

Guidelines for Commercial Exploration and Production Waste Management Facilities

**Exploration and Production Waste Management
Facility Guidelines Workgroup**

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Foreword

This document is the result of a cooperative effort among representatives of the oil and gas industry, commercial waste management facilities, and state governments to develop guidelines for managing exploration and production (E&P) waste. These guidelines reflect our industry's continuing commitment to environmental protection and to assuring that the wastes from oil and gas exploration and production are properly managed. These guidelines were developed by the an Exploration and Production Waste Management Facility Guidelines Workgroup, coordinated by the American Petroleum Institute (API), which represents a broad cross-section of parties interested in E&P waste management issues. The workgroup includes representatives from the following entities:

- ◆ American Petroleum Institute
- ◆ ARCO
- ◆ Chevron
- ◆ Exxon
- ◆ Marathon
- ◆ Mobil
- ◆ Newpark Resources
- ◆ Shell
- ◆ State of Colorado
- ◆ State of Louisiana
- ◆ State of Oklahoma
- ◆ State of Texas
- ◆ Texaco
- ◆ U.S. Liquids

These guidelines are intended to identify design, construction, and operational options that may be used, depending on site-specific conditions, at facilities to protect human health and the environment. Their purpose is to provide flexible guidance to waste management facility owners and operators while remaining protective of human health and the environment. Although these guidelines are intended to be useful to a varied audience, three audiences will find the information contained herein particularly useful: (1) E&P waste facility owners and operators; (2) customers of the waste management facility (*i.e.*, E&P companies); and (3) state regulatory personnel.

Please note that the terminology for various waste management techniques (*e.g.*, land treatment) may vary from state to state. This document includes a glossary (Appendix D) that describes what is meant by the terms as they are used in this document.

Users of this document should also refer to API RP 2219, *Safe Operation of Vacuum Trucks in Petroleum Service* for additional guidance on safe handling of hazardous material and safety in vacuum truck operations. API RP 2219 includes emphasis on hazard communication with its associated training (including BS&W), and specific comments regarding open discharge and alternatives when unloading vacuum trucks. For additional guidance, users may also refer to OSHA Safety and Health Information Bulletin SHIB 03-24-2008 *Potential Flammability Hazard Associated with Bulk Transportation of Oilfield Exploration and Production (E&P) Waste Liquids*.

Table of Contents

Foreword	i
Table of Contents.....	ii
Introduction	1
Section I: Key Facility Considerations.....	3
Overview	3
Chapter 1: Key Facility Considerations.....	4
1.1 Compliance with Required Regulations	6
1.1.1 Federal regulations.....	6
1.1.2 State regulations	7
1.1.3 Local regulations.....	7
1.2 Permitting Requirements	7
1.3 Closure/Post-Closure Planning	8
1.3.1 Closure plan	8
1.3.2 Post-closure plan	9
1.4 Financial Issues.....	9
1.3.3 Financial assurance for facility operation	9
1.3.4 Financial assurance for closure and post-closure activities.....	9
Chapter 2: Siting, Design, and Operating Considerations	11
2.1 Facility Siting.....	11
2.2 Basic Construction and Technical Considerations	12
2.2.1 Traditional land treatment.....	12
2.2.2 Hybrid land treatment.....	13
2.2.3 Evaporation ponds and other surface impoundments	13
2.2.4 Percolation ponds	14
2.2.5 Landfills.....	14
2.2.6 Salt caverns	14
2.2.7 Residual piles	15
2.2.8 Tank storage.....	15
2.2.9 Phase separation	16
2.2.10 Thermal desorption.....	16
2.2.11 Transfer stations	17
2.3 Basic Facility Operational Considerations.....	17
2.3.1 Operating plan.....	17
2.3.2 Employee training	17
2.3.3 Site security.....	18
2.3.4 Wildlife protection	18
2.3.5 Community relations	18
2.3.6 Inspection and monitoring	19
2.3.7 Maintenance.....	19
2.3.8 Pollution prevention	19
2.3.9 Waste acceptance plan.....	20
2.3.10 Waste tracking.....	20
2.3.11 Waste testing.....	20
2.3.12 Cross-media impacts.....	21
2.3.13 Secondary disposal	21

Section II: Assessing Risks/Mitigation Options	23
Chapter 3: Air Emissions and Related Issues	24
3.1 Introduction	24
3.1.1 Air Pathway Screening Tools.....	24
3.2 Mitigation Options Designed to Control Air Emissions	27
3.3 Mitigation Options For Aerated Surface Impoundments.....	27
3.3.1 Altering the operational practices at the facility.....	27
3.3.2 Changing the physical properties of the treatment process	28
3.3.3 Changing the properties of the waste prior to treatment	29
3.3.4 Changing the distance to potentially exposed populations	30
3.4 Mitigation Options For Evaporation Ponds, Mixing Basins, Land Treatment, and Other Similar Treatment Methods	30
3.4.1 Altering the operational practices at the facility.....	30
3.4.2 Changing the physical properties of the treatment process	31
3.4.3 Changing the properties of the waste prior to treatment	31
3.4.4 Changing the distance to potentially exposed populations.....	31
3.5 Mitigation Options For Residual Piles.....	31
3.5.1 Altering the operational practices at the facility.....	32
3.5.2 Changing the physical properties of the treatment process	32
3.5.3 Changing the properties of the waste.....	32
3.5.4 Changing the distance to potentially exposed populations.....	32
3.6 Controlling The Potential Impacts Of Sulfide-Bearing Wastes.....	33
Chapter 4: Water Issues.....	34
4.1 Introduction	34
4.2 Mitigation Options Available For Controlling Releases To Water	36
4.2.1 Changing the properties of the waste prior to treatment	36
4.2.2 Containing waste and waste leachate.....	36
4.2.3 Applying overflow protection measures	38
4.2.4 Installing leak detection methods	39
4.2.5 Monitoring the waste management area	39
4.3 Planning and Preparing for Spill Response.....	40
Section III: Appendices.....	41
Appendix A: Overview of Federal Statutes	41
Resource Conservation and Recovery Act (RCRA)/Solid Waste Disposal Act	42
Safe Drinking Water Act (SDWA)	45
Clean Water Act (CWA).....	45
Clean Air Act (CAA).....	47
Emergency Planning and Community Right-to-Know Act (EPCRA).....	47
Appendix B: Summary of State Regulations Related to E&P Waste Management Facilities	49
Appendix C: State Regulatory Contacts.....	64
Appendix D: Glossary.....	70

