SOLID WASTE DISPOSAL FACILITY OPERATOR STUDY GUIDE

For

FACILITY MANAGER CERTIFICATION

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PREFACE

This STUDY GUIDE represents an effort by the Department to assist those seeking certification as Solid Waste Disposal Facility Managers. The material contained in the study guide should be used as a supplement to Wisconsin Administrative Codes NR 500 - 590, especially 502, 503,504, 506, 507, 516 and 524, and other sources of information (e.g., landfill related books and other informational publications). Wisconsin Administrative Codes can be found online at: http://legis.wisconsin.gov/rsb/code/nr/nr500.html

PURPOSE

This STUDY GUIDE contains minimum basic information a candidate for the Solid Waste Disposal Facility Manager certification needs to know. The information contained in the study guide may not be sufficient to pass the certification examination. Every certified Facility Manager needs to have sufficient knowledge regarding landfill design, operation and maintenance, health and safety issues, and heavy equipment management to safeguard the environment and public health and welfare.

Types Of Landfills

There are two primary types of landfills: (1) *natural attenuation*, and (2) *engineered* or *containment*. Natural attenuation landfills do not have a liner—they rely on natural soils to filter, dilute, or otherwise prevent leachate from the landfill from contaminating groundwater. Engineered landfills utilize a liner to prevent groundwater contamination.

Wisconsin administrative code allows a specialized type of engineered landfill known as a *zone-of-saturation* landfill. Generally, the base of an engineered landfill's liner is required by Wisconsin code to be 10 feet above the seasonal high groundwater table elevation, but the base of a zone-of-saturation landfill is allowed to be installed below the groundwater table. Zone-of-saturation landfills are located in fine-grained soil

environments that transmit water very slowly, and their position below the water table ensures that groundwater will flow into the landfill where it will be removed via a leachate collection system. To ensure that groundwater flow is modest enough that it can be handled by the leachate collection system, all granular or silty soils detected during construction that are within 5 feet below the base of zone-of-saturation landfills are required to be removed and replaced with compacted fine-grained soil.

In Wisconsin, based on waste type, landfills are divided into three categories: Construction and Demolition (C&D), Municipal, and High Volume Industrial waste. C&D landfills are further subdivided into two categories based on waste volume: small (waste volume up to 50,000 cubic yards) and intermediate (waste volume more than 50,000 cubic yards but no more than 250,000 cubic yards). Small size construction and demolition (C&D) waste landfills and one-time disposal landfills are typically constructed as natural attenuation type landfills. All other landfills authorized under Wisconsin administrative codes are engineered.

C&D waste typically consists of concrete, bricks, asphalt, wood, glass, masonry, roofing, siding and plaster, alone or in combinations. However, waste paint, solvents, sealers, adhesives and similar materials are not considered to be C&D waste. A liner is not required for small C&D landfills, but the base of the landfill must be at least 10 feet above groundwater table or bedrock. Intermediate C&D landfills must have a 3-foot-thick clay liner and a leachate collection system. The diameter of leachate collection pipes must be at least 6 inches.

Municipal solid waste landfills are regulated under Subtitle D of the federal Resource Recovery and Conservation Act as well as under state solid waste codes in the NR 500 series. C&D landfills, one-time disposal landfills, and high-volume industrial waste landfills are regulated under state codes but are not currently regulated by the federal government.

Landfill Design and Construction

Landfills may not be sited within certain specified distances of the following resources amd structures: navigable lake, pond or flowage; river and stream; floodplain;

state or federal highways; and airports. Landfills are also not allowed to be located where they have a reasonable probability of causing groundwater contamination, a detrimental effect on surface water or wetlands, a taking of an endangered or threatened species, the migration of dangerous levels of explosive gases, or the emission of any hazardous air pollutant above state standards. For details regarding the locational and performance criteria refer to ss. NR 503.04 and NR 504.04, Wisconsin Administrative Code.

Although a natural attenuation landfill has no liner at the base, a final cover is required for this landfill type. Final covers for these landfills are typically constructed with two feet of compacted fine-grained soil sloped enough to allow stormwater to run off instead of ponding up.

Engineered landfills for municipal and industrial waste are constructed with a base liner and a leachate collection system. The primary purpose of the liner is to prevent groundwater pollution. The liner may consist of clay only or be a combination of geomembrane and clay (known as a composite liner). The liner is constructed with at least a 2% slope towards perforated leachate collection piping to direct leachate to a collection system.

