RCRA Training Module

Solid Waste and Emergency Response
(5305W)
EPA530-K-05-014

Introduction to

Land Disposal Units

(40 CFR Parts 264/265, Subparts K, L, M, N)

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United States
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Agency

LAND DISPOSAL UNITS

CONTENTS

1. INTRODUCTION

Subtitle C of the Resource Conservation Recovery Act (RCRA) creates a cradle-to-grave management system for hazardous waste to ensure proper treatment, storage, and disposal in a manner protective of human health and the environment. Under RCRA §3004(a), Congress authorized EPA to promulgate regulations establishing design and operating requirements for land disposal units (LDUs). The requirements are intended to minimize pollution resulting from the disposal of hazardous waste in or on the land. RCRA §3004(k) defines land disposal as placement of hazardous waste in any of the following nine types of units:

- landfill
- surface impoundment
- waste pile
- injection well
- land treatment facility.
- salt dome formation
- salt bed formation
- underground mine
- underground cave

EPA has promulgated unit-specific technical standards for four of these LDUs within the treatment, storage, and disposal facility (TSDF) requirements in 40 CFR Part 264/265. This module provides an overview of the requirements for these four LDUs: landfills, surface impoundments, waste piles, and land treatment units. LDUs that do not qualify as one of these units are considered miscellaneous units (see the module entitled Miscellaneous and Other Units for more details).

When you have completed this module, you will be able to summarize the land disposal unit standards and list the relevant statutory and regulatory citations. Specifically, you will be able to:

- cite the statutory and regulatory minimum technological requirements
- summarize the differences between interim status (Part 265) and permitted (Part 264) standards for land disposal units
- find the definition of "surface impoundment" and distinguish surface impoundments from tanks
- describe surface impoundment retrofitting and retrofitting variance procedures
- explain the connection between land disposal unit standards, post-closure, and groundwater monitoring requirements.

Use this list of objectives to check your knowledge of this topic after you complete the training session.

2. REGULATORY SUMMARY

Regulations governing surface impoundments, waste piles, land treatment units, and landfills are codified in Part 264/265, Subparts K through N. The standards for permitted and interim status units address design and operating requirements, including liners and leachate collection and removal systems (LCRS); closure and post-closure requirements; and special standards for ignitable, reactive, and dioxin-containing wastes. In addition to these unit-specific requirements, LDUs managing hazardous waste are subject to the general facility standards found in Subparts A through E in Part 264/265, as well as the appropriate groundwater monitoring, closure and post-closure, and financial assurance requirements.

For each unit discussed, this module addresses five topic areas: design and operation, inspections, response actions, closure and post-closure, and special issues. This format will enable you to compare and contrast the regulations for each unit.

2.1 SURFACE IMPOUNDMENTS

Subpart K in Part 264/265 contains the design and operating standards for surface impoundments used to treat, store, or dispose of hazardous waste. Surface impoundments are very similar to landfills in that both units are either a natural topographic depression, manmade excavation, or diked area formed primarily of earthen materials, such as soil (although the unit may be lined with manmade materials). The units are, however, very different in their use. Surface impoundments are generally used for temporary storage or treatment, whereas a landfill is an area designated for final waste disposal. Therefore, while the design and operating standards are very similar, the closure and post-closure standards differ.

Most of the design, operating, and inspection requirements are very similar for surface impoundments, waste piles, and landfills. The requirements are discussed in detail in this section, with successive sections referring to this section for specifics.