Introduction

Production of oil and natural gas results in substantial volumes of waste products. Produced water and drilling muds and cuttings represent the majority of these wastes. In addition, a wide range of other wastes are produced in much smaller volumes. E&P wastes typically contain volatile organic compounds (VOCs) and other waste components that, if managed properly, have little potential to impact human health and the environment. Although most E&P wastes are managed on-site, approximately one percent of these wastes are managed by commercial and centralized waste management facilities located off-site. These facilities use a variety of treatment and disposal methods and are located in a variety of environmental settings throughout the United States. Although all oil and natural gas producing states regulate on-site E&P waste management, regulations specific to off-site E&P facilities are less universal. States lacking regulations specific to commercial facilities apply a combination of on-site requirements and site-specific determinations. In addition, all facilities, regardless of state regulation, are subject to numerous federal environmental regulations.

This document provides guidelines for the design and operation of commercial E&P waste management facilities. These guidelines may also be applicable to large centralized facilities operated by E&P companies. One objective of the guidelines is to allow facility operators to identify areas where their facility could have impacts on nearby populations or the surrounding environment and to provide options for preventing or reducing those impacts. These guidelines are not meant to supercede any applicable local, state, or federal requirements; they are intended to work with existing regulations and allow facilities to enhance protection of human health and the environment as warranted.

Specifically, this document provides facility operators with the following information:

- ◆ Key facility considerations (Chapter 1);
- ◆ Siting, design, and operating considerations for building a new facility or operating an existing one (Chapter 2);
- ◆ Options for assessing and reducing the potential impacts or nuisance that a facility's operations may pose to the surrounding environment and community (Chapters 3 and 4); and
- ◆ Other basic information, such as summaries of existing state regulations, regulatory contacts, and a glossary (Appendices).

Users are cautioned that the information in this document is not all-inclusive and may not cover all types of waste management situations. Because of the diversity of geographic, geologic, hydrologic, and climactic conditions in which E&P waste management facilities operate, these guidelines are designed to offer options or alternatives rather than prescribe recommended practices. What is appropriate for one location may not be appropriate in another. In developing these guidelines, it has been impossible to consider every factor that could affect whether the facility may have an impact on the surrounding environment; this effort has focused on the major considerations. Facility operators should consider the applicability of the options provided to the conditions at their site, also considering any relevant factors not covered by this document. Facility operators, working with state regulators where appropriate, are best positioned to determine the appropriate design, operation, and environmental protection measures for a specific facility.

These guidelines are divided into three sections:

Section I contains reference information designed to assist operators in the design and operation of a facility that is appropriate to its setting. Section I is divided into two chapters: Key Facility Considerations (Chapter 1); and Siting, Design, and Operating Considerations (Chapter 2).

Section II provides information necessary for a facility operator to assess the potential risks posed by a facility's operations and also offers suggestions for reducing those potential risks. Section II is divided into two chapters: Air (Chapter 3); and Water Issues (Chapter 4). Depending on the specific wastes managed and treatment processes used at a facility, one or both of these chapters may be applicable.

Section III contains appendices to these guidelines, which include summaries of relevant regulations, a list of regulatory contacts, and a glossary of terms. Because state agencies vary in their use of terminology, the glossary describes what is meant by particular terms used in this document.

Section I: Key Facility Considerations

OVERVIEW

Section I focuses on considerations that are not directly related to whether a facility currently poses any risks to human health or the environment. They range from logical good business practices (i.e., being in compliance with all applicable laws and regulations) to design and operational considerations associated with specific waste management practices. This section of the guidelines should be reviewed by all facilities to identify any areas where changes or improvements may be warranted. This section of the guidelines is divided into two chapters:

- ◆ Chapter 1 provides key functional considerations for facilities. These include typical factors evaluated in auditing protocols used by E&P companies to determine if a facility is suited to handle their wastes.
- ◆ Chapter 2 presents general siting, design, construction, and operating considerations appropriate for different waste treatment, storage, and disposal methods. This section provides a brief overview of each method, followed by important considerations for assuring environmental protection. Because of differences among states in the use of terminology to describe waste treatment and disposal practices, readers should refer to the Glossary (*Appendix D*) for the meanings of terms used in this document.

As mentioned before, it is impossible for guidelines of this type to consider all of the differences that may be appropriate for the wide diversity of settings in which commercial facilities exist. The practices suggested in these guidelines should always be evaluated for applicability in a given situation. However, where reasonable opportunities exist for improvements in environmental protection above current facility operations, facilities are encouraged to consider their implementation.

CHAPTER 1: KEY FACILITY CONSIDERATIONS

Chapter 1 outlines key considerations for all commercial E&P waste management facilities. Each facility should consider whether its practices and procedures are consistent with the material presented in this chapter (or with more stringent state regulations, where applicable). **Sections 1.1 and 1.2** of this chapter provide a brief discussion of regulations that are potentially relevant for many commercial and centralized waste facilities. Facility owners and operators should not, however, rely on the information presented for compliance. Legal counsel should be sought as appropriate regarding federal, state, and local requirements applicable to a particular facility. **Sections 1.3 and 1.4** provide a brief overview of financial assurance and closure/post-closure considerations for waste management facilities.

