potentially receive any kind of fluid, particularly brackish water, dangerous chemicals, pesticides, and sewage.

SLIDE #14-91 This abandoned water well is used for sewage waste disposal. This well should be reclassified as a septic system sewage waste disposal well (5W31) since the waste disposed is known to be sewage waste from a septic tank.

- Well-Types Specific Questions/Inspection Tips

  - Are there any other abandoned water supply (potable, irrigation, or process water) wells on site?

  - Are the wells properly plugged and abandoned? If not, are any wastes, intentionally or unintentionally, discharged to the wells? If so, please specify type, quantity, and quality of fluids injected.

  - How long and by whom has this injection been occurring?

  - Have any nearby water wells been affected? [Inspect all wells, including the abandoned water wells, on or near site.]

- Peculiarities/Potential Problems

  - Finding out about such wells is difficult.

  - Many cases of abandoned wells being used for waste disposal come from citizen complaints or anonymous telephone calls.

  - The State or local water resources agency or health departments may be aware of such practices.

Other Wells (5X27)

Other wells include any other unspecified Class V wells. Well type/purpose and injected fluids must be specified. Use your best judgment on inspections, based on above listed suggestions.

UNDERGROUND INJECTION CONTROL PROGRAM
GUIDE FOR CONDUCTING INSPECTIONS
OF CLASS V WELLS

General Information

- Facility Name, Address, and Phone Number
- Facility Contact(s) and Title(s)
- Parent Company/Corporate HQ, Address, and Phone Number
- Inspection Date and Time
- Weather Conditions
- Names and Affiliations of Inspectors
- Additional Participants or Observers

Nature of Business/Site History

- What products or services are offered at the facility?
- How long has the current business been operating at the facility? When was the facility constructed?
- What kinds of business have been active at the site and for how long?
- Have there been any additions to the facility since its initial construction? If so, when and which ones? How many buildings exist at the facility?
- How many persons are currently employed at the facility?
- Is the facility hooked to the city sewer system or is it on septic?

Class V Injection Well Information

- Ask for plumbing plans and a site map illustrating all buildings. With the assistance of the facility contact, construct a flow diagram of processes, waste generation, and disposal showing any floor drains, restrooms, sinks, pits, storm/parking lot drains, ponds, creeks, surface discharge points, septic tanks, drainfields, dry wells, chemical storage areas, etc. Verify the accuracy of this information during the site tour. Concentrate on plumbing associated with Class V systems.

  The facility contact states that floor drains discharge to a self-contained tank, ask for as-built diagrams. If these are not available, ask what the volume of the tank is, and how often it is pumped. Ask for a hauling invoice from the last hauling date. (If information provided does not add up, chances are that the "self-contained tank" is not self contained; therefore, it is a Class V injection well.)

- What processes or operations are performed at the facility? Observe and note these operations during the site tour.

- What liquids are used in each process/operation and how are generated wastes disposed?

- Verify numbers and types of Class V injection wells. Where are the wells located and what fluids are discharged to the wells?

- Obtain the current status of the well(s) and years of operation.

- Obtain well construction data such as depth, diameter, casing type, etc. If such data are not available, please note.

- Are the injection wells regulated by a State or local program? Does the facility have any operational permits? If so, obtain copies of permits and information regarding permit requirements.

- Describe the source of injectate for each Class V well. Include ALL points of entry to the system (e.g., process wastes through floor drains, sink drains, etc.).

- Describe any pre-treatment processes which may occur prior to injection (e.g., oil-water separation, neutralization).

- Describe possible contaminants by observing the constituents of fluids which are stored near disposal points or which enter floor drains, etc.

- How much fluid is injected into each well? How often is fluid injected?

- When touring the facility, visually examine floor drains, Class V wells, etc. Take photos of liquid discharge points and Class V well sampling points, recording film roll number and frame number. Visual observations to note would include dimensions of well, susceptibility to chemical spills, security, general appearance of well, color and consistency of fluids in well, etc. Are the Class V wells accessible at the surface? Describe any obstacles that may exist at sampling points (e.g., heavy vegetation at septic tank access port).

- How often are septic systems/holding tanks cleaned? Have any operational problems occurred?

Other Information

- What chemicals are stored on site? This would include any process chemicals such as paints, solvents, oils, etc. Where are the chemicals stored and in what quantities are they used? Obtain Material Safety Data Sheets (MSDS) for any chemicals contained in waste streams discharged to Class V disposal systems.

- Are waste oils generated at the facility? If so, how are they disposed of? Obtain an invoice demonstrating that the facility has waste oils hauled.

- What hazardous wastes are generated at the facility? What process generates the wastes? Where and how are they stored? How often are wastes hauled? Obtain or observe hazardous waste manifests from the facility contact. Note the waste generator ID number and EPA waste stream numbers. If the facility utilizes solvents, paints, or other hazardous chemicals but claims that no hazardous wastes are generated, question the facility contact in regard to disposal methods of waste products.

- Are there any underground storage tanks (USTs) on site? If so, where are they located? Note tank sizes and contents. When were the USTs last pressure tested?

- Does the facility discharge wastes to surface waters? If so, does the facility operate under an NPDES permit for surface discharge to creeks or tributaries?

- How does the facility receive its water supply? If there are supply wells on site, locate them on the site map. Does the facility use the water for drinking purposes? If not, why not? Obtain any water analyses available. Obtain water supply well construction and depth information. Obtain depth to water (static water level) information.

- Are there any monitoring wells on site? If so, where are they located, why were they installed, and how are they constructed?

Checklist for Documents to Request from Facility Contact

- Map of Facility/Plumbing Plans
- Flow Diagram of Processes, Waste Generation, and Disposal
- Pertinent Material Safety Data Sheets
- Invoice Demonstrating Waste Oil Hauling/Reclaiming
- Manifests Demonstrating Hazardous Waste Disposal
- As-built Diagrams of Injection Wells
- Reports on Well Performance or Maintenance
- Records of Injectate Composition and Volume
- Drillers' Logs or Wireline Logs (if applicable)
- Water Supply Well Location and Construction Data
- Water Quality Analyses
- Reports on Site Hydrogeology, Other Regulatory Agency Investigations
- Monitoring Well Location and Construction Data

GUIDELINES FOR PROPER MAINTENANCE OF A FIELD NOTEBOOK

1. The field notebook normally serves as a place to record data for later use in the office. It may, however, be used in litigation, or as evidence in court. As such, it represents an official document which should provide an objective record of both the normal and the abnormal. Accordingly, personnel are asked to adhere to the following guidelines regarding field notes.

2. Notebooks must be bound and contain water resistant pages. All entries should be clearly legible and in ink. The notebook should contain the employee's name and company identification. Each page should be numbered, front and back, with no skips. In the event a page is left blank, draw a single diagonal line across the page, write "Blank Page," and initial the entry. Deletions should be lined out with a single line and initialed.

3. Entries for field days should include the time you left home or office, destination, mode of transport, time of arrival at the destination, weather conditions, and activities planned. The names of all personnel with whom you have contact should be noted. These might include client representatives, subcontractors, observers, regulators, guests and visitors.

   The end of any given field day should also be noted. If for some reason a log book is discontinued, the notation, "Log Closed" with date and name should be written on the last page. If the book is full, note "continued in book ________."

4. Profanity, jokes, or reference to anyone's character should specifically not be recorded. Remember that the field book is a serious document and that lawsuits have been won and lost based on the information contained in a field notebook.

SECTION 15

SAMPLING OF CLASS V INJECTION WELLS

This section contains material associated with Class V sampling operations. Particular topics discussed include:

- Lab Selection
- Sampling Point Selection
- Sampling Equipment
- Sampling Containers
- Sampling Methods and Procedures
- Quality Assurance/Quality Control
- Sample Collection
- Types of Samples and Analyses
- Sample Documentation and Shipment
- Field Modifications
- Health and Safety SOP
- Typical Sampling Event

DISCUSSION

This section provides a summary of Class V sampling activities. Let's turn to the Sampling Section in the Class V Addendum.

We will review together "Standard Operating Procedures for Injectate and Sediment Sampling at Class V Facilities" and "Standard Operating Procedures Concerning Health and Safety During Sampling at Class V Facilities."