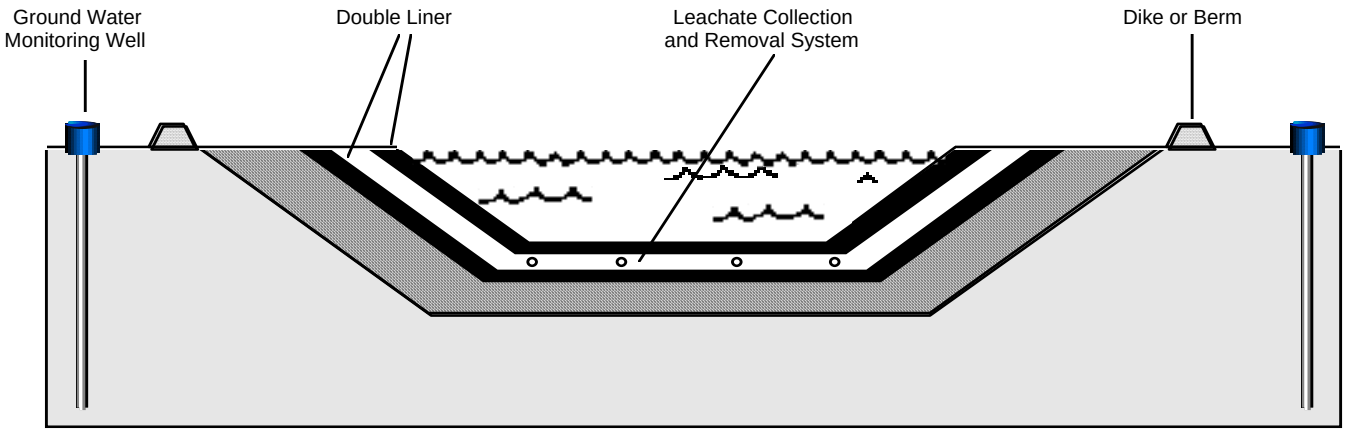
DESIGN AND OPERATION

In developing design and operation requirements for surface impoundments (as well as landfills and waste piles), EPA adopted a regulatory goal of minimizing the formation and migration of leachate to the adjacent subsurface soil, groundwater, and surface water.

These comprehensive technical requirements for surface impoundments are the minimum technological requirements (MTRs) mandated by RCRA §3004(o)(1)(A) and (o)(4). These sections require a double liner, a LCRS, and a leak detection system (§§264.221(c) and 265.221(a)). These MTRs apply to all new units, lateral expansions, and replacement units for which construction (or reuse) commences after July 29, 1992. New, lateral expansion, and replacement units for which construction (or reuse) began between July 15, 1985, and July 29, 1992, were required to have only the double liner and LCRS. Surface impoundments not subject to these MTRs are subject only to single liner requirements (§264.221(a)).

The double liner system consists of a top liner to prevent migration of hazardous constituents into the liner and a composite bottom liner consisting of a synthetic geomembrane and three feet of compacted soil material. The unit must also be equipped with an LCRS, which also serves as the leak detection system. The LCRS, along with the leak detection system drainage layers, must be designed with a bottom slope of at least one percent, be made of materials chemically resistant to the wastes placed in the unit, and be able to remove the liquids at a specified minimum rate. The LCRS itself must be designed to collect liquids in a sump and subsequently pump out those liquids. In addition to the performance and design requirements, the LCRS must be located between the liners immediately above the bottom composite liner, enabling the LCRS to collect the largest amount of leachate, while also representing the most efficient place to identify leaks. These MTRs are depicted in Figure 1 using a cross-section of a surface impoundment.

Figure 1
CROSS-SECTION OF A SURFACE IMPOUNDMENT AND ITS MINIMUM TECHNOLOGICAL REQUIREMENTS



A surface impoundment must also be designed to prevent the flow of liquids over the top of an impoundment (or overtopping) and ensure the structural integrity of any dikes. Also, §264.222 requires that the owner or operator establish a site-specific leachate flow rate, called the action leakage rate (ALR), to indicate when each regulated unit's system is not functioning properly.

None of these technologies will be effective if the impoundment is installed improperly or constructed of inferior materials. To ensure that a surface impoundment meets all technical criteria, EPA requires a construction quality assurance (CQA) program. The CQA program requires a CQA plan that identifies how construction materials and their installation will be monitored and tested and how the results will be documented (§264.19). The CQA program is developed and implemented under the direction of a registered professional engineer, who must also certify that the CQA plan has been successfully carried out and that the unit meets all specifications before any waste is received.

INSPECTION AND RESPONSE ACTIONS

In addition to the general inspection requirements found in §264/265.15, there are two types of specific inspections required at LDUs. The first inspection requirement addresses the design and structural integrity of the unit (§264/265.226). The owner and operator must inspect liners and covers for any problems after construction or installation and continue inspections weekly and after storms to monitor for evidence of deterioration, malfunctions, improper operation of overtopping systems, sudden drops in the level of the impoundment contents, and severe erosions of dikes and other containment devices.

Per the second inspection requirement, owners and operators must monitor leak detection sumps at least weekly to measure the amount of liquid in the sump and determine whether the ALR has been exceeded. This verifies both liner integrity and leachate pump efficiency. If a leak exceeds the ALR, the owner and operator must notify the Agency and respond in accordance with the response action plan (§264/265.223).