1.1 Compliance with Required Regulations

Facilities must comply with all applicable federal, state and local regulations. This section identifies federal statutes relevant to E&P waste management. The Environmental Protection Agency (EPA) implements these statutes through hundreds of pages of regulations that are codified in the Code of Federal Regulations (CFR). **Appendix A** contains a brief synopsis of the statutes and regulations that are most likely to apply to E&P waste management facilities. For more complete information regarding which regulations apply to a specific facility, a comprehensive regulatory analysis should be completed to determine the applicability of more specific federal, state, and/or local regulations. Facilities should consult with appropriate federal, state, or local regulatory agencies. Consultation with legal counsel and an experienced environmental engineer is also recommended.

The information below and in Appendix A are neither comprehensive, nor applicable in all situations. Facilities should be aware that pending rulemakings may alter current requirements in the near future. It is the responsibility of each facility to identify and comply with all relevant requirements.

1.1.1 Federal regulations

Since the 1970's, a myriad of federal legislation has been enacted that either directly or indirectly regulates the management of waste generated during oil and natural gas E&P activities. Again, not all of the following environmental laws will be applicable to every facility, and additional federal laws may apply in certain circumstances. Potentially relevant federal statutes include the following:

- ◆ Resource Conservation and Recovery Act (RCRA);
- ◆ Safe Drinking Water Act (SDWA);
- ◆ Clean Water Act (CWA);
- ◆ Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA);
- ◆ Emergency Planning and Community Right-to Know Act (EPCRA; also referred to as "SARA Title III");
- ◆ Clean Air Act (CAA);
- ◆ Toxic Substances Control Act (TSCA);
- ◆ Oil Pollution Act of 1990 (OPA);
- ◆ Migratory Bird Treaty Act (MBTA);
- ◆ Endangered Species Act (ESA); and

- ◆ Hazardous Materials Transportation Act (HMTA).

Additional requirements may be imposed for those facilities located on lands administered by the Bureau of Land Management (BLM). The Federal Land Policy and Management Act of 1976 establishes comprehensive land use guidelines for BLM on properly managing the public lands under its jurisdiction. As such, facilities may be subject to additional BLM requirements where applicable.

1.1.2 State regulations

Applicable state regulations can include air quality standards, permitting requirements, and siting criteria that may be significantly more stringent than existing federal regulations. For a complete listing of all state regulations applicable to the operation of an E&P waste management facility, it is recommended that facilities consult with the proper regulatory agency. In most cases, state agencies can be contacted on the World Wide Web at [www.state.\[state abbreviation\].us](http://www.state.[state abbreviation].us) (e.g., the State of Texas is www.state.tx.us). Summaries of selected state regulations specifically applicable to commercial E&P waste management facilities are provided in Appendix B of this document. Key state agency contacts can be found in Appendix C.

1.1.3 Local regulations

Applicable local regulations may also include more stringent air and water quality standards, permitting requirements, operating conditions, and siting criteria. For a complete listing of all local regulations applicable to the operation of an E&P waste management facility, it is recommended that facilities consult with the proper regulatory agency. This information can usually be obtained by contacting the related state agency (*see Appendix C*).

1.2 Permitting Requirements

Although many E&P wastes are exempt from RCRA Subtitle C hazardous waste regulations, facilities are likely to be responsible for complying with several state and local permitting requirements that may be more stringent than current federal regulations. To determine applicability, facilities should begin by completing a regulatory analysis of federal, state, and local laws to determine applicable permitting requirements (*see section 1.1 of this document*). The permits required will vary depending on a facility's practices and operations. In many cases, even though a permit is required under federal law, the state may be the applicable permitting authority. State permitting requirements may also apply. Federal environmental permits applicable to commercial E&P waste management facilities could include, but may not be limited to the following:

- ◆ NPDES Permits under the Clean Water Act. National Pollutant Discharge Elimination System (NPDES) and/or state equivalents are required for point source discharges into U.S. waters.
- ◆ Storm Water Permits under the Clean Water Act. Part of the NPDES program, these regulations require that facilities discharging storm water associated with construction or industrial activity obtain an Individual, Group, or General Storm Water Permit.
- ◆ UIC Permits under the Safe Drinking Water Act. The Underground Injection Control (UIC) Program and individual state programs are designed to protect underground sources of drinking water; injection and disposal wells must be permitted through the UIC program. In some cases, production wells may also be covered by the UIC program.

- ◆ Clean Air Act Permits. If a facility's emissions are above certain thresholds, or if the facility is located in an area that does not meet one or more national ambient air quality standards, an operating permit may be required. Additional permits may be required for construction activities.
- ◆ Solid Waste Disposal Facility Permits. Many states require a permit or other authorization (for example, a permit by-rule) for facilities that dispose of E&P wastes. If the facility handles other types of wastes, or generates wastes of its own, additional federal or state waste disposal permitting requirements may also apply. Financial assurance (*see section 1.4*) and closure/post-closure (*see section 1.3*) provisions may also be included in a facility permit.

After identifying applicable federal, state and local permit requirements, a facility should apply for all required permits, and upon issuance, comply with the requirements outlined in the permit. It is recommended that facilities implement a system for assuring compliance with permit terms and conditions, including the use of compliance audits. All permitting information should be kept up-to-date and on file in a location available to both regulators, customers, and facility auditors.

1.3 Closure/Post-Closure Planning

The responsibility of the facility operator does not end with the last load of waste managed. Facility operators will have costs for closing the facility and for any post-closure monitoring and care that the state regulatory agency or the facility operator determines is appropriate. Since the facility owner and operator will have liability for the site, even after closure, an evaluation of appropriate closure and post-closure measures is recommended.

The closure process is designed to ensure that any contaminants remaining at the site after closure do not pose an unacceptable risk to public health, safety, and the environment. Closure may include installation of containment structures and removal or further treatment of on-site wastes. Post-closure care may also be required to ensure thorough long-term monitoring and maintenance and that the facility is properly closed.