The minimum thickness of a clay liner is 5 feet except in intermediate C&D landfills where 3 feet is allowed. In a composite liner, a 60-mil or thicker geomembrane is placed directly over a 4-foot-thick clay liner. Composite liners are required for all new municipal waste landfills. The maximum allowable slope of inside walls of a landfill is 3 horizontal to 1 vertical.

The leachate collection system helps withdraw leachate from a landfill and thus helps prevent groundwater pollution. The leachate collection lines in each phase are sloped towards the landfill's edge or perimeter berm to simplify the process of withdrawing the leachate from the landfill. The leachate collection lines are designed to allow access by water jetting devices and video cameras for cleaning and inspection.

In clay-lined landfills, leachate transfer lines may penetrate the liner horizontally at the perimeter berm. An antiseep collar is placed around the transfer line penetrating the liner to minimize the escape of leachate. In composite-lined landfills, on the other hand, leachate is pumped from the landfill's leachate collection system inside a sideslope

riser—a large-diameter pipe that extends from a sump at the base of the landfill to the top of the berm.

Municipal solid waste combuster residue is most likely to be identified as hazardous waste based on toxicity characteristic leaching procedure (TCLP) testing. The residue is disposed in a composite-lined monofill (i.e., a landfill that accepts only one kind of waste) cells. However, if the residue exceed allowable concentration limits of certain chemicals, a double composite-lined monofill cell with two separate leachate collection systems is necessary.

Fine-grained soil as defined by the Unified Soil Classification System (USCS) is used for clay liner construction. According to USCS a soil is classified as fine grained if a minimum of 50% of a given sample by weight passes through the #200 sieve. In addition, the clay used for liners must have:

- a saturated hydraulic conductivity of $1x10^{-7}$ cm/sec or less after compaction,
- an average liquid limit of 25 or greater with no values less than 20, and
- an average plasticity index of 12 or greater with no values less than 10.

Because freezing and thawing increases the permeability of clay, newly constructed liners must be protected from freeze – thaw damage using 4 feet of solid waste or other frost protection material during winter months. Both the base liner and the lower 10 feet of the inside slopes are required to be protected from freeze – thaw damage.

While constructing clay liners, clods larger than 4 inches should be broken up and the lift heights must not be greater than six inches after compaction. The clay must be compacted to 90% modified or 95% standard Proctor density at or wet of optimum moisture content using a sheep's foot roller with a minimum weight of 30,000 pounds.

State codes require the following tests to demonstrate the constructed quality of landfill clay liners and final cover clay layers: dry density and as-placed moisture content, grain size analysis up to .002 millimeter particle size, Atterberg limits, and hydraulic conductivity of field samples.

The geomembrane in composite liners must be placed on a properly rolled and smoothly graded clay liner surface. Geomembranes made of polyethylene resins must be welded using double track fusion welding machines. Seams on the geomembranes placed

on inside slopes must run perpendicular to the slope baseline as far as practicable. Wrinkles that are higher than they are wide must be smoothed or cut out and repaired. The geomembrane product in composite liners and final covers must be tested for the following physical characteristics: thickness, tensile properties, density, melt index of the polymer, and environmental stress. In addition, the following 'after installation' tests of the geomembrane liner are necessary to ensure proper installation: non-destructive and destructive field tests of sample geomembrane panel seams, field and laboratory shear and peel tests of geomembrane seams, and a leak location survey.

A granular drainage blanket made of sand or gravel is placed over the liner. To ensure leachate flows freely and quickly within the drainage blanket to the collection piping, the saturated hydraulic conductivity of the leachate collection blanket must be at least $1x10^{-2}$ cm/sec for non-municipal waste landfills and 1 cm/sec for municipal waste landfills.

The final cover on engineered landfills, except low strength sludge landfills, consists of a six-inch grading layer, a two-foot-thick clay capping layer, a minimum two-and-a-half-foot-thick drainage and rooting zone layer, a one-foot-thick drainage layer, and a six-inch topsoil layer. If the landfill has a composite liner, then the final cover must also include a geomembrane placed directly over the clay capping layer. The clay capping layer in a composite cap may be replaced with a geosynthetic clay liner (GCL). GCLs consists of a layer of sodium bentonite clay encapsulated between two geotextiles. The GCL must be covered with the geomembrane layer on the same day. A seal of loose bentonite granules must be placed in seam overlaps. The topsoil layer is vegetated to reduce the amount of precipitation entering the waste (since vegetation takes up water from the soil and transpires it though leaves) and to reduce erosion. The amount of infiltration passing through the final cover is influenced by the final cover surface grade, the permeability of the capping layer, the amount of precipitation on the final cover and the quality of the vegetative cover.