Surface impoundments must also comply with two types of response actions for the design and performance of the unit. The response action for the performance of the unit is determined by the terms of the response action plan, triggered when the ALR has been exceeded (§264/265.223). If the action leakage rate has been exceeded, the owner and operator must notify the Regional Administrator or authorized state; determine what short-term actions must be taken (e.g., shut down of the facility for repairs); determine the location, size, and cause of any leak; and send the assessments to the Region or authorized state.

There are also emergency repair provisions for unit design failure at permitted facilities (§264.227). If there is an indication of a failure of the containment system (e.g., a sudden drop in the level of the contents not attributable to changes in the flow in or out of the impoundment), the surface impoundment must be removed from service. When this occurs, the owner and operator must follow the procedures in the contingency plan, including any necessary emergency repairs.

CLOSURE

Owners and operators can use one of two options to close a hazardous waste surface impoundment. The first option, called clean closure, requires the owner and operator to remove or decontaminate all wastes and unit components at closure (§264/265.228(a)(1)). If the unit cannot be clean-closed, then the owner and operator must employ the second alternative. Under this approach, wastes are left in place and stabilized, free liquids are removed, and a cap or cover is placed on top of the waste. Since surface impoundments are generally used for storage, the second option is equivalent to closing as a landfill and requires the owner or operator to take certain precautions for a set time period after closure, known as post-closure care (§264/265.228(a)(2) and (b)).

SPECIAL REQUIREMENTS FOR CERTAIN WASTES

RCRA places special requirements on surface impoundments that handle ignitable or reactive wastes because these wastes require continuous protection from conditions that could cause them to ignite or react (§264/265.229).

Additionally, §264/265.230 prohibits the placement of incompatible waste or materials, as described in Appendix V in Part 264/265, in the same surface impoundment unless certain precautions are taken.

Furthermore, if an owner or operator of a surface impoundment plans to manage dioxin-containing waste (i.e., F020, F021, F022, F023, F026, and F027), he or she must employ a special management plan approved by the Regional Administrator or authorized state (§264.231). These wastes can only be disposed of in a permitted surface impoundment.

SURFACE IMPOUNDMENT RETROFITTING

Owners and operators of existing surface impoundments that become subject to RCRA as the result of a new hazardous waste listing or characteristic must retrofit or cease receipt of hazardous waste and begin the closure process within four years of the promulgation of the listing or characteristic. For example, owners and operators of surface impoundments that became subject to RCRA as the result of the promulgation of the Toxicity Characteristic on March 29, 1990, were required to retrofit those units to meet the minimum technological requirements or cease receipt of hazardous waste and begin the closure process by March 29, 1994 (55 FR 11798, 11835; March 29, 1990). However, surface impoundments that do not meet minimum technological requirements may continue to receive restricted wastes if the Regional Administrator or authorized state grants the unit a waiver under §3005(j) of RCRA.

SURFACE IMPOUNDMENT VS. TANK

The definitions of surface impoundment and tank are very similar and tend to create confusion. The major difference in the two definitions is what provides the structural support to the unit. Surface impoundments are supported by earthen materials, while tanks are supported by non-earthen materials (e.g., wood, concrete, steel, plastic). In determining whether a unit is supported by earthen or non-earthen material, it should be evaluated as if it were free-standing and filled to its design capacity. If the unit can maintain its structural integrity, it is considered a tank. If the unit cannot retain its structural integrity, it is considered a surface impoundment.

2.2 WASTE PILES

Regulations governing the management of hazardous waste in waste piles are found in Part 264/265, Subpart L. Waste piles, which are essentially noncontainerized piles of solid, nonflowing hazardous waste, are temporary units used for storage or treatment only (§260.10). Because waste piles are temporary units are not intended for final disposal of wastes, Subpart L does not contain post-closure care regulations for waste piles that are closed with waste in place;