1.3.1 Closure plan

Facilities should have a written closure plan for all wastes contained within the facility's borders. The plan should identify the necessary steps to perform closure of the facility, assuming all tanks, pits, landfills, etc. are at capacity. Although each state may have its own requirements for closure plans, each facility's closure plan should be tailored to the site-specific characteristics present and take into account future land use. Facilities should consider, at a minimum, the following when developing the closure plan:

- ◆ Overall goal and method of closure;
- ◆ Future land use;
- ◆ Treatment unit type;
- ◆ Waste type, waste volume, and the physical state of waste contained in the unit;
- ◆ Waste components;
- ◆ Closure schedule;
- ◆ Estimated cost of closure and how it will be funded;
- ◆ Contingency plans (where needed); and

- ◆ Performance-based standards for the unit's post-closure life.

1.3.2 Post-closure plan

Once the facility's treatment units have been closed, post-closure care may be required. State or local regulations may establish time frames for post-closure requirements. Hazardous waste facilities are generally monitored for 30 years after closure. Often, E&P waste facilities require no post-closure care or a period of monitoring significantly shorter than that required for facilities handling hazardous wastes.

Much like closure, post-closure care should be done to reduce or eliminate the potential for off-site migration of any wastes or waste components. Post-closure care should take into account site-specific characteristics, the elements of the closure plan, and the elements of the post-closure plan. Routine maintenance of the facility's treatment units, groundwater monitoring wells, and other controls are all key components of proper post-closure care. The post-closure plan should consider, at a minimum, the following:

- ◆ How the costs for maintenance and monitoring will be secured; and
- ◆ A detailed description of the steps necessary to assure that wastes remain contained within the facility and do not pose a threat to human health and the environment.

1.4 Financial Issues

Permitting may be contingent upon securing appropriate financial assurance. Financial assurance may be required to cover payment of closure and post-closure care and monitoring costs. Permit applicants are encouraged to complete a regulatory analysis to assess the requirements for financial assurance and the structure and amount of assurance required.

Even where a state does not require financial assurance, a facility operator may find that it is beneficial to assure that adequate liability insurance is maintained and that adequate funding is available for closure of the facility and any post-closure care. Customers are generally reassured that they will face minimal future exposure if the facility can demonstrate it has adequately provided resources for the continued operation and eventual closure of the facility.

1.3.3 Financial assurance for facility operation

Facilities should maintain comprehensive general liability insurance covering items such as bodily injury and property damages caused by accidental occurrences. State or local regulations may specify the amount of coverage required depending upon several factors, including the type and size of the facility. Facility operators should evaluate the amount of insurance coverage appropriate and be able to provide evidence to customers of the level of insurance in place.

1.3.4 Financial assurance for closure and post-closure activities

The amount of financial assurance required for closure and post-closure is based on the unique characteristics present at each facility. Once a company has evaluated the necessary closure and post-closure requirements (*see section 1.3.1 and 1.3.2*), an estimated cost should be developed for each element to determine the total amount of financial assurance that may be appropriate. When determining the appropriate amount, estimates should take into account the costs that a third party would incur during the closure and post-closure processes. Depending upon state regulations, a variety of financial mechanisms may be available to demonstrate financial assurance, including: cash in a trust fund, a financial means test, surety bonds, letters of credit, environmental insurance, and guarantees.

Facility operators may find it beneficial to maintain copies of their financial assurance provisions at the facility or another location at which they can be made readily available to customers, regulators, and environmental auditors.

CHAPTER 2: SITING, DESIGN, AND OPERATING CONSIDERATIONS

This section outlines the basic design, siting, and operating considerations appropriate for the types of treatment and disposal methods typically employed at commercial E&P waste management facilities. More specific information on environmental protection measures that may be appropriate to mitigate any risks posed are included in Chapters 3 and 4. As with many of the other considerations discussed in these guidelines, the proper design of a facility and the appropriate environmental controls are a function of many site-specific factors.

In some states, oil and gas production may result in wastes containing naturally occurring radioactive materials (NORM). NORM waste requires special management to assure protection of human health and the environment. Facilities that plan to accept NORM wastes should work with state agencies on appropriate design, management, and protective measures. The considerations outlined in this section of the report are for non-radioactive wastes and may not be sufficient for NORM wastes.

Establishing facility design guidance for different waste treatment and disposal methods ensures the adequate containment and disposal of wastes within given treatment units and also reduces the overall impact facilities may have on the surrounding environment and nearby populations.

2.1 Facility Siting

Facilities should consider the surrounding land use when siting treatment units or building new facilities. Facilities should be appropriately spaced from established residences, churches, schools, day care centers, surface water bodies used for a public drinking water supply, dedicated public parks, or sensitive environmental areas, such as wetlands. Facilities located near sensitive populations or environmental areas may need to take steps to ensure that facility impacts are minimized given the site-specific characteristics of the facility (*see Chapters 3 & 4 of these Guidelines*). Although there are differences in siting requirements among federal, state, and local regulations, owners should consider avoiding siting facilities in the following areas, whenever feasible. Additional design criteria may be necessary for facilities located in these areas:

- ◆ 100-year flood plains;
- ◆ Wetlands;
- ◆ Directly over an aquifer's recharge zone;
- ◆ Areas of direct drainage into a lake, river, or stream;
- ◆ Near aboveground or underground pipelines or transmission lines;
- ◆ Habitat for designated threatened and endangered species; and
- ◆ Recreation or preservation areas and scenic river locations.

E&P waste management facilities are located in a variety of environmental settings across all producing states, so the specific geologic and hydrologic considerations will vary from one site to the next. Nonetheless, the following geologic and hydrologic factors may be appropriate to consider during the siting, design, and operating phases of a facility:

- ◆ Highest anticipated elevation of underlying groundwater;
- ◆ Soil characteristics and the hydraulic conductivity of underlying natural geologic materials;

- ◆ Earthquake potential; and
- ◆ 100-year floods, hurricanes, tsunamis, seiches, and surges.