The Standard Operating Procedures (SOPs) were developed in response to EPA guidance for development of SOPs for any routine activities carried out under EPA direction. The SOPs are continually updated as additional experience is gained.

We'll begin by reviewing the Standard Operating Procedures for Sampling.

LAB SELECTION

Several factors must be considered when selecting a laboratory for analyzing samples.

As pointed out on page 3 of the Sampling SOP, a laboratory operating under the EPA Contract Lab Program (CLP) should be used whenever possible.

- CLP labs are familiar with EPA protocol.
- The contract Lab Program is the only national certification-type program.

Efforts should be made to locate a laboratory which is in close proximately to sampled sites in order that samples may be hand-delivered.

A State-certified lab may be used if approved by the EPA Region. States can supply a list of labs along with the types of analyses they are certified to run. This is generally determined by standard samples which are sent by the State for analyses (i.e., Oklahoma Water Resources Board, New York Department of Environmental Protection).

The lab chosen must retain all equipment, maintenance and calibration records, sample information and results, plus all lab data for the required time frame designated by EPA.

The selected lab must also be able to run analyses by requested methods and meet internal quality assurance/quality control (QA/QC) requirements (i.e., split samples, standards).

SAMPLING POINT SELECTION

The goal of sampling investigations is to characterize the injectate at the point of injection (we want to know what contaminants are entering the subsurface). Therefore, the sampling point selected should be as near to the injection point as possible.

It is preferable to sample after all pretreatment; however, this is not always possible. Always sample as far downstream from the source as possible. For instance, in the case of discharge to a seepage pit or well, the most desirable sampling point is the actual well containing fluid which has passed through all pretreatment systems and is destined for injection.

SAMPLING EQUIPMENT

Sampling equipment includes the following items:

SLIDE #15-1

- Modified Pond Sampler
  - The pond sampler consists of an adjustable telescoping aluminum pole (swimming pool skimmer pole) with an adjustable stainless steel C-clamp. A stainless steel beaker can be attached (the beaker size can vary; typically 1000 ml.).
  - The pond sampler is used when access to the sampling point is easy (i.e. bay sumps, catch basins).

SLIDE #15-2

- Bailer
  - We carry both stainless steel and teflon bailers. Dimensions are about 2" in diameter (1 7/8") by 3' in length.
  - Bailers are generally used to sample small-diameter wells, septic tank clean-outs, and catch basins where the fluid depth is greater than the length of the pond sampler.
  - In these cases, a rope is attached and the bailer is lowered into the well or basin, etc.

SLIDE #15-3

- Nalgene Beaker
  - A nalgene beaker is used for liquid sample transfer, mixing, and splitting.
- Oil-Water Interface Probe
  - An oil-water interface probe is used to determine the exact depth to fluid or depth of any floating phase, and can be used to measure total depth.
  - How it works: Distinct tones designate oil and water; the line is marked off in 5 foot intervals; a tape measure is used to measure exact footage between the top of the floating phase and the water.

SAMPLE CONTAINERS

Sample containers must be compatible with the conditions expected during the sampling event. Typical containers are illustrated on pages 8 and 9 of the sampling SOP.

- Fluid Containers
  - Samples for volatile organics analysis (VOA) are taken in two-40 ml. glass vials with teflon septa.
  - Each metals sample, including total, dissolved, EP toxicity, or TCLP is taken in one-1 L. plastic bottle (a preservative is included for total and dissolved metals analyses).
  - The ignitability sample is taken in one-1 L. amber glass bottle.
- Sediment Containers
  - The EP toxicity metals sample is taken in one-500 ml. glass jar.
  - Volatile organic analysis (VOA) samples are taken in two-250 ml. wide-mouth jars with teflon lids.

- All sample containers and preservatives generally are suppled by the lab.

BASIC SAMPLING METHODS AND PROCEDURES

The following procedures are recommended for sampling:

- Preliminary Activities
  - A site-specific sampling plan should be completed for each site prior to sampling. The plan should be attached to page 41 of the SOP. We will go over filling one out a little later in the presentation.
  - All sample data sheets, tags, labels, and custody seals should be completed prior to conducting sampling (saves time in the field).
  - All notes should be recorded in a bound field notebook.
- Site Entry
  - The samplers should show credentials and provide a Notice-of-Sample-Collection form. A copy of the form is found on page 12 of the Health and Safety SOP.
  - The Notice-of-Sample-Collection form was developed to inform the operator that samples will be collected, and to get (in writing) his/her denial of the need for a split sample. The operator's signature on the form also verifies that a disposal bucket containing possible hazardous waste was left with the operator.
- Site Reconnaissance
  - Basically, a quick reinspection of the site should be performed, verifying sampling points and site conditions, and confirming decisions made with regard to which samples are to be obtained and which sampling equipment is to be used. Note any modifications made to the site-specific sampling plan.

- Operations Set-Up

  - The sampling van should be parked in a location convenient to all sampling points so that it will not have to be moved during sampling operations.

  - The decontamination station should be set up.

  - As required by the Health and Safety SOP, work space air monitoring should be performed prior to sampling.

SLIDE #15-4

- Equipment Decontamination

  - All necessary sampling equipment should be decontaminated prior to and following each sampling event (i.e., if 2 points are sampled at the same site, 3 decontaminations are necessary).

  - Decontamination involves the following steps:

    1. Disassemble all equipment.

    2. Wash with tap water and non-phosphate detergent (alconox).

    3. Rinse with tap water.

    4. Squirt rinse with acetone or isopropyl alcohol (if sampled waste was oily).

    5. Rinse with deionized water.

    6. Squirt rinse with certified, metals free/organic free water (supplied by the lab).

QUALITY ASSURANCE/QUALITY CONTROL (QA/QC)

Quality assurance (QA) is the process of assuring that data obtained are technically sound and properly documented. Quality control (QC) procedures are employed to measure the degree to which quality assurance objectives are met. The following are common QA/QC measures:

- Equipment Blanks
  - Equipment blanks are taken immediately after the initial decontamination for all fluid analyses to be conducted.
  - Use metals free/organic free rinse water to fill sample containers.
  - Label as other samples are labeled in order that lab personnel will be unaware that the sample is a blank.
  - Equipment blanks are required for 10% of sampled sites; however, we generally take blanks more often to provide solid enforcement-quality data.
- Trip Blanks
  - These blanks are lab prepared. One should accompany each transport cooler full of samples.
- Replicate Samples
  - Replicates are generally collected for 10% of total sampled sites (1 of 10).
  - Replicates need to be true splits of sample (VOAs); must be filled from the same bailer-full or poured from the same beaker dipped. Metals and EP toxicity (metals) are composited, mixed, and poured up.
  - Label replicates as separate samples (so that the lab won't know that it's a replicate).

- Background or Transfer Blanks
  - A background blank is taken if samplers suspect that the atmosphere may contain volatiles.
  - A transfer blank is taken at the Region's request; when equipment blanks are taken, the blank is poured directly from the mineral free, organic free water container.

SAMPLE COLLECTION

First, the oil-water interface probe is used to determine the presence and extent of any free-floating phase, depth to water (fluid), and total depth of the sampled system. The probe is useful for the following reasons:

- If sampling a well, you get an idea of the quantity of free product typically present.
- Use of the probe can help determine if separate phase samples are obtainable. Some Regions request separate phase samples if there is greater than 2" of floating product and you are sampling from a shallow sump. The floating phase is collected first by use of a beaker which must be dipped carefully. The floating phase is skimmed and is then transferred to containers. The fluid beneath the floating phase is then sampled by directly filling containers. To date, this procedure has never been performed.
- The interface probe can help determine the depth to sediment (if obtainable). Sediments are collected with the pond sampler.

After taking measurements with the oil-water interface probe, samples are collected. Liquid samples are collected first and sediment samples are collected second. As described earlier, a bailer and/or pond sampler are used to collect samples. If possible, each should be lowered approximately 2 feet below the fluid surface.

TYPES OF SAMPLES AND ANALYSES

Liquid Samples

Liquid samples are always collected before sediment samples. Liquid samples are taken for the following types of analyses:

- Volatile Organics Analysis (VOA)

  This is the first sample collected in order to limit disturbance and prevent the loss of volatiles in the liquid to be sampled. The sample is carefully poured to form a meniscus at the lip of the vial, and is capped so that no head space or air bubbles are present. This is easier said than done; oily or soapy samples make it much harder to eliminate head space. From field experience, prechilled VOA vials assist in controlling head space.