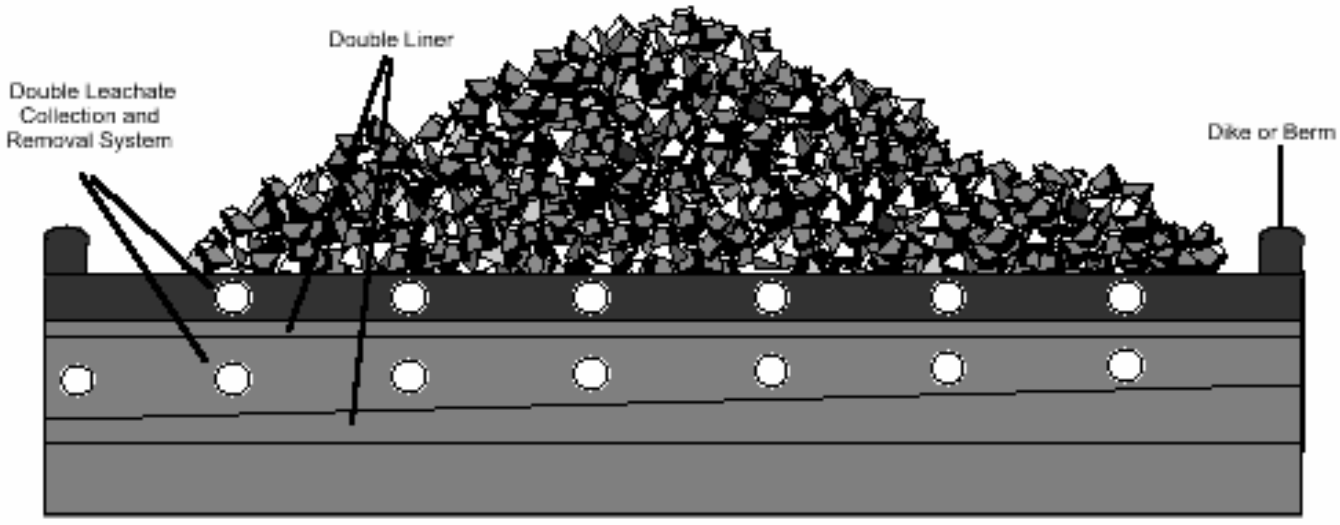
such units however, are considered permanent or disposal units and are subject to post-closure care since they are closing as landfills (see Section 2.4).

Owners and operators of permitted waste piles that meet special requirements are subject to reduced regulation. Specifically, the waste pile must be located inside or under a structure and not receive free liquid, protected from surface water run-on, designed and operated to control dispersal of waste, and managed to prevent the generation of leachate. If these standards are met, the owner and operator of the permitted waste pile are exempt from groundwater monitoring requirements, as well as the design and operation requirements for waste piles (§264.250(c)).

DESIGN AND OPERATION

Waste piles are subject to nearly the same MTRs as surface impoundments. Specifically, new units, lateral expansions, and replacement units require a double liner and LCRS (§§264.251(c) and 265.254). In addition, waste piles, with certain exceptions, require a second leachate collection and removal system above the top liner. Figure 2 depicts these requirements. If the permitted waste pile is not subject to MTR (i.e., a unit, lateral expansion, or replacement for which construction commenced before July 29, 1992), then the unit is subject to a single liner and basic LCRS requirements. Interim status waste piles that are not subject to MTR are subject only to liner, run-on, and runoff controls if leachate or runoff is found to be a hazardous waste.

Figure 2
CROSS-SECTION OF A SURFACE IMPOUNDMENT AND ITS MINIMUM TECHNOLOGICAL REQUIREMENTS



provision only requires the owner and operator of a waste pile meeting MTR to record the amount of liquids removed from the leak detection system sump at least once a week (§265.260). Note that waste piles are not subject to the emergency repair provisions for surface impoundments.

CLOSURE

Since waste piles are storage units, as opposed to disposal units, all waste residues and contaminated subsoils and equipment must be removed or decontaminated at closure (§264/265.258(a)). This requirement is identical to the clean closure requirements for a surface impoundment. If the owner or operator removes or decontaminates all waste residues and makes all reasonable efforts to remove or decontaminate all structures and soils and finds that some contamination remains, the waste pile will then be subject to the closure requirements for landfills, including post-closure care (§264/265.258(b)).

SPECIAL REQUIREMENTS FOR CERTAIN WASTES

Waste piles are subject to the same specialized standards for ignitable, reactive, incompatible, and dioxin-containing waste as surface impoundments. These requirements are discussed in Section 2.1.

WASTE PILE VS. CONTAINMENT BUILDING

Containment buildings, sometimes characterized as "indoor waste piles," are units used to hold noncontainerized piles of hazardous waste. The difference between waste piles and containment buildings, from a regulatory standpoint, is that containment buildings are not land disposal units. For this reason, containment buildings are designed with a containment system rather than a liner and leak detection system (Part 264/265, Subpart DD). The module entitled Containment Buildings provides more information about the standards that apply to containment buildings.