2.2 Basic Construction and Technical Considerations

To ensure the successful treatment of wastes consistent with environmental and human health concerns, basic construction and technical considerations are provided for each of the treatment methods typically used at E&P waste management facilities. The information in this section represents a range of factors that facilities are encouraged to consider, based on the site-specific characteristics found at the facility. For instance, for facilities that handle only produced water and/or are located in areas that are distant from human populations, less stringent criteria may be appropriate. Facilities located close to human populations may need more stringent criteria. Additional information on environmental control technologies relevant to these treatment methods can be found in Chapter 3 (air mitigation technologies) and Chapter 4 (water mitigation technologies).

Routine inspection and maintenance at the facility and proper recordkeeping are important considerations in the operation of all types of waste treatment units to assure that human health and the environment are protected.

Because states vary in their use of terminology for certain waste treatment and disposal practices, it is recommended that readers consult the Glossary of terms located in Section III to clarify the meanings used in this document.

2.2.1 Traditional land treatment

Land treatment includes land farming, land spreading, and other similar waste application methods. Land treatment units generally utilize biodegradation to treat waste. Except in certain circumstances, traditional land treatment may be inappropriate for liquid wastes. Where biodegradation is important to the treatment process, the treatment unit must be designed and operated properly to facilitate the biodegradation process.

Design considerations. Land treatment units should be equipped with controls to prevent rain water and other liquids from running onto the unit (creating leachate) and to prevent leachate from running off the unit and carrying waste components into surrounding soils and nearby waters. Controls to prevent wind gusts from blowing small particles off land treatment units into the air and onto surrounding property and surface water should also be employed. As part of these efforts, facilities should consider the following:

- ◆ Wind dispersal controls (*e.g.*, decreased agitation, sprinkler system [*see section 3.2*]);
- ◆ Run-on and runoff controls (*e.g.*, adequate freeboard, dikes, berms [*see section 4.2*]); and/or
- ◆ Proper moisture content in the soil-waste matrix.

Operating considerations. Several operational activities are key to the successful operation of a land treatment unit. Land treatment units should be operated considering the following:

- ◆ Preventing pooling of oily liquids;
- ◆ Controlling the rate and method of waste application;
- ◆ Controlling soil chemistry and moisture content; and
- ◆ Enhancing microbial, chemical, and physical reactions appropriate for proper waste treatment.

The American Petroleum Institute has developed several publications that may be helpful in establishing operational considerations for land treatment units. These include “Evaluation of Limiting Constituents Suggested for Land Disposal of E&P Wastes” (API Pub. No. 4527), “Criteria for pH in Onshore Solid Waste Management in E&P Operations” (API Pub. No. 4595), and “Metals Criteria for Land Management of E&P Wastes” (API Pub. No. 4600). These publications may be ordered by calling API at 202-682-8000 or through the API web site at www.api.org/cat.

2.2.2 Hybrid land treatment

Hybrid land treatment is a technique that involves the placement of E&P waste in an excavated cell, washing the waste with freshwater to remove salts, injecting the resulting water into a Class II well, and then drying the remaining solids. The primary objective of this treatment method is the reduction of total chlorides to below regulatory criteria to allow the waste to be reclassified as reuse material. Some biodegradation of hydrocarbons in the waste also occurs, but this is not the primary objective of this treatment method. This technique is used most frequently in the State of Louisiana.

Design considerations. To facilitate the washing process, the treatment cell should be lined with a leachate collection system. The liner material and thickness should be appropriate to the hydrologic conditions at the site. Where wastes with higher hydrocarbon content are accepted, the need for additional separation prior to loading wastes or skimming of free oil during the washing process should be considered.

2.2.3 Evaporation ponds and other surface impoundments

Where climate allows, evaporation ponds and surface impoundments can be very effective for managing certain waste types. In designing and operating evaporation ponds or surface impoundments, it may be appropriate to consider the amount of salt, oil and grease, and metals in the waste streams managed in this manner, and how they may affect the dried, residual material and/or liner, if applicable. Wastes with a high oil or hydrocarbon content may be inappropriate for treatment in evaporation ponds or other surface impoundments unless the hydrocarbons are removed prior to placement in the impoundment.

Design considerations. Evaporation ponds and other impoundments should be designed to minimize the potential leakage of waste material or leachate from the treatment unit and to prevent migration of wastes into nearby water resources. Appropriate measures include proper siting of the facility (*section 2.1*) and consideration of site-specific characteristics. In designing the facility, an appropriate combination of the following protective measures should be considered:

- ◆ Dikes, berms, and freeboard;
- ◆ Clay or synthetic liners;
- ◆ Leachate collection and removal systems;
- ◆ Leak detection systems;
- ◆ Groundwater monitoring to identify leachate migration (where deemed appropriate); and/or
- ◆ Wildlife protection measures (*see section 2.3.4*).

Operating considerations. Evaporation ponds and surface impoundments should be operated in a manner that prevents off-site migration of waste or waste components from the treatment unit. Facility operators should consider the need for:

- ◆ Routine visual inspection of the treatment units to assure adequate freeboard and that wildlife protection measures are intact (where applicable); and
- ◆ Routine skimming operations to remove floating waste components, thereby reducing volatilization of free hydrocarbons.

2.2.4 Percolation ponds

Percolation ponds are used to allow produced water to percolate into the ground. The pond should act only as a holding facility while gravity allows the water to percolate or seep through the soil or other unconsolidated medium. Percolation ponds are allowed in only a few states; check applicable state regulations for information on their design. Typically, states will permit percolation ponds only in areas where groundwater is quite deep or absent, or separated by geologic barriers, such as clay or shale zones, to minimize the potential for impact from the produced water.