Two other types of cover are used in landfills: intermediate cover and daily cover. Intermediate cover must be constructed over areas that have not yet reached final grade if they are not going to receive waste for six months or more. Intermediate cover must be

placed in a layer at least one foot thick. High-volume industrial waste landfills are not subject to intermediate cover requirements.

Daily cover is also required for landfills other than high-volume industrial waste landfills. The operator applies daily cover to the active portion of the landfill at the end of the workday to reduce odors, windblown material and bird and animal activity. If soil is used as daily cover, then it must be six inches thick. If approved by the department, materials other than soil may be used as daily cover. These alternate daily covers may include industrial wastes such as foundry sand and auto shredder residues, or they may consist of synthetic products, such as textiles, designed specifically as landfill cover. The potential benefits of using synthetic daily cover include savings in airspace, easy installation, use of one textile piece for several days and lower cost.

Surface erosion and sedimentation must be minimized during landfill construction and also in active and closed landfills. Erosion control prevents or minimizes the disturbance and movement of soil particles by water and wind, while sediment control is the trapping of eroded soil particles. Establishing thick and healthy vegetation is key to minimizing erosion. Drainage ditches, swales and berms are constructed on and around landfills to divert surface water runoff properly. Drainage ditches and swales are lined with a minimum of two feet of clay. Sedimentation basins are constructed to trap eroded soil and thus help to reduce surface water pollution. In addition to reducing soil erosion, properly designed surface water controls help to reduce leachate production.

Precipitation (i.e., rain and water from ice and snowmelt) is the primary source of leachate formation in landfills. If the landfill base is below the water table, then water may also enter the landfill through the base liner. The water already present in the waste (also known as moisture content) also contributes to leachate. If proper surface water control structures are not constructed, then surface water may enter a landfill adding to leachate generation. In summary, the quantity of leachate generated in a landfill depends on the amount of precipitation falling on the landfill, the moisture content of the waste, and any groundwater and surface water entering the landfill.

Although disposal of liquid waste in landfills is generally not allowed, incidental liquids present in small containers from households may be disposed of. In addition, the

department may approve the recirculation of collected leachate into the waste at individual municipal solid waste landfills that have composite liners with a drainage layer having a permeability of 1 cm/sec or more. Leachate recirculation is often used by landfill operators as an economical means of disposing of leachate; it also increases the moisture content in the waste, which promotes more rapid decomposition and stabilization of the waste mass and freeing up airspace for additional disposal.

To minimize the potential for leachate to leak or seep out the side of the landfill, leachate may not be recirculated within 100 feet of the landfill's exterior sideslope unless otherwise approved by the department. At least 20 feet of waste must be in place before leachate recirculation is allowed. Every effort must be made to prevent leachate recirculation equipment freeze-up. Since leachate recirculation increases landfill gas production, a gas collection system must be in operation before recirculation is permitted.

Biological activities within a landfill lead to the generation of gas. The quality, quantity, and chemical characteristics of landfill gas are primarily a function of the type of solid waste placed in landfills. Approximately equal proportions of methane and carbon dioxide gases are generated in municipal and paper mill sludge landfills. Landfill gas may also contain several other gases, like nitrogen, hydrogen sulfide, and several hazardous air contaminants.

In general, an active gas extraction system (that uses pumps or blowers to remove gas) is required for all but the smallest municipal waste landfills. The extraction and control of landfill gas reduces the emission of methane, a powerful greenhouse gas, as well as hazardous air pollutants; it also reduces underground movement of landfill gas which may cause explosions in nearby structures. Because of the significant content of methane, extracted landfill gas may be used to generate energy. Landfill gas extraction systems must be tuned and maintained properly to avoid pulling air into the waste and raising the risk of landfill fire, to meet the required performance standard and the needs of the energy production system, and to minimize the release of landfill gas into the atmosphere in the form of fugitive emissions.

Passive gas vents (that do not use pumps or a blower) are installed in some C&D and paper mill sludge landfills where the gas generation is relatively low. The

maintenance of passive gas vents include periodic visual examination to assure that they have not been plugged or damaged.