The analytical method requested is EPA Method 624 or Method 8240, as described in SW 846. These methods detect extractable volatile organic compounds by purge and trap GC/MS Analysis.

The VOA is performed because it can detect:

- Hazardous wastes, such as solvents denoted under RCRA, 40 CFR, Part 261.31. If present, the well would be classified as a Class IV well, which is banned.

- Exceedance of EPA Drinking Water Maximum Contaminant Levels (MCLs) or Health Advisories (HA). Such exceedances may constitute potential endangerment.

The maximum holding time before running a VOA on the sample is:

- 7 days for unacidified; and

- 14 days for acidified (HCl).

• Semi-Volatile Organics Analysis

This type of analysis is rarely performed; however, it may be appropriate if the waste stream is suspect for semi-volatile organics.

• Metals Analyses

A determination must be made in regard to the type of metals analysis to run (i.e., total, dissolved, or EP toxicity). This determination should be made by the EPA Region. Unless otherwise specified, each of the metals analyses are run for arsenic (As), barium (Ba), cadmium (Cd), chromium (Cr), lead (Pb), mercury (Hg), selenium (Se), and silver (Ag).

Total Metals Analysis

- An unfiltered fluid sample is taken and transferred to a 1 L. plastic bottle containing HNO_3 in a sufficient volume to acidify the sample to a pH of less than 2.0. This should be checked by the samplers with litmus paper and additional HNO_3 should be added, if necessary.

- The lab digests the sample with heat and HNO_3 to free all chemically bound metals. Each metal is then run by the approved EPA method AA or cold vapor (Refer to page 26 of the SOP, Table 4).

- The problem in using this type of metals analysis is that the analysis also determines the metal content of particulate suspended materials. Once injected, the suspended materials do not actually travel with the liquid (suspended material settles or is filtered by the injection zone).

- The maximum holding time before running the analysis is 39 days for Hg, and 6 months for the other metals.

Dissolved Metals Analysis

- The fluid is filtered in the field through a 0.45 micron membrane filter and is acidified to a pH of 2.0 or less (AA).

- The lab uses the same method as with total metals samples, except that digestion is only required if a precipitate forms.

- When filtering in the field, oily samples may present serious filtration problems, and often require multiple filter membranes.

- The maximum holding time for the analysis is 39 days for Hg, and 6 months for all other metals.

EP Toxicity Analysis

- Due to the problems associated with the total and dissolved metals analyses, only the EP toxicity analysis for metals is typically run, unless the presence of pesticides and herbicides is suspected (see page 28 of the SOP, Table 5.

- The fluid sample taken is not filtered or acidified prior to being submitted to the lab.

- The lab separates the solids from the liquid ASAP and determines whether there are greater than 0.5% solids present (see schematic on page 29 of the SOP).

- To date, there has always been less than 0.5% solids; therefore, the liquid is treated as the extract and the metals are run either by AA or cold vapor methods (Hg), as mentioned before.

- The EP toxicity analysis is performed because:

  - o It can detect EP toxicity metals in a liquid. A liquid can be defined as an EPA hazardous waste by characteristics of EPA toxicity (see page 28 of the SOP, Table 5). If present at certain levels, the well may be a Class IV well, which is banned.

  - o A large amount of time is saved in the field (no field filtering).

  - o Metals concentrations below toxic levels can still be used to indicate endangerment based on EPA Drinking Water Maximum Contaminant Levels and Health Advisories.

- A fluid is considered hazardous due to toxicity if these EP Tox metals levels are exceeded:

As	5.0 mg/L
Ba	100.0 mg/L
Cd	1.0 mg/L
Cr	5.0 mg/L
Pb	5.0 mg/L
Hg	0.2 mg/L
Se	1.0 mg/L
Ag	5.0 mg/L

- If there are greater than 0.5% solids in the sample, the metals concentration extracted from the solids portion is combined with that of the fluid.

- Most Regions have decided that the analysis used for EP toxicity-metals is the most economically feasible.

- A possibility exists that the Toxicity Characteristic Leaching Procedure Test (TCLP) 40 CFR, Part 268 App. 1, could replace both the VOA and EP toxicity analysis when fully approved, since it is designed to determine the mobility of both inorganic and organic contaminates present in liquids and multiphase waste.

- The analtyical method requested is EPA Method 1310 (from SW 846).

- The holding time for the extract is 6 months.

• Ignitability Analysis

If a fluid is ignitable, it is characteristically hazardous, as defined in 40 CFR, Part 261.21.

The analytical method used is Method 1010 from SW 846 (Pensky Martin Closed Cup Method); a flash point of less than 60°C (140°F) is considered ignitable.

The holding time for the sample is 14 days.

- pH, Temperature, and Conductivity Analysis (see page 32 of the SOP)

This is a field test; the sample is obtained with a temperature compensated pH/conductivity meter; pH values are recorded in the appropriate place in the site-specific plan.

The pH probe is calibrated at every site (a 2 point calibration is performed bracketing the expected pH - typically a pH of 7.0 and 10.0 buffer solution is used for repair bays, where pH is expected to be slightly caustic; and a pH of 4.0 and 7.0 is used for industries such as electroplaters).

The pH sample is split into 3 beakers and the pH is determined on each. Each pH value must be within 0.1 of the others.

If the pH is less than or equal to 2.0, or greater than 12.5, the waste is defined as a characteristically hazardous corrosive waste, as defined in 40 CFR, Part 261.22.

- Other fluid analyses which have been requested by some EPA Regions include reactivity, BOD, COD, total phenol, and ethylene glycol analyses.

Sediment Samples

Sediment samples are always collected after all liquids samples are obtained. As mentioned earlier, sediment samples are collected with a pond sampler. Analyses performed on sediments include:

- VOA

  Method 8240 is used; sample preparation is the only difference.

- EP Toxicity - Metals only

  The analysis determines which metals are mobile and will leach out of the sludge under a pH condition of 5.

Sediment samples can help determine if a sludge is characteristically hazardous.

SAMPLE DOCUMENTATION AND SHIPMENT

The following steps should be taken to ensure proper documentation and shipment of samples:

- Affix the container labels, which are generally supplied by the lab. Each lab supplies slightly different labels, but labels should always include the sample number, analysis requested, date and time of collection, collection point, and names of samplers; all should be recorded in indelible ink.

- Sample tags made of tyvek should be filled out with indelible ink and placed in each baggie with the sample bottles. These are used in case the bottle label smears due to leakage.

- Parafilm lids if samples are to be shipped.

- Place each sample container in a baggie with a tyvek tag; remove air, seal, and place the custody seal around the baggie.

- Chill samples.

- Hand deliver or pack for shipment to the lab.

- The Department of Transportation (DOT) requires high concentrations to be packed in tin containers such as paint cans (this is rarely required).

- Typically, pack the chilled samples in a cooler lined with a plastic bag. Fill the bag with vermiculite, tape the bag shut, put ice on top, and seal the cooler with strapping tape and a custody seal. It is helpful to complete labels, tags, and custody seals before going into the field; then fill in the blanks as required.

- A sample data sheet will be filled out for each sample collected and kept as part of the permanent record along with the site-specific sampling plan. The sheet helps to identify the sample, matrix, and analysis (see page 38 of the SOP).

- A chain-of-custody form will accompany the samples from the field to the laboratory (see page 39 of the SOP).

- All decontamination fluids, excess fluids and sludges from samples, along with rags, paper towels, coveralls (Tyvek), and gloves which have contacted the fluid or sediment, will be disposed of in a 5-gallon bucket and left on site as discussed in the Notice-of-Sample Collection form.

FIELD MODIFICATIONS

Any deviation from the SOP or modifications made to the site-specific sampling plan must be completely documented in the plan.

We will now review Standard Operating Procedures concerning Health and Safety.

HEALTH AND SAFETY SOP

Field inspectors/samplers must complete a 40-hour approved health and safety training course for hazardous waste site workers and have 3 days field experience under a trained and experienced supervisor.

In addition, an 8-hour annual refresher course is required.

Prior Preparation

- A health and safety site plan should be completed from inspector notes and other resources.

On-Site Procedures

- Site reconnaissance must be conducted to verify points noted during the inspection and to make sure the health and safety site plan addresses them.