2.2.5 Landfills

A landfill is a disposal unit at which non-liquid waste is placed in or on the land. Landfills are not designed to treat wastes as, for example, land spreading or a surface impoundment may. Landfills are generally intended to be a final disposal site for waste or waste residues. Landfills are used to dispose a significant portion of the industrial and non-industrial waste that is generated in the United States. Many municipal landfills throughout the country currently accept certain types of E&P waste. Facilities that are permitted to operate as either industrial or municipal landfills handling E&P wastes must do so in accordance with applicable state and local rules, regulations, and permit provisions. Although not common, a landfill can be operated solely for acceptance of E&P wastes. For purposes of completeness, these guidelines include design and operating considerations for landfills because some wastes from E&P waste management facilities are taken to landfills.

Design considerations. Depending on the types of wastes placed into a landfill, facilities should take appropriate measures to minimize the potential for leachate to leak from the unit and contaminate nearby resources. Facilities should consider an appropriate combination of the following controls:

- ◆ Single or double liner (clay or synthetic);
- ◆ Leachate collection and removal system;
- ◆ Leak detection system; and
- ◆ Run-on, runoff, and wind dispersal controls.

Operating considerations. Facilities should follow applicable state regulations to minimize and/or prevent the formation and subsequent migration of leachate. Facilities should take appropriate measures to prevent voids under the landfill cover and to assure that liners and other controls are maintained.

2.2.6 Salt caverns

Interest in the use of salt caverns for disposal of E&P wastes has been growing. Salt cavern disposal generally consists of injecting waste into an excavated or solution-mined salt deposit under low pressure for permanent disposal. Currently, there are only a few salt caverns in the United States licensed to accept E&P waste, all of which are located in Texas. Because the waste is injected into the caverns through a well, salt caverns are regulated as part of the state's underground injection control program. As use of this waste management option increases, injection regulations and more specific design and operating guidance tailored to salt cavern disposal may be developed.

2.2.7 Residual piles

A residual pile is an open pile used for treating or storing non-liquid material. Although the requirements for these units are very similar to those for landfills (*see section 2.2.5*), residual piles should be used only for temporary storage, not ultimate disposal.

In some cases, E&P waste management facilities may store residual, treated material in the residual pile prior to re-use. This material should be managed to minimize particulate emissions from the storage piles (*see section 3.4*). Liners and other protective measures are generally not needed because the waste being stored has already been treated to state standards for re-use. However, facility operators should consider whether dikes, berms, or other containment structures around the area of the residual piles should be installed to prevent the migration of soils into nearby streams. This is true even for materials that have met treatment standards and are considered reusable material. Uncontrolled runoff from these piles can still cause excessive sediment loading and thereby negatively impact nearby waterways.

2.2.8 Tank storage

Tanks are stationary devices (as opposed to portable containers) used to store or treat waste. Tanks are widely used for liquid waste storage or accumulation. Tanks can be aboveground or underground, although aboveground tanks are preferred because they are easier to inspect and maintain. In order to ensure that a tank system can hold waste for the tank's intended lifetime, the facility should ensure that the tank is properly designed. The tank system and its components should be designed with adequate foundation, structural support, and corrosion protection to prevent it from collapsing or leaking. Leak detection and prevention provisions – such as a concrete base, leak detecting bottom, or a raised foundation – should also be considered.

Installation considerations. New tank systems should be inspected prior to use to ensure that the tank was not damaged before or during installation. All new tanks and ancillary equipment should be tested to make sure that there are no leaks; any leaks discovered must be repaired before the tanks are covered, enclosed, or placed in use.

Design/Operating considerations. Tanks should always be operated in a manner that minimizes or eliminates releases. Waste characteristics should be consistent with the design of the tank (e.g., wastes that may react with the tank components should not be placed in the tank). Because the loading or filling of tanks may create the potential for spills or releases of waste into the environment, the following prevention or containment measures should be considered:

- ◆ Spill prevention controls (such as valves) designed to prevent the backflow of waste during filling;
- ◆ Overfill prevention controls, such as alarms that sound when the waste level in the tank exceeds a specified point, or valve systems that automatically close when overfill is likely;
- ◆ When appropriate, emissions controls, such as vapor recovery units or flares;
- ◆ Sufficient space within an uncovered tank between the surface of the waste and the top of the tank (minimum freeboard);
- ◆ Secondary containment (dikes or berms) that is capable of containing the entire volume of the tank; and/or
- ◆ Regular inspection of site security measures.

Where tanks contain wastes or liquids that may be flammable (regardless of whether they are exempt E&P wastes under RCRA), facilities should consider state and local fire regulations that may affect tank operations.

2.2.9 Phase separation

Phase separation is often used as part of waste treatment, although these methods are typically combined with other treatment or disposal techniques. Commonly employed phase separation techniques include the use of skimming operations, centrifuges, belt presses, and shakers. While all of these techniques differ in their particulars, each of them generally serves as a pre-processing step to disaggregate the waste into solid, oil, and water phases. This allows both for the recovery of useable oil and for the most efficient treatment of remaining solids and liquids.