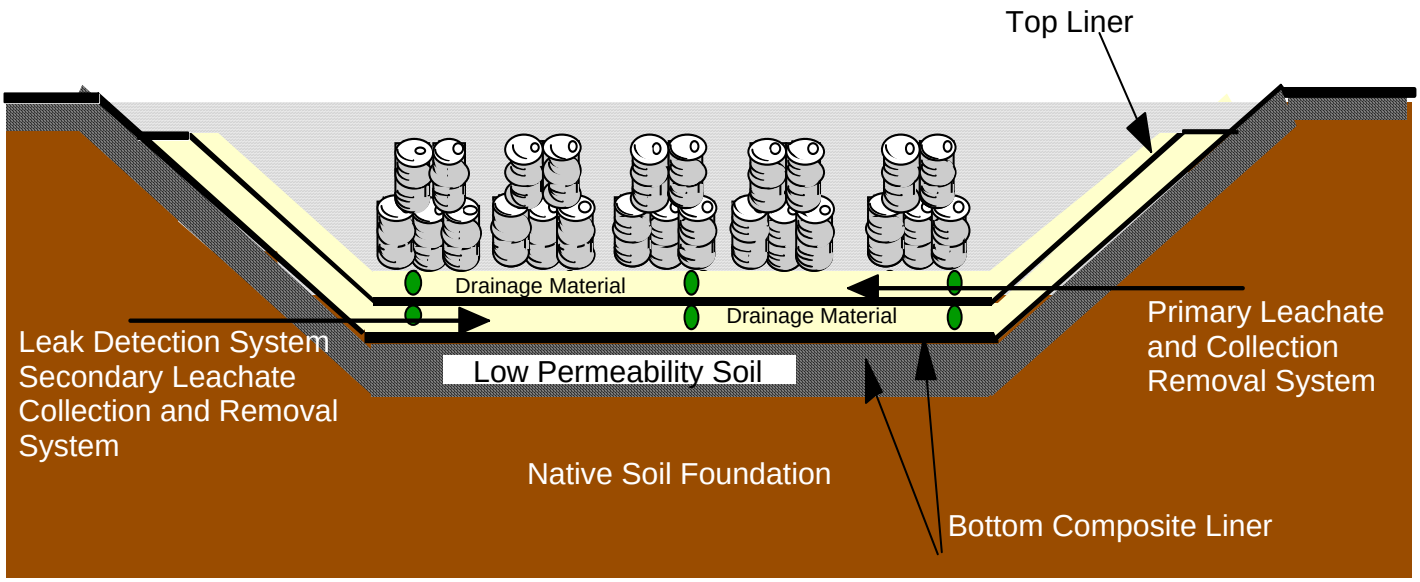
2.3 LANDFILLS

Since landfills are used as final disposal sites for a large portion of the nation's hazardous waste, it is critical that they are monitored during their entire active life, including closure, and the post-closure period. The regulations concerning hazardous waste landfills are codified in Part 264/265, Subpart N.

DESIGN AND OPERATION

Landfills are subject to virtually the same MTRs as surface impoundments and waste piles. They must have a double-liner, LCRSs, and leak detection (§264/265.301), and an ALR (§264/265.302). Like waste piles, landfills require a second LCRS that is above the top liner. Figure 3 illustrates the MTRs of landfills. In addition, landfills must have stormwater run-on and runoff controls to prevent migration of hazardous constituents for at least a 25-year storm and a cover to prevent wind dispersal.

Figure 3
CROSS-SECTION OF A LANDFILL AND ITS MINIMUM TECHNOLOGICAL REQUIREMENTS



INSPECTION AND RESPONSE ACTIONS

Once again, the inspection and response action plans are almost identical to the requirements for surface impoundments, including a response action plan if the ALR is exceeded (§§264.304 and 265.303) and a CQA program (§264/265.19). In addition, the owner and operator of a hazardous waste landfill must perform monitoring and inspections (§§264.303 and 265.304). As with surface impoundments and waste piles, these requirements ensure that the unit is maintained in good working condition and that any problems are promptly detected.