Operations Set-Up

- A first aid station is typically set up on the front dash board and front passenger seat of the sampling van. The station includes:
    - First aid kit;
    - Eye wash;
    - Respirators;
    - Potable water;
    - Fire extinguisher; and
    - Site health and safety plan (with map to hospital and MSDS for chemicals).

Air Monitoring

- Air monitoring is generally required when sampling pure product from drums, or when sampling in an enclosed area (i.e. service bay). In an open air environment (outside), there may be no need to monitor the air. Do not stick you head into the well.
- Air monitoring equipment includes:
    - Instruments used to measure organic vapors. These include the HNU meter, organic vapor analyzer (OVA), and organic vapor monitor (OVM).
    - Combustible Gas Indicator (CGI) measuring O_2 and H_2S levels.
- Background readings should be taken near the sampling van (not running), work space, sump, and/or well bore.
- Readings should be recorded in the field book, as those on page 5.
- Weather conditions affect the HNU; therefore, it is important to record the relative amount of moisture and the temperature.
- Upgrading to Level C respiratory protection from Level D is indicated when a 10 ppm increase over background is observed with the HNU.

- If Level B is required, do not sample. This would occur when:

  - O_2 reading $\leq$ 19.5%;

  - Detection of H_2S occurs at any level;

  - Any enclosed space,which is not used on a daily basis, must be entered.

- Sampling is not to be conducted when:

  - The Lower Explosive Limit (LEL) exceeds 20% or greater than a readout of 20 on the digital Combustible Gas Indicator (CGI).

- All air monitoring is covered in-depth during the 40-hour health and safety course. Participants get the opportunity to use the instruments and learn about protective equipment.

- All sampling is typically conducted in Level D equipment, with double-glove (inner surgical and outer neoprene/ plastic) protection for hands (Level C); hands are routinely immersed and should be protected.

- Outer gloves should be decontaminated prior to and following sampling operations.

- Personal protective equipment and the routes of exposure were covered previously in the training course.

Health and Safety Plan

A site Health and Safety Plan must also be completed for each facility to be sampled (see in Class V addendum). The plan is basically a fill-in-the-blank form.

The most important items include:

- Emergency phone numbers;
- A map depicting the route to the hospital;
- MSDS; and
- Unusual physical features such as power lines or automobile traffic.

A safety review meeting must be conducted at each site prior to sampling. The meeting should be held on-site with sampling and all regulatory personnel present. Each attendee must sign the last page of the health and safety plan indicating that he/she was present at the safety meeting.

TYPICAL SAMPLING EVENT

We will now run through a typical sampling event together. We will begin by reviewing the inspection notes. Then we will complete a site-specific sampling plan (see the Class V addendum).

You have reviewed all the day's inspections; one site ranked extremely high; however, you did not personally conduct the inspection.

A septic tank accepts effluent from both a drainage sump in a repair bay and a floor drain in a paint booth at a small garage and auto body shop. The septic tank has an access port to both chambers.

From the septic tank, the waste discharges to a drainfield with a monitoring tube. Fluid is present in the monitoring tube.

The septic tank chamber cover is approximately 2 feet in diameter, and fluid depth within the tank is approximately 4 feet from the surface. The diameter of the monitoring tube is approximately 4 inches, and depth to fluid is approximately 8 feet.

The sump in the repair bay appeared to be very oily during the inspection. The service bay sump measures 3 feet by 2 feet; Fluid depth in the sump measures 6 inches.

A paint booth measures 10 feet by 12 feet and exhibits a very shallow slope to floor drain.

Waste oil and solvents are hauled for recycling; no Material Safety Data Sheets (MSDS) are available.

Please turn to the blank sampling plan found in the Class V Addendum.

First of all , the cover page of the sampling plan should be completed.

Page 3 of the sampling plan depicts various sampling points which may be encountered. For this example, the dimensions of the monitoring tube should be documented. This is the primary sampling point.

The secondary sampling point is the septic tank. Its dimensions should be noted on page 3, also.

A third sampling point will probably not be necessary as back-up, but you may want to take sediments from the sump in the repair bay; if so, fill out the appropriate section on page 3.

Page 6 contains the Potential Contaminant Checklist. Let's run through the checklist quickly.

On page 7, we find a schematic of samples to be collected and analyses requested.

For liquids, we would normally collect samples for VOA, ignitability, and EP toxicity-metals. For sediments, we would normally run EP toxicity-metals.

Page 9 includes an equipment checklist. This should be checked before going to the field.

Page 10 contains a checklist for sample containers.

Page 11 contains sample data sheets. One should complete a form for each sample taken. Fill out labels, tags, and custody seals as completely as possible.

The basic steps involved during the sampling trip are listed below:

- Arrive at the site.
- The samplers should show credentials and fill out the Notice-of-Sample Collection form. The facility operator should sign the form.
- Site reconnaissance should be conducted. In our example, you would see the sump, paint booth, and septic tank.
- The safety meeting should be conducted; no new hazards are identified.
- The oil-water interface probe should be decontaminated before other equipment. The depth of fluid in the monitoring tube should be checked; only 2 inches, an insufficient volume to obtain a sample; so a secondary sample point will be chosen.
- Changes should be noted under field modifications, which should be page 11 of the site-specific plan.
- Collect the samples (no problems).
- Clean up the decontamination station. All fluids and materials which contacted the fluid should be placed in the disposal bucket. This includes the plastic sheeting placed beneath the decontamination wash tubs.
- Label the disposal bucket as mentioned earlier.

- Leave the bucket and a copy of the Notice-of-Sample Collection form with the facility operator.

- Leave the site.

HYPOTHETICAL SITUATIONS

SECTION 16

HYPOTHETICAL INSPECTION SITUATIONS
CLASS II WELLS

This section contains eleven cases with hypothetical situations which might arise while conducting inspections of Class II wells. Each case provides a background description, as well as questions and answers for class participants.

CASE #II-1

You arrive at the well to perform an inspection. The completion is conventional. The injection is intermittent and the pump is on the down cycle. How should you proceed with the inspection?

- Check the tubing pressure.
- If positive, check the annular pressure.
- If both the annular and tubing pressures are zero:
  - Wait for the pump to kick on. Then check both pressures again.
  - If operator is present, have him initiate injection.

Should you turn the pump on without the operator?

- No. Either:
  - Come another day or time; or
  - Contact the operator.

Why conduct an inspection?

- Field Presence
- Monitoring Equipment
- Well Status
- Photo Documentation

CASE #II-2

You arrive at the location to run the standard annular pressure test. Tubing pressure is 800 psi, and the annulus pressure is zero. At what pressure is the test to be conducted?

- The test should be conducted at the pressure required by the EPA Region or State that you are working in. This test pressure is usually 300 psi for 30 minutes.

Is it necessary to run the MIT at a higher pressure than tubing pressure?

- No. If tubing pressure is high (such as 800 to 1000 psi), running the MIT at a pressure above tubing pressure will possibly cause casing damage. In old wells, the casing may have deteriorated to a point that it may not hold if subjected to a large amount of pressure. Testing a well at a high pressure may cause more problems than the results will justify.

If tubing pressure is substantially higher than annular pressure, doesn't annular pressure verify lack of tubing and packer leak?

- Yes. If the tubing pressure is at 500 psi and annular pressure is zero, you can assume that there is not a leak in the tubing and packer.

- When testing wells with tubing pressure, the main thing to remember is that you need to have a differential of at least 100 psi at the packer between the annulus pressure and the tubing pressure. The specific gravity of the injectate and the annular fluid also need to be considered.

CASE #II-3

You have contacted an operator about performing an inspection. He indicates that the pumper is difficult to contact and has no problem with you performing an inspection in his absence. Upon arriving at the well site, you visually observe the annulus pressure to read 1,000 psi and there is no gauge on the tubing. How should you proceed with the inspection? Should the gauge be removed to verify the annulus pressure?

- Ascertain the tubing pressure if possible.
- Do <u>not</u> attempt to remove the annulus pressure gauge.
- Return to the injection plant.
- Check the injection plant for indicators of tubing pressure.
  - Is the pump running?
  - Check chart recorders.
  - Sample tap at the pump (access tubing pressure at the pump).
  - Take pressure reading off of gauges (if present).
  - Note pressures, date, and time.
  - Call to notify the operator of findings.