- ◆ *Skimming operations.* One of the most common phase separation techniques used at E&P waste management operations is surface skimming from impoundments and open-top tanks. A typical skimming operation involves the placement of oily wastes in a quiescent (still, or non-aerated) surface impoundment or a tank, allowing free oils to collect on the surface, and then using some method to skim the free oil into a collection basin. Regardless of the specific method by which the oil is collected, this process enables free oils to be collected and recycled.
- ◆ *Belt press.* Wastewater treatment processes in other industries often use a belt press to separate solids and liquids. This technique is sometimes used with E&P wastes. In a typical belt press operation, the waste sludge is pumped onto a fabric or mesh belt. The belt moves through a series of rollers that squeeze the liquid out of the sludge producing relatively cleaner liquid and a solid “cake.” Following treatment with a belt press, the solid and liquid components can be further recycled, treated, or disposed in separate processes.
- ◆ *Centrifuges/Hydrocyclones.* Common in offshore produced water treatment, centrifuges and hydrocyclones can also be effective in separating solid particles from liquid streams. In this process, the waste stream to be cleaned is placed into a separator in which the waste stream then moves in a circular pattern around the unit. Centrifugal force created by this spinning stream forces the heavier particles to the outer edges, while lighter particles remain in the carrier material. Non-liquid materials are removed from the separator for further treatment or disposal.
- ◆ *Shale shakers.* Shale shakers use vibrating platforms to separate larger solids from a waste stream. Shale shakers are typically used in oil and gas drilling operations as part of the drilling mud system to separate the cuttings from the mud so that the cuttings can be disposed and the mud can be recycled. In an E&P waste operation, shale shakers serve a similar purpose of separating larger solids prior to sending the wastes to a treatment/disposal process (e.g., deep well injection) that may be negatively affected by the presence of those larger components. The larger (solid) components are then disposed in another environmentally sound manner.

Design considerations. Phase separation operations should be designed to contain the wastes being treated and minimize the potential for soil or groundwater impacts. The specific design will be dependent on the waste being treated, the intended next step in the treatment process, and site-specific considerations. Where hydrocarbons are being separated and collected, adequate, well-designed storage should be available for the hydrocarbons removed (until they are sold for reclamation/recycling).

2.2.10 Thermal desorption

Thermal desorption is a treatment/pretreatment method that can be used to reduce the concentration of volatile waste components prior to primary treatment or ultimate disposal. Thermal desorption units heat the waste material and transport the volatilized water and organics to a gas treatment system. Two

common designs are generally employed – the rotary dryer and thermal screw (details of these designs and the process are further described in section 3.3.3). In many cases, thermal desorption may reduce the chemical content of the waste such that no additional treatment is needed. Thermal desorption, while significantly more expensive than some other E&P waste treatment methods, has the potential to reduce air emissions from facilities, provided that appropriate emission controls or vapor recovery units are applied to the process vents of the unit.

2.2.11 Transfer stations

Transfer stations receive and temporarily store E&P waste prior to transportation to a permitted treatment or disposal facility. A transfer station is an E&P waste receiving and temporary storage facility, located off-site, but operated at an approved location in conjunction with a permitted commercial treatment and/or disposal facility.

All transfer stations should be designed and operated to minimize releases to the atmosphere during waste transfer and unloading activities. Transfer stations should be limited to areas having adequate secondary containment structures to prevent releases to soil, surface water, or groundwater.

2.3 Basic Facility Operational Considerations

2.3.1 Operating plan

This section discusses the major components of a facility operating plan. The operating plan should cover the facility's main operational activities and may incorporate or reference other plans as appropriate. This section discusses a range of elements that facilities should consider; which of these are appropriate to include will vary with state regulations, site-specific conditions, wastes managed, and treatment methods employed.

An operating plan helps to document that the facility is properly designed and operated. In many cases, regulators will require that the facility document compliance with the elements of its operating plan (for example, through certification by professional engineers, inspection logs, and maintenance records) to provide an additional level of quality assurance.

2.3.2 Employee training

Employee training is a key element of a facility operating plan. All employees should be trained in facility procedures, plans, practices, etc. An effective training program should take into account the unique characteristics of the facility (*i.e.*, treatment methods, waste and waste components, and location). Because facility operations can potentially pose risks to workers, employees should understand the processes used to store, treat, and/or dispose waste and waste components.

As part of this effort, employees should be provided with safety training. A safety program should be consistent with requirements set forth by the Occupational Safety and Health Administration (OSHA) and any applicable state regulations. Possible topics in a facility safety program include, but are not limited to:

- ◆ Treatment methods and operating procedures;
- ◆ Waste identification and reporting;
- ◆ Inspection and monitoring;

- ◆ Safety hazards at the site;
- ◆ Health-related effects of facility operations; and
- ◆ Emergency response.

2.3.3 Site security

Security provisions are intended to prevent accidental or unauthorized entry into the active portion of a facility (*i.e.*, where waste is treated, stored, or disposed). The appropriate level of security depends in part on facility location and the use of surrounding lands. Potential security measures include, but are not limited to, the following:

- ◆ An artificial or natural barrier (*e.g.*, a fence, lockable gate) that completely surrounds the active portion of the facility and serves as a means to control entry to the active portion of the facility;
- ◆ A warning sign (*e.g.*, reading: “Danger — Unauthorized Personnel Keep Out”) at each entrance to the active portion. The sign should be written in English and any other language that is predominant in the area surrounding the facility; and/or
- ◆ A surveillance system that monitors and controls entry onto the active portion of the facility (*e.g.*, television monitoring, guards). Where deemed appropriate (*e.g.*, those in close proximity to residential areas, or high-activity wildlife areas), facilities may employ 24-hour security staffing and/or video monitoring.

2.3.4 Wildlife protection

Occasionally, birds and other wildlife may enter the facility. Birds, and other wildlife, are particularly attracted by impoundments or open top tanks containing liquids. Unable to distinguish between oil and water, they may become trapped or covered with oil, even if only a slight film of hydrocarbons covers the surface. The Migratory Bird Treaty Act of 1918 (16 U.S.C. 703) establishes criminal negligence penalties for any acts that may cause the death of migratory birds. Additionally, Section 7003 of RCRA authorizes EPA to order a facility to take action if its operations pose an imminent and substantial endangerment to human health or the environment. This authority has been used to protect birds and wildlife.