CLOSURE

Since landfills typically serve as permanent disposal sites, the closure and post-closure requirements for landfills are somewhat different from those for other land-based units. One example is the requirement for a final cover over the landfill that can provide long-term minimization of liquid migration through the closed landfill, promote drainage, accommodate settling, and function with a minimum amount of maintenance (§264/265.310(a)). After closure, the owner or operator must comply with the post-closure requirements in §§264/265.117 through 264/265.120 covering such actions as monitoring and maintenance (see the module entitled Closure and Post-Closure). In addition, the owner and operator must maintain the final cover, leak detection system, and groundwater monitoring system, as well as prevent run-on and runoff from damaging the final cover and protect the surveyed benchmarks (i.e., location and characteristics) of the landfill.

SPECIAL REQUIREMENTS FOR CERTAIN WASTES

Like surface impoundments and waste piles, landfills are subject to certain restrictions for the management of ignitable, reactive, incompatible, and dioxin-containing wastes. Unlike other units, though, the placement of bulk or noncontainerized liquid hazardous waste or hazardous waste containing free liquids in any landfill is prohibited (§264/265.314(b)). The placement of nonhazardous liquids in a landfill is also essentially prohibited (§§264.314(e) and 265.314(f)). There are only certain situations when containers holding free liquids can be placed in a landfill (e.g., small containers such as ampules, containers that are products such as batteries, or lab packs) (§§264.314(d) and 265.314(c)). If sorbents are used to treat hazardous wastes so that the waste no longer contains free liquids, the owner and operator must use nonbiodegradable sorbents.

SPECIAL REQUIREMENTS FOR CERTAIN CONTAINERS

To prevent significant voids that could cause collapse of final covers when containers erode, and to maintain and extend available capacity in hazardous waste landfills, containers placed in a landfill must be either at least 90 percent full or crushed, shredded, or in some other way reduced in volume, unless the containers are very small, such as ampules (§264/265.315).

Finally, there are special standards for lab packs or overpacked drums being placed in a landfill (§264/265.316). Lab packs generally contain small containers of a wide variety of hazardous wastes in relatively small volumes that are packed in sorbent material to prevent leaking. This sorbent material must be nonbiodegradable.

2.4 LAND TREATMENT UNITS

While surface impoundments, waste piles, and landfills share many regulatory standards, land treatment units (LTUs) are significantly different both in purpose and in management. Land treatment involves the application of waste on the soil surface or the incorporation of waste into the upper layers of the soil in order to degrade, transform, or immobilize hazardous constituents present in hazardous waste. Essentially, the waste is treated within the matrix of the surface soil, whereas the major goal of the other units is to prevent migration to the surface soil. Specifically, the waste must be placed only in the unsaturated zone, the portion of the surface soil above the water table (or the highest point of the groundwater flow). Based on the proximity to the groundwater, the success of land treatment is highly dependent on the operational management of the unit.

Because the goal of land treatment is to let the soil microbes and sunlight degrade the hazardous waste, the design and operating standards are significantly different from those imposed on the three types of units previously discussed. Land treatment units generally do not use impermeable liners to contain wastes. Instead, units rely on the physical, chemical, and biological processes occurring in the topsoil layers. In a sense, these units can be viewed as an open system.

Maintenance of proper soil pH, careful management of waste application rate, and control of surface water runoff are all key to the operation of a land treatment unit. The regulations for hazardous waste land treatment units are in Part 264/265, Subpart M.

Because placement of hazardous waste in a land treatment unit is considered land disposal, land disposal restrictions (LDR) standards must be considered. If the hazardous waste does not meet the applicable treatment standard prior to placement in the land treatment unit, the unit owner or operator must obtain a no-migration variance before applying any hazardous waste to the unit, per §268.6. (See the Land Disposal Restrictions module for more details concerning the LDR standards and no-migration variances.)

DESIGN AND OPERATION

Owners and operators of land treatment units must devise a program and demonstrate its effectiveness given the design of the unit and characteristics of the area. In addition, the regulations require specific operating requirements to be met in the treatment program. The following discussion details these requirements.

Treatment Program and Demonstration

The requirements outlined for the treatment program, including design and operating criteria and unsaturated zone monitoring, stem from a treatment demonstration. The purpose of the treatment demonstration is to show that hazardous constituents in the waste can be completely degraded or immobilized in the treatment unit. A treatment demonstration may involve field testing on a sample soil plot or laboratory testing. The Regional Administrator or authorized state uses information provided by the treatment demonstration to set permit standards. Interim status units are not required to establish a treatment program because the interim status regulations are self-implementing. Owners and operators can only place hazardous waste in the LTU, however, if the waste will be rendered nonhazardous or less hazardous (§265.272(a)).