A phone call to the operator indicates that the operator is aware of the problem with the well. What should you do?

- Indicate that the well needs to be brought back into compliance.
- <u>Suggest</u> that the operator cease operation until such work has been completed.
  - Unless you work directly for the EPA or State Agency, inspectors cannot <u>tell</u> an operator to shut the well in. Inspectors can only <u>suggest</u> that the operator shut the well in until he works the well over.
- Indicate that an MIT will need to be run subsequent to a workover, before reinitiating injection.

CASE #II-4

The EPA Regional office received a letter indicating that the operator's lease was protected by Smith and Wesson. At a later date, having been informed of the requirement to perform an MIT, the operator contacts the inspector to set up the test. As an inspector, how do you handle this situation?

- Contact the regional supervisor.
- The supervisor may advise legal counsel of the situation.
- Legal counsel may suggest that if the inspector felt threatened, that the services of a federal marshal would be warranted.
- A State conservation officer or equivalent may accompany the inspector. The inspector should keep a low protective profile.

CASE #II-6

In route to your favorite trout stream, you notice that the retention pit located near the tank battery of production facilities is receiving a good 2" stream of produced water from the water tank. The pit is full and the levee has been broken, allowing water to flow out. The tank battery is located 1/4 mile from the creek. Tracing the stream of discharge proves that water empties into the creek. What do you do?

- Note the date, time, and occurrence.
- Recognize the incident as a potential surface discharge violation.
- Notify appropriate NPDES or equivalent State program representative of your findings.
- Call the operator to collect information regarding the situation.

CASE #II-7

A well is constructed with 5 1/2" surface casing, and 2 3/8" tubing set, cemented, and perforated into the injection interval. Injection occurs down the tubing in this well. Other wells in the field are conventionally completed and are being tested by arching from the injection line to pressurize the annulus. Pressure does not exist at the injection line because of leaks up the line. The well has been idle for an undisclosed period of time. The operator contends that the well requires 2,200 psi to initiate any fluid movement (the reason for cessation of injection activities). Tubing pressure reads 1,000 psi and remains so the following day. The operator contends that the fact that it takes 2,200 psi to initiate flow indicates that the perforations are impervious and act as a bottom hole plug. Discuss.

- This well could be tested by:
  - Bleeding the tubing pressure back to zero if possible; see if the tubing repressurizes overnight.
  - If not, run a pressure test.
  - If so, set a retreiveable bridge to isolate the tubing from the injection zone. Run a pressure test.
  - Run a radioactive tracer survey to demonstrate internal mechanical integrity.

CASE #II-8

You arrive at the location to perform a routine inspection and find this scenario. Water around the wellhead bubbles slightly, but steadily. Subsequent inspections reveal a similar situation at 3 to 4 more wells in the area. What do you do?

- Question the pumper about the existence of the fluid migration.
- Take photographs of the wells for documentation.

The pumper claims to have never noticed the occurrence. Completion of inspections is followed by discussion with the field foreman, whom confirms prior knowledge of the situation. He also volunteers to pump the cellar to identify the source of the problem.

- Contact the Regional supervisor.
- Have the operator talk with the Regional office before conducting any work.

Further contact with operator representatives indicates that the situation was first noticed in a plugged well. The well was re-entered and steps were taken to eliminate the fluid migration. The source was identified as hydrocarbon from an underlying gas storage zone. Is this situation enforceable under the UIC program?

- No. See 40 CFR, Part 144.6 (b)(3); must be liquid under standard conditions to be UIC enforceable.

The gas is apparently moving behind the surface casing, to the surface. Do these wells have mechanical integrity?

- Yes, if they passed the internal MIT. External MI is questionable, but if well passed other external MIT test then well has mechanical integrity.

What do you offer as a solution to this situation?

- Have the operator contact the gas storage company. Help them work out a method to fix the problem.

CASE #II-9

You are asked to run MITs with a new operator of a recently purchased lease. After performing several tests on wells throughout the field, you arrive at a well which has bull plugs located on both sides of the wellhead. The tubing pressure is determined to be approximately 1,900 psi. All the wells in the field are conventional completions; that is, a standard annulus pressure test needs to be performed. Discuss.

- Attempting to remove either bull plug could be extremely dangerous in this situation. If there is a tubing or packer leak in this well, then there is 1,900 psi on the annulus. One turn of either bull plug with a pipe wrench could result in failure of the threads. The result would be a projectile with the velocity to do serious damage to health or property. Do not attempt to remove the bull plug.

- Do not allow the operator to attempt to remove the bull plug in your presence without your resistance. If the operator insists on removing the bull plugs, do not stand in the pathway of the bull plugs should they be shot away from the wellhead.

- Record the well as a failure until the operator proves otherwise.

CASE #II-10

You are conducting a routine inspection of a salt water disposal well. Tubing pressure is found to be 1,500 psi. Annulus pressure is 250 psi during inspection. The operator returns with you to the well to bleed off pressure. Discussion indicates that pressure usually runs around 100 to 150 psi. What could explain this situation?

- Consider the construction characteristics of the well.
- Consider expansion and contraction characteristics due to temperature as a possibility.
- Open hole zones may be contributing pressure.
- The inspector should check permit conditions. Some permits are written with annulus pressure limits.

CASE #II-11

The operator has been notified of the need to perform an inspection. However, the operator was not present at the time of the inspection. Upon entering the injection plant, there is noticeable evidence that discharge has been occurring at the pump. Erosion has created a trench which cuts underneath the shed. Exiting the injection plant, to view the fate of the apparent discharge, reveals the existence of a small pit dug by the operator to contain the discharge. The injection is intermittent and the pump is not operating at the time of the inspection. Is this a violation? On what basis?

- The inspector should:
    - Document the date and time. Take photographs.
    - Contact the operator to confirm findings and gather further information regarding the situation.
    - Contact the appropriate State agency to confirm permit approval or existence.

HYPOTHETICAL SITUATIONS

SECTION 17

HYPOTHETICAL INSPECTION SITUATIONS
CLASS V INJECTION WELLS

This section contains six cases with hypothetical situations which might arise while conducting inspections of Class V injection wells. Each case provides a background description, as well as questions and answers for class participants.

CASE #V-1

Your contact on an assignment is the service manager of a corporate-owned gasoline service station. He gives to you the Material Safety Data Sheets for the stored fuels at the site, as provided by the corporate office. The contact claims to know nothing of the construction of the disposal system at the location. There is a floor drain located in the service bay area. What should the inspector do?

- Observe waste handling and disposal practices.
- Observe the floor drain to check for fluid contents, note the general nature of the contents, and photograph the drain (if potentially harmful fluids are observed).
- Determine if there is a municipal sewer system.
- If so, ask to see a record of the city billing.
- Determine the owner of the building.
- Attempt to contact the owner.
- Ascertain the construction of disposal systems from the owner (request blue prints).
- Categorize the Class V well appropriately (i.e., 5W11, 5X28).

CASE #V-2

The operator of a commercial dishwasher distributor provides details of three septic systems located on site. One receives solely sanitary wastes. The second system receives sanitary wastes, but also accepts fluids from the sink in the shop area. The third receives wash water from cleaning returnable containers used in their blending operation. What is the classification of each well?

- Determine the construction of Septic System 1.
  - Classify as either a 5W11, 5W31, or 5W32 system.
- Determine the potential contaminants from the sink (System 2).
  - System 2 may be classified as a 5W20.
- System 3 is a 5W20.

CASE #V-3

While interviewing the operator of a service station, you are informed that floor drains feed to a line which discharges to a dry creek bed. What would be your course of action?

- Ask for blue prints (seldom have).
- Ascertain the discharge point (i.e., the creek bed). If found:
  - Photograph.
  - Indicate on facility map.
  - Possibly run water into a floor drain to verify information provided by the operator.
  - Include an NPDES referral, if permit is not produced.
- If the discharge to the creek bed cannot be found:
  - Determine if the facility is on sewer.
  - Request additional information to be mailed.
  - Classify as a possible 5X28 (the facility discharges to the subsurface if it is not sewered, and if it is not discharging to the surface).

CASE #V-4

A single restroom and shop sink exist in the maintenance shop at this municipal golf course (SLIDE #17-1). The restroom and sink are located adjacent to and in the same building as the mower and chemical storage area (SLIDE #17-2). While the sink was heavily stained, no odor of paint or other chemicals could be detected. What information is necessary to classify the system?