To prevent birds or other wildlife from becoming fatally injured, facilities should consider preventive measures, such as netting or covering open topped tanks or pits that contain oil, hydrocarbons, oil by-products, or oily wastes. Specific measures include the following:

- ◆ Open top tanks can be fitted with a solid cover made of wood, steel, or fiberglass or can be covered with a screen or net. Polypropylene netting with a 1-inch mesh size is frequently installed on open top tanks. The 1-inch mesh is needed to prevent small birds from getting through the net.
- ◆ Open-cell treatment units can be covered with a polypropylene net, with a tie down and support system to ensure the net stays in place. A secured net extends the life of the netting material.
- ◆ Fences and similar security measures can also prevent larger wildlife from entering the facility.

2.3.5 Community relations

The surrounding community’s perception of an E&P waste management facility can be as important as the reality of a particular facility’s daily operations. Community approval is often key to the siting of new facilities. For this and other reasons, it is essential that facilities located in populated areas consider the nature of their relations with the surrounding community.

An effective community relations effort should consider the unique nature of both the facility and its surrounding community. Facilities may find it valuable to evaluate the needs and concerns of the community. The needs and resources of the facility should also be considered. The greatest positive benefits are likely to be achieved through a program that facilitates respect, cooperation, and communication between the facility and the surrounding community.

If a facility decides to implement a community relations program, a key first step is to evaluate the facility and its operations, including assessing employee attitudes toward the facility. Once completed, facilities will be able to identify programs, practices, and initiatives that are effective and that can be shared with others. It may also alert the facility to aspects of facility operations that could be improved.

After assessing its own operations, the facility can then assess the needs and concerns of the surrounding community. Effective outreach will be facilitated by: (1) determining what issues are important to the community; (2) understanding the current relationship of the facility to the community; and (3) developing contacts with key local figures.

For more information about implementing a community relations program, see *Community Matters*, a guidance document from the American Petroleum Institute (order number G13660). The document can be ordered from API by calling 202-682-8000 or on the Internet at www.api.org/cat.

2.3.6 Inspection and monitoring

As part of the facility operation plan, the level, frequency, and type of inspection and maintenance needed should be considered. To ensure the safe and efficient operation of a facility's treatment units, routine inspections and monitoring are advised. The specific equipment or other elements (*e.g.*, freeboard, tank height, injection well data) to be monitored at each treatment unit should be detailed in a facility's plan. The facility should also consider the appropriate documentation of its inspection and monitoring activity and how this documentation should be made available for review by regulators, auditors, and customers.

2.3.7 Maintenance

Routine maintenance of all facility equipment and treatment units is essential for proper operation. A clean and orderly facility can be an effective step in preventing contamination, run-on, and runoff of waste and/or waste components. Preventive maintenance, which can include programs identifying inspection techniques and repair and replacement procedures, should also be considered. Visual inspection of the facility's treatment units, operational controls, and all related components can alert a facility to potential problems. Likely spill locations, storage areas, handling and transfer areas should be inspected routinely and effectively. Properly maintained operational and control equipment can minimize routine emissions to the environment as well as decrease the risk of accidental spills. Complete written maintenance records should be maintained at the facility.

2.3.8 Pollution prevention

Preventing waste generation and maximizing the recycling of waste components can minimize the amount of actual waste that will require some type of treatment or disposal. Opportunities to recycle include the recovery of hydrocarbons from crude oil tank bottoms, oily sludges, and oiled soils. Facilities should try to reuse or reclaim as many waste components as possible. Whenever possible, hydrocarbons should be reclaimed. The regulations applicable to recovered hydrocarbons may differ from those for E&P wastes. Facilities should evaluate whether different requirements apply and assure compliance with them.

2.3.9 Waste acceptance plan

Waste acceptance plans can help to ensure that facilities do not accept unauthorized waste types. The purpose of a waste acceptance policy is to define the requirements for characterizing, certifying, and documenting wastes handled by a facility. Proper waste identification and treatment are necessary components for the safe and effective management of wastes. State regulators may specify testing requirements that assure facilities receive certain constituent data from waste generators.

In some cases, additional information is required to appropriately manage certain wastes. In these cases, the facility may need to conduct its own sampling and analysis before beginning treatment of the waste. As an alternative, a facility may elect to require additional information from waste generators prior to waste acceptance; this requirement would probably be limited to a few wastes or waste streams for which special handling may be appropriate. To assist on-site personnel, who in some cases may be accepting waste 24 hours per day, a facility's waste acceptance policy should include, at a minimum, the following elements:

- ◆ Types of wastes accepted;
- ◆ Generators pre-authorized to dispose of wastes at the facility;
- ◆ Waste haulers pre-certified to transport wastes to the facility; and
- ◆ Procedures to follow when unauthorized wastes or wastes from an unauthorized generator or hauler arrive at the facility.

2.3.10 Waste tracking

Waste tracking can be used to regulate the transportation of E&P waste to a commercial or centralized disposal facility. Some states have existing waste tracking or manifest systems. Even if the state where a facility is located does not have a manifest system or tracking system, a facility could request that generators and haulers complete a bill of landing for the waste as part of the disposal requirements for the facility. This practice benefits the facility, providing a method to identify the waste and its sources, along with a certification by the generator or hauler that the waste is as described.

Facilities that want to implement a waste tracking system (in the absence of a state program) may consider the following:

- ◆ Utilizing a multi-part form with information on the generator, hauler, and source facility; a description of the waste; the time and date it was collected, hauled, and deposited at the disposal facility; and the volume of the waste;
- ◆ Retaining the form for a minimum of three years;
- ◆ Certifying that wastes are exempt and have been properly handled; and
- ◆ Documenting discrepancies.

2.3.11 Waste testing

Waste testing may be performed by the generator of the waste (i.e., the E&P company), the E&P waste treatment facility, independent laboratory, or any combination of these. Depending on the waste type or concern, the objectives for testing wastes could include:

- ◆ Verifying that the waste is an E&P waste and is approved for disposal at the facility;
- ◆ Verifying that a non-exempt waste is non-hazardous (testing for hazardous characteristics);