During the treatment demonstration, the owner and operator must establish the following parameters:

- Specify the wastes that may be handled at the unit. In general, land treatment is confined to wastes that are primarily organic and that can be greatly reduced in volume by physical, chemical, and biological decomposition in surface soils. The owner and operator must be able to account for smaller fractions of heavy metals and persistent organic compounds by immobilizing those constituents (§264.271(a)(1)).

- Formulate a set of operating measures. The LTU must be operated in a manner that will maximize degradation, transformation, and immobilization of hazardous waste constituents. The specifics of the operation are discussed in the following section of this module (§264.271(a)(2)).

- Establish unsaturated zone monitoring. The purpose of this program is to make sure that treatment is occurring within the treatment zone and that all hazardous constituents are being adequately treated. The information provided from the monitoring can help the

owner and operator "fine tune" the treatment process to maximize the success of the treatment. Unsaturated zone monitoring involves soil monitoring (e.g., obtaining soil samples) immediately below the treatment zone (§264.271(a)(3)).

- Define the treatment zone. This zone comprises the horizontal and vertical dimensions of the unsaturated zone in which the owner and operator intend to perform the actual treatment. The zone can be no deeper than 1.5 meters (5 feet) and the bottom of the zone must be at least one meter (3.2 feet) above the seasonal high water table (§264.271(c)).

Operation

Basic design and operating requirements are outlined in §§264.273 and 265.272. These sections require the Regional Administrator or authorized state to specify certain parameters in the facility permit:

- rate and method of waste application
- measures to control soil pH
- measures to enhance microbial and chemical reactions
- measures to control the moisture content of the treatment zone.

In addition, land treatment units are subject to requirements for stormwater run-on and runoff controls. Management to control wind dispersal and weekly inspections are also required.

Food Chain Crops

In some cases, the owner and operator may grow food-chain crops on a land treatment unit (§264/265.276). The Agency believes that this can be done safely if certain conditions are met that require the owner or operator to demonstrate that hazardous constituents are not present in the crop in abnormally high concentrations. Additionally, if cadmium is present in the unit, the owner and operator must comply with additional management standards specified in §264.276(b) and (c).

INSPECTIONS AND RESPONSE ACTIONS

Although there are no requirements to inspect the unit, the owner and operator must maintain unsaturated zone monitoring to assure that the unit is meeting its performance standards (§264/265.278).

As discussed earlier, the purpose of unsaturated zone monitoring is to provide feedback on the success of treatment in the treatment zone and to determine if hazardous constituents are migrating out of the treatment zone (i.e., the monitoring program must be designed to determine the presence of hazardous constituents below the treatment zone). Generally, this means that the owner and operator would monitor for the most stable hazardous constituents found in the wastes placed in or on the treatment zone. However, unsaturated zone monitoring is not a substitute for groundwater monitoring. Both are required for land treatment units.

To perform unsaturated zone monitoring, the owner and operator must first establish which constituents must be monitored and the background levels of those constituents in the soil. The frequency of the monitoring is based on the elements of the operation of the LTU, such as the frequency, timing, and rate of application of the waste. Once the samples have been taken, the owner and operator must determine whether there is a statistically significant change over the background values (i.e., the natural constituent levels in the soil) for any hazardous constituent. If there is a statistically significant increase in the hazardous constituents of concern, the owner and operator must notify the Regional Administrator or authorized state within seven days, and submit a permit modification within 90 days to change the operating practices at the facility to sufficiently treat hazardous constituents within the treatment zone.

CLOSURE

When a land treatment unit is being closed, the owner and operator must maintain all operating parameters to continue the treatment processes, as well as maintain run-on and runoff controls and unsaturated zone monitoring. The major element of the closure procedure is placing a vegetative cover over the closing unit that is capable of maintaining growth without extensive maintenance. At the completion of closure, the owner or operator may submit the closure certification by an independent qualified soil scientist in lieu of an independent registered professional engineer. Closure and post-closure requirements are waived when the hazardous constituents in the treatment zone no longer exceed background levels.

SPECIAL REQUIREMENTS FOR CERTAIN WASTES

Like other LDUs, land treatment units are subject to limitations regarding ignitable, reactive, incompatible, and dioxin-containing wastes (§§264/265.281, 264/265.282 and 264.283).