- How many people does the system have the capacity to serve?
- Try to ascertain what goes down the sink.
- Get construction blueprints from the facility operator; if not available, ascertain as best as possible from employees.
- What chemicals are stored on site? Are MSDS available?
- Are there any floor drains present in the chemical storage area?

Of greater concern at this facility was a steam cleaning pad used to clean the golf course equipment. Such equipment includes mowers, pickup trucks, and fertilizer sprayers. The pad drains to a sump immediately below the wash area (SLIDE #17-3). What information is necessary to classify this system?

- Investigate the fate of the wash water.
- Request blueprints.
- Ascertain the constituents in the wash water.

During the inspection, a pesticide sprayer was being washed down and the inspectors noted the surface discharge (SLIDE #17-4). What does this indicate?

- The wash pad is not associated with a Class V well.
- Washing this equipment and discharging to the surface may constitute an NPDES violation. An NPDES referral should be completed and included with the inspection report.

The important points to make in regard to this case are as follows:

- Many facilities operate disposal systems which do not have construction blue prints. Interrogation of employees is sometimes successful in ascertaining these details. In this case, the location and well type were identified by a long-term employee at the facility. The well in question was determined to be a 5W10 (cesspool) serving 20 persons daily and receiving solely sanitary wastes. Details regarding the sink which discharges to this system are not clear. These uncertainties are duly noted in the inspection report.

- Once again, determining the fate of the effluent from the sump is critical. Construction plans were evidently not furnished by the operator and the surface discharge may have gone undetected under other circumstances.

- The discharges observed at the site, due to the nature of the facility and amount of equipment, is substantial.

- The presence of fertilizers and pesticides, as well as greases and oil, is evident in the wash water being discharged. The decision to include an NPDES referral with the UIC inspection report was appropriate in this case.

CASE #V-5

An inspection was completed at a large manufacturing complex which produces semiconductors and associated components. The first building on site was constructed in 1957 and expansion has been ongoing since that time.

The area surrounding the facility in east Phoenix was proposed as an addition to the National Priority List of Superfund sites in late 1984. Inclusion on this list would make the site eligible to receive Federal Superfund monies for activities such as investigation and cleanup. The operator has assumed responsibility for evaluating the extent of this groundwater contamination problem and for implementing appropriate remedial measures. These activities are being conducted under the auspices of a State and Federal task force as outlined in the project's Remedial Investigation/Feasibility Study work plan. The work plan was approved by EPA in October of 1984.

In January of 1983, the facility confirmed a trichloroethane leak in a virgin materials storage tank. Subsequent investigations revealed extensive soil and groundwater contamination, associated primarily with the company's past disposal practices. Trichloroethene (TCE) and trichloroethane (TCA) have been found under the facility at levels of 1,400,000 ppb (parts per billion) and 750,000 ppb, respectively. Several other organic chemicals and heavy metals have also been detected in lesser amounts. Off-site groundwater monitoring has indicated that contamination has traveled about one mile west of the plant boundary. Several irrigation and unused domestic wells in the area have been tested and found to contain organic pollutants, especially TCE. The closest public drinking water well, however, is located more than six miles from the plant. Ten storm-water drainage wells are present at this site.

To date, the facility has drilled 33 groundwater monitoring wells, including 23 multi-point wells. With this knowledge, how should we proceed with the investigation?

- Determine if contamination was the result of injection practices. If so:
  - Determine the fate of the injection wells (plugged?).
  - Who conducted and supervised the plugging event (if wells are plugged)?

What should be considered to classify the 10 injection wells?

- Are they susceptible to spills or receiving fluids other than storm water?
- Do the wells receive discharge from elsewhere? The inspector must remove the grate or well cover to make this determination.
- Make a physical evaluation of the liquid present at the time. Note: Evidence is an indication of what is happening at that moment. Classify each well as a 5D2 if it accepts solely storm water. Classify as a 5D4 if the system is susceptible to accepting other fluids (chemicals). Classify as a 5W20 if industrial process wastes are routinely discharged.

Also located on the facility were a number of wells used to dispose of condensate generated by air conditioners on the facility. How should the wells be classified?

- Classify as 5G30.

CASE #V-6

The following case introduces a situation in which a violation under another regulatory program could be helpful in identifying a UIC violation. The facility in question manufactures ejection seats and associated survival equipment for military aircraft. This equipment includes small rocket motors and solid rocket fuel. They began leasing this property from the State in 1972. The whole operation has been at this 160-acre site since 1978. There are 29 buildings and approximately 190 employees. Over 200 different materials are used in various manufacturing processes. A list of these was supplied to the inspectors.

There are six septic systems which serve restrooms in various buildings. There are two other subsurface disposal systems on the facility property. One septic system with a dry well receives wash water from an X-ray developing machine used for quality control. This system was operating from 1978 to 1983, at which time the waste stream diverted to a dry creek bed on site. From 1983 to 1986, the film developer wash was discharged continuously to the creek bed. The facility was cited for an NPDES violation regarding this discharge so they have reverted to the septic system. Analyses of the film wash water indicate that it exceeds National Primary Drinking Water Regulations standards for silver, cadmium, and chromium. The total dissolved solids level of the wash solution is very high. The system currently discharges 3 gpm for an average of 2 to 3 hours per day.

- The NPDES violation resulted in identification of the disposal practice in this case. The field inspectors in this instance sought and were supplied with analyses of the film wash water. The analyses showed some constituents to be in excess of the National Primary Drinking Water Standards. The system in question receives 360 to 540 gallons of effluent per day.

- The inspection report included the following recommendation: "It is recommended that a sample of the film developer wash water be collected and analyzed to verify its composition. Because an on-site water well supplied drinking water to employees, EPA may wish to require monitoring of the developer wash discharge and/or water supply well under a Class V permit."

- Although not confirmed, the basis of the NPDES violation was most probably due to the silver content in the waste stream. The constituents of the discharge have not changed unless the process which produces them has been altered. Sampling of the waste stream could prove it to be characteristically hazardous by EP Toxicity. If the sampling effort supports this suspicion, the inspection effort may identify the existence of a dry well disposing of hazardous waste into USDWs. This defines a Class IV injection well, which is declared illegal and banned under RCRA and UIC regulation.

FIELD WORK REQUIREMENTS

SECTION 18

FIELD WORK REQUIREMENT SUGGESTIONS

USEPA training course field requirements for program-specific training have not been established by EPA Order 3500.1.

The UIC inspector training course should contain a measure of field involvement by the participating persons. Previous training courses presented by the L.O.E. contractor have included 8 hours of field work (including drive time).

Some field activities should be planned based on the needs of the Region(s) involved. The degree of knowledge within a given group can be widely varied, and suitable field training for all may be unattainable. This fact may alienate some members of the group if the field activities do not stir their interest. The field work for previous courses has been kept elemental to address the needs of new inspectors. Each member regardless of background, shall benefit in some regard from the work. This section summarizes past activities planned by EEI to fulfill the field requirements for the USEPA inspector training course.

CLARKSVILLE, INDIANA

The group was led on a tour of the Dupont Louisville Plant. The facility has two permitted Class I hazardous waste injection wells. The facility tour was conducted in a manner similar to that practiced during an actual inspection.

The group first sat down with Dupont personnel to discuss background, nature of the facility processes, and waste generation. This was followed by the facility tour to view the well site and monitoring system. The tour was completed with a closing session to address any unanswered questions.

The afternoon field session was completed by visiting the lease of an independent oil and gas operator. The small lease was comprised of two producing wells and one Class II injection well. The session was initiated by an introduction by the operator at the injection plant. The group was then led to the well site to view the wellhead configuration and equipment.

SAN FRANCISCO, CALIFORNIA

The group was transported to Modesto, California to witness a number of municipal wells located throughout the city. The class was able to view stormwater drainage (5D4) wells in both a parking lot and loading dock.

Modesto contains a drainage basin designed to handle large volumes of storm water. Drainage wells are intermittently located along the length of the basin. The class was able to take a close look at several of these wells.

In addition to the Modesto visit, the class was given a field demonstration of sampling equipment. A crate of equipment was utilized to familiarize the group with material necessary to collect acceptable samples from Class V wells. A mock sampling station was set up, and each piece of equipment was identified with its specific function.