Both waste management and air management rules apply to landfill gas control systems. A construction permit from the department's air management program is needed when a landfill obtains approval for initial siting or for expansion. as well as when an engine or flare not covered under a construction permit is added. Operation of a landfill also requires an operating permit from the department's air management program.

Landfill Operation and Maintenance

Proper operation of a landfill is essential to minimize odors, noise, insect and rodent problems, windblown paper, generation of dust and the creation of environmental impacts to water and air. The following operational practices, among others, help reduce the environmental impact of landfill actvities:

- Liquids that contact waste must be managed as leachate.
- Odor from a municipal landfill can be minimized by using daily cover, proper collection and treatment of landfill gas, and correcting leachate seeps.
- If clay soil is used for daily cover, then the daily cover must be scarified or removed before placing the next lift of waste.
- Animal carcasses must be covered immediately upon disposal
- The daily disposal area should be confined to smallest possible area
- Disposal must begin at the edge of each phase.
- Waste should be pushed over granular drainage blanket to avoid vehicle damage to the blanket.
- After disposing the first 4-foot layer of waste, the subsequent layers should be compacted in 2-foot increments.
- To reduce the generation of dust and windblown paper or plastic film in landfills, waste should be dumped in areas sheltered out of the wind, paved or graveled roads should be constructed for truck traffic, and crusted compacted waste should not be disturbed.

Unstable waste slope is a problem in sludge landfills. Slope stability of sludge landfills may be improved by disposing of low-moisture sludge with a low waste slope. Usually the final slope in a sludge landfill is between 6 to 10 horizontal to 1 vertical. Knowing how to determine the elevation or grade is essential to determining whether an active landfill area is close to the grade for which the landfill has been designed and permitted.

Friable (crumbly) asbestos-containing materials may be disposed of in landfills approved for asbestos disposal. The asbestos containing loads must be covered with three feet of waste after disposal. Both the horizontal and vertical location of the disposal area must be recorded.

Subsurface landfill fires can create serious air pollution problems and are very difficult and costly to extinguish. Precautions must be taken to prevent a landfill fire. In most cases landfill fires are started by hot waste loads.

All landfills operated for public use need to install an acceptable sign near the entrance, which must include landfill name, license number, hours of operation, acceptable waste types, penalty for unauthorized use, safety precautions, and other pertinent information. A landfill must be secured properly using fences, gates or other physical barriers. The landfill gate must be locked when an attendant is not on duty. No solid waste shall be dumped near the entrance gate. Surveillance of site visitors and site users is needed for site security and to prevent dumping of unauthorized materials.

Leachate lines must be cleaned with a high pressure water jet immediately after construction and annually thereafter. The leachate lines are also to be cleaned after a cell is closed. The leachate lines are to be inspected with a video camera after construction of a new cell, and once every five years. Leachate must be removed from a leachate storage structure as often as necessary to maintain gravity flow. Leachate must be disposed of at a wastewater treatment facility approved by the department (unless recirculation has been approved for the landfill). Eroded landfill surface areas must be repaired immediately to prevent erosion from spreading. An effective maintenance program for landfill structures and equipment minimizes costly repairs.

Waste oil, yard waste, lead-acid batteries, major appliances, electronic devices, oil filters and absorbents and infectious waste, are not allowed to be disposed of in

Wisconsin landfills. In Wisconsin sharps are regarded as infectious waste. Sharps must be disinfected and rendered non-usable before disposal in a landfill. Hazardous waste is also banned from landfill disposal, but an exception is in place for hazardous waste from individual households.

The following wastes are classified as "universal wastes": mercury-containing lamps, dry cell batteries, waste oil, and certain pesticides. Universal wastes are those wastes that would be classified as hazardous waste unless they are recycled. Universal wastes may not be disposed of in landfills, except from individual households.

Certain recyclable materials are banned from landfill disposal in Wisconsin if they have been separated out for recycling. These include aluminum, glass, steel and plastic containers, newspapers and magazines, cardboard, office paper other than from households, and waste tires. These materials are also banned from landfill disposal if they originate from a municipality that does not have an effective recycling program in accordance with department regulations. Currently, however, all Wisconsin municipalities are operating effective recycling programs, so incidental amounts of these recyclables that may be present in waste loads may be legally landfilled.