DALLAS, TEXAS

The group was transported to Sadler, Texas near Lake Texoma to tour the Big Mineral Production Unit. The production foreman for the field led the class on a guided tour of the entire unit. Beginning at the injection plant, the class watched the start-up of injection wells which had gone down due to an overnight power failure. The class was shown pumping units, source wells, injection wells, dual completion separation equipment, tanks, and the elaborate computer-controlled radio system of transmission at Big Mineral. Four injection zones and five production groups make Big Mineral a complex waterflooding operation, necessitating an equally complex monitoring system.

Facility tours, although valuable from an exposure standpoint, fall short of providing hands-on experience of inspection work. There are a myriad of field training activities which could be developed to enhance the knowledge of new inspectors. It must be understood that most inspection-related activities will require the cooperation and assistance of an operator to conduct such activities. The Region participating in the training course may choose the field training activities it considers most beneficial. Here are some suggestions for hands-on field activities, which could be arranged by the Regions:

- Conduct a mechanical integrity test.
- Witness a cased hole logging operation, such as:
  - Radioactive tracer survey;
  - Temperature log;
  - Noise log; or
  - Oxygen Activation log.
- Witness remedial work, such as:
  - Squeeze cementing; or
  - Compliance remediation
- Witness a plugging operation, which would involve:
  - Determining cement tops;
  - Pulling casing, tubing, and packer; and
  - Calculating and pumping cement.
- Conduct inspections (small teams).
- Perform sampling.
- Witness well construction activities.
- Review injection well permits.

CERTIFICATION TEST

UIC INSPECTOR CERTIFICATION TEST

REGULATORY STRUCTURE

1) The National Pollutant Discharge Elimination Systems was established by which environmental act?

   a) Safe Drinking Water Act
   b) Clean Water Act
   c) Resource Conservation and Recovery Act
   d) Toxic Substance Control Act
   e) Solid Waste Disposal Act

2) Point source discharges to waters of the U.S. are authorized by the:

   a) Safe Drinking Water Act
   b) National Pollutant Discharge Elimination Systems
   c) Resource Conservation and Recovery Act
   d) Toxic Substance Control Act
   e) Solid Waste Disposal Act

3) Spill Prevention Control Countermeasure regulations were established by which of the following?

   a) Resource Conservation and Recovery Act
   b) Safe Drinking Water Act
   c) Clean Water Act
   d) Toxic Substance Control Act
   e) 40 CFR

4) Which program was established to protect USDWs from endangerment by subsurface emplacements of fluids?

   a) Underground Injection Control
   b) National Pollutant Discharge Elimination System
   c) Superfund
   d) Wellhead Protection Program

5) The Underground Injection Control program was established under which of the following?

   a) Resource Conservation and Recovery Act
   b) Clean Water Act
   c) Safe Drinking Water Act

6) Management of hazardous waste falls under Subtitle C of the:

a) Safe Drinking Water Act
b) Federal Water Pollution Control Act
c) Resource Conservation and Recovery Act
d) Comprehensive Environmental Response, Compensation and Liability Act

7) Listed hazardous wastes are contained in:

a) Resource Conservation and Recovery Act
b) Solid Waste Disposal Act
c) Federal Water Pollution Control Act
d) Comprehensive Environmental Response Compensation and Liability Act
e) 40 CFR

8) Which act mandated a study to be performed to determine the effects of drilling fluids, produced water and other wastes associated with production of crude oil and natural gas?

a) Federal Water Pollution Control Act
b) Safe Drinking Water Act
c) Resource Conservation and Recovery Act
d) Clean Water Act

9) List the four criteria by which a waste can be considered characteristically hazardous as defined by RCRA.

1. ______________________
2. ______________________
3. ______________________
4. ______________________

10) Oil Pollution Prevention Regulations are established in:

a) Federal Water Pollution Control Act
b) Resource Conservation and Recovery Act
c) 40 CFR
d) Safe Drinking Water Act
e) Solid Waste Disposal Act

11) The National Priorities List refers to which of the following?

a) 40 CFR
b) Resource Conservation and Recovery Act
c) Safe Drinking Water Act
d) Comprehensive Environmental Response Compensation and Liability Act

12) Name three of seven containment systems acceptable to prevent discharged oil from reaching navigable waters.

1. ______________________
2. ______________________
3. ______________________

13) 40 CFR Part _____ establishes criteria and standards for underground injection wells.

a) 144
b) 145
c) 146
d) None of the above

14) The Land Disposal Restrictions Program regulates liquid hazardous wastes or free liquids associated with treatment of hazardous wastes.

a) True   b) False

15) Transporters of listed hazardous wastes may store the wastes for up to...

a) 5 days
b) 10 days
c) 15 days
d) 30 days

16) Dilution of wastes is allowed as a method of treatment in the Land Disposal Restriction regulations.

a) True   b) False

17) Name three areas that are prohibited for use as disposal sites by the Land Disposal Restrictions Program.

1. ______________________
2. ______________________
3. ______________________

UIC STRUCTURE

1) UIC Regulations are found in 40 CFR Part(s)...

   a) 144
   b) 146
   c) 144, 145, 146
   d) 144 through 148
   e) None of the above

2) States which have primary enforcement responsibility for the UIC program are called ____________________ states.

3) States which have Federally administered UIC programs are called ______________________ states.

4) Match each well to its class of well type.

1.	Class I	A.	Oil and gas enhanced recovery injection well
2.	Class II	B.	All other well types
3.	Class III	C.	Hazardous waste injection well
4.	Class IV	D.	Mineral extraction well
5.	Class V	E.	Radioactive waste injection well injecting above the USDW

5) Which of these is <u>not</u> a well according to the EPA definition?

   a) 24-inch casing driven 10 feet deep
   b) A pit with surface dimensions 4' by 4' by 6' deep
   c) A hole that is 4 feet deep and 6 feet in diameter
   d) A drilled hole 12 feet deep and 6 inches in diameter

6) A well completed with casing, tubing, and packer is an example of a ____________________ completion.

7) Name three types of unconventional completions.

   1. ______________________
   2. ______________________
   3. ______________________

8) Which of these is not a Class III well type?

a) Frasch sulfur mining well
b) Enhanced recovery well
c) In-situ leaching well
d) Solution mining well

˜˜ASS V WELLS

-) How many subclasses of Class V wells have been identified to date?

a) 16 b) 24 c) 32 d) 48

?) Which of the following represents a high-tech Class V well?

a) Improved sinkhole (5D3)
b) Cesspool (5W10)
c) Automobile service station disposal well (5X28)
d) Radioactive waste disposal wells (5N24)
e) None of the above

n

or

A 4' by 4' by 3' deep rock-filled pit located at an industrial facility and accepting only storm-water runoff is classified as a:

a) Storm-Water Drainage Well (5D2)
b) Industrial Drainage Well (5D4)
c) Special Drainage Well (5G30)
d) None of the above

;' in

drainage well located in a parking lot of an industrial ıcility, designed to accept stormwater, appears to be :cepting spills (stains on asphalt) from a chemical storage ea located up-gradient. The well should be classified as

erving
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l 1' in

Storm-Water Drainage Well (5D2)
Industrial Drainage Well (5D4)
Industrial Process Water and Waste Disposal Well (5W20)
Special Drainage Well (5G30)
None of the above

:er with

ı of the following items should be noted at each ction site?

ʼhe facility is connected to sanitary and/or storm ewer

ıe injectate is treated prior to injection

e construction date of the well

.ı and b

of the above

10) Which scenario would most likely pose the greatest environmental threat?

a) Service bay waste, treatment prior to injection, nearest water supply well <1 mile, low permeability injection zone, 100' vertical distance between injection zone and currently used USDW

b) Electroplating waste, treatment prior to injection, 1/2 mile to water supply well, moderate permeability, 25' vertical distance between injection zone and USDW

c) Silkscreening shop waste, no treatment, 3/4 mile to water supply well, high permeability (karst), 75' vertical distance between injection zone and USDW.

11) During a site inspection, the facility operator informs you that all waste fluids generated are discharged to the city sewer, except for storm water which is handled by drainage wells. Therefore, you --

a) only inspect the drainage wells and ignore a sump in the service bay and a floor drain in the painting booth.

b) inspect all drainage wells, sump, and floor drain.

c) verify that the facility is hooked into the city sewer system.

d) a and c

e) b and c

12) What two well types appear to pose the greatest threat to USDWs?

a) Industrial Drainage Wells (5D4) and Industrial Process Water and Waste Disposal Wells (5W20)

b) Industrial Drainage Wells (5D4) and Automobile Service Station Disposal Wells (5X28)

c) Industrial Process Water and Waste Disposal Wells (5W20) and Automobile Service Station Disposal Wells (5X28)

d) Industrial Process Water and Waste Disposal Wells (5W20) and Untreated Sewage Waste Disposal Wells (5W9)

SAMPLING

1) When sampling a Class V system, the preferred sampling point is:

   a) as near to the potential contaminants as possible (drainage sump)

   b) at an intermediate stage between the point of origination and injection (septic tank)

   c) as near to the injection point as possible (monitoring tube)

   d) none of the above

2) To avoid sample contamination due to equipment materials, fluid sampling equipment should be constructed out of these materials:

   a) Teflon
   b) PVC
   c) Glass
   d) Stainless steel
   f) a, c, and d
   g) All are preferred materials

3) Fluid samples collected for a Volatile Organics Analysis should be transferred to the following container type:

   a) 2-40 ml. glass vials
   b) 1-80 ml. glass vial
   c) 2-500 ml. glass bottles
   d) 1-1 liter glass bottle

4) All sampling equipment should be decontaminated...

   a) before each sampling event.
   b) after each sampling event.
   c) prior to each day's sampling.
   d) following each day's sampling.
   e) a and b

5) Equipment blanks are:

a) supplied by the lab to assure no cross contamination in transport.

b) supplied by the lab to assure contamination is not present in their lab equipment.

c) prepared in the field to assure proper sampling techniques.

d) prepared in the field to assure proper equipment decontamination.

6) A fluid is considered RCRA hazardous based on pH if the pH is...

a) $\leq$ 1 or $\geq$ 11.5
b) $\leq$ 2 or $\geq$ 12.5
c) $\leq$ 3 or $\geq$ 13.5
d) $\leq$ 4 or $\geq$ 10

7) All waste fluids generated during the sampling process...

a) can be dumped back into the disposal well.

b) must be containered and put in the trash.

c) must be containered and stored on-site until analysis is complete for further determination of proper handling.

d) must be containered and always treated as hazardous waste.

8) Site health and safety plans should contain the following information:

a) Material Safety Data Sheets
b) Route map to nearest hospital emergency room
c) Police and fire department phone numbers
d) a and b
e) All of the above

FIELD SAFETY

1) Name the four basic routes of entry to the human body relative to exposure of harmful substances:

   1. ______________________
   2. ______________________
   3. ______________________
   4. ______________________

2) Which level of protection provides maximum protection from potentially hazardous contaminants?

   a) 1
   b) 4
   c) A
   d) D

3) Which route of entry is the most common accidental form of exposure and most likely cause of systemic illness?

   ____

4) Which four body parts should be afforded protective equipment to prevent injury during regular inspection activities?

   1. ______________________
   2. ______________________
   3. ______________________
   4. ______________________

MECHANICAL INTEGRITY TESTING

1) Wells completed with a small tubular string cemented to surface are ______________ completions.

   a) packerless
   b) slimhole
   c) tubingless
   d) dual
   e) annular disposal

2) Wells which injected between the surface casing and long string casing are ______________ completions.

   a) packerless
   b) slimhole
   c) tubingless
   d) dual
   e) annular disposal

3) When witnessing the cementing of a well, it is important to record all volumes of cement pumped, pressures exerted, and sizes of casings.

   a) True   b) False

4) Name three types of internal mechanical integrity tests:

   1. ______________________________
   2. ______________________________
   3. ______________________________

5) When conducting the standard annular pressure test, the pressure in the tubing has no bearing on the test pressure used for the test.

   a) True   b) False

6) Which of the following is a viable method of pressuring up the annulus for the standard annular pressure test?

   a) Pump truck
   b) Hand pump
   c) Nitrogen bottle
   d) Injection line pressure
   e) All of the above

7) It is good operating practice for the inspector to witness and record the amount of fluid returned from a pressure test.

a) True b) False

8) Which of the following is allowed by regulations to demonstrate external mechanical integrity?

a) Casing bond log
b) Noise log
c) Cement evaluation log
d) Temperature log
e) b and d

UIC INSPECTIONS

1) Which section of the Safe Drinking Water Act provides authority for inspectors to enter upon and inspect any facility subject to the UIC program?

   a) 1422
   b) 1425
   c) 1445
   d) 1545

2) When conducting an on-site field inspection it is important to...

   a) present proper credentials to the operator before conducting the inspection.
   b) gain entry unnoticed and identify yourself only when noticed by the operator.
   c) identify yourself to the operator before conducting the inspection.
   d) a and c
   e) All of the above

3) A notice of inspection form needs to be completed for every inspection.

   a) True b) False

4) Operators must always be notified when an inspection is going to take place at their facility.

   a) True b) False

5) Which of the following is <u>not</u> information that should be recorded at a Class II well inspection?

   a) Injection pressure
   b) Evidence of surface discharge
   c) Evidence of recent workover
   d) Annulus pressure
   e) Color of the wellhead sign

6) Inspection reports should be completed....

   a) within 24 hours
   b) within a week
   c) by the end of the month
   d) All of the above
   e) None of the above

7) Name three types of well inspections.

1. ______________________
2. ______________________
3. ______________________

8) Name three situations in which warrantless facility access is legally justified.

1. ____
2. ____
3. ____

9) When gaining entry into a facility, it is acceptable for the inspector to allow the operator to make a copy of the inspector's credentials.

a) True b) False

10) Specific information regarding the planned activities during the inspection should be written on the notice-of-inspection form prior to presentation to the operator.

a) True b) False

11) Inspection notes should be written in a:

a) spiral notebook
b) any pad of paper
c) bound notebook
d) bound notebook with numbered pages

12) Corrections to field notebooks should be handled by:

a) tearing out page and throwing away
b) correcting by copying on a separate sheet and discarding initial notes
c) marking out and putting initials near correction
d) erasing mistake and making correction

13) Interviewing employees at a facility that you are inspecting is a waste of time since they will not give you any good information due to their company loyalty.

a) True b) False

14) During a sampling inspection, when the owner/operator of the facility requests split samples, you should:

a) give the operator samples in the containers which he provides you with
b) give the operator samples in spare containers brought along for the inspection
c) refuse the operator samples
d) None of the above

PLUGGING AND ABANDONMENT

1) Produced water is suitable for mixing cement.

a) True b) False

2) When setting multiple plugs, each plug should be allowed to set for how long before the hole is recirculated and another plug sets?

a) 2 hours
b) 4 hours
c) 8 - 24 hours
d) Until the test cement at the surface hardens
e) None of the above

3) Removal of equipment (tubing, packer, etc.) in the well is the first operational step in plugging and abandoning the well.

a) True b) False

4) List 3 activities or considerations that can ensure cement plug quality:

1. ______________________________
2. ______________________________
3. ______________________________

WELL LOGGING

1) Because planned procedures are always altered at the well site, it does no good to be familiar with the well or procedure before you arrive on location.

   a) True   b) False

2) How long should a well be shut in before running a base temperature log?

   a) 0 hours
   b) at least 3 hours
   c) at least 8 hours
   d) at least 12 hours
   e) at least 24 hours

3) The cement bond log depends on sonic energy traveling through the casing fluid, casing, cement, and formations and returning to the sensor to give an indication of cement bond to the casing and formation.

   a) True   b) False

4) Cut off frequencies for the noise log output are (in Hz):

   a) 10; 100; 1000; 10,000
   b) 1; 5; 10; 20
   c) 200; 600; 1000; 2000
   d) 100; 500; 1000; 2000

5) The primary advantage of the Cement Evaluation Tool over the Cement Bond Log is that:

   a) it investigates radially
   b) it is a newer generation tool
   c) it is less expensive
   d) it is standardized

SECTION 19

INSPECTOR CERTIFICATION TEST

The UIC inspector certification test is to be administered to the class participants at the conclusion of the training course. Arrangements for grading the test may be made with the designated Work Assignment Manager at USEPA Headquarters.