Landfill operators must have good knowledge about the types of waste approved for their facility. Random load inspections must be performed at all municipal solid waste landfills for every 5,000 tons of waste accepted, or once a month, whichever is more frequent; no more than one inspection per week is required. The following items must be recorded during a random load inspection:

- the date and time the load for inspection was received,
- the name of the waste hauling firm, driver and the vehicle's license plate number,
- Wisconsin solid waste transporter license number,
- the community or communities in which the solid waste was generated,
- the waste type (i.e., commercial, industrial, residential or a combined load),
- the name of the manager or site operator inspecting the load, and
- comments regarding the inspection.

All landfills should have a contingency plan for injuries, illness, and spills and releases. All spills and releases must be reported to DNR immediately.

Monitoring and Reporting

The required monitoring program for a landfill is included in the department's approvals. In general, the following items may need to be monitored: groundwater, surface water, leachate, landfill gas, ambient air, landfill settlement, berm stability, side slope and final cover, structures related to surface water control and gradient control, and vegetative growth.

Knowledge about monitoring of groundwater and other items is essential for proper management of a landfill. A good groundwater monitoring well design includes, installation of the well at the proper depth relative to the elevation of the groundwater table, proper screen size and length, pipe and casing design, protective cover pipe and cap lock, surface seal of concrete or bentonite sloped away from the well, and a label identifying the well (e.g., well number). A good knowledge about monitoring of ground water is essential for managing a landfill. While collecting groundwater samples, the following items must be checked at a minimum: the condition of the protective casing and lock cover, condition of the concrete or bentonite ground surface seal, and the condition of the well pipe itself.

While groundwater monitoring wells are installed to allow sampling of groundwater in the vicinity of the landfill site, lysimeters are installed to monitor liner leakage. Lysimeters collect fluids directly below the liner so they can be measured and analyzed. Leachate head wells are another monitoring device: they are used to monitor leachate head within a landfill. Monitoring of leachate heads within a landfill is important because excessive leachate pressing down on the liner increases the possibility of liner leakage.

The remaining capacity of a landfill and total amount of waste the landfill received in the previous year must be recorded and may need to be reported to the department annually.

Health and Safety

Health and safety rules must be followed by all landfill personnel working in a landfill, irrespective of whether he/she is a supervisor or site operator. All employees must have a good understanding of the health and safety rules. To prevent accidents, public access to the landfill working face must be restricted. In addition, the following practices are essential for accident prevention:

- regular and effective training of landfill personnel,
- use of personal protective equipment where appropriate, and
- observing Occupational Safety and Health Administration (OSHA) requirements such as confined space entry guidance. Examples of confined space in landfills include leachate storage tank manways, trenches within or outside of a landfill that are five or more feet deep, and manholes within or outside of landfills. Concentrations of oxygen, methane, and hydrogen sulfide within a confined space must be checked before entry.

Special care should be taken while handling friable asbestos because airborne asbestos particles pose a significant health risk. Friable asbestos containing materials must not be burned because such burning causes release of asbestos fibers into the air.

Although burns and vehicle accidents occur in landfills, the most common causes of injuries in landfills are slips, trips and falls. In addition, the following health and safety problems are usually associated with landfill operation: long-term exposure to loud equipment noise, hypothermia (lowering of the body temperature due to exposure to cold weather), frostbite, heat exhaustion and heat stroke.

Certification and Employee Training

Either a facility manager or a certified site operator must be present during all hours of operation in landfills except in high-volume industrial waste landfills; presence of a certified site operator only is required for small C&D landfills. Non-certified site operators may operate high-volume industrial waste landfills provided they have landfill

design and operation related knowledge as required by ch. NR 524, Wisconsin Administrative Code. For all types of landfills where the presence of facility manager or operator is required during hours of operation, if a facility manager is not present at a landfill during hours of operation, then a designated person, whom landfill personnel must be able to contact during 75% of the hours of operation, must be present within 50 miles of the landfill. The above provision is allowed only if no violation has been issued against the landfill during the previous three years. For high-volume industrial waste landfills, a facility manager need not be present during all hours of operation but must visit the landfill at least once a week during active hours of operation.

A facility manager certificate may be obtained by paying the required fee and passing an examination conducted by the department; the certificate is valid for 2 years. To renew a certificate, facility managers must complete 8 hours of continuing education training in solid or hazardous waste management related subjects and pay the required re-certification fee.

Employees must receive training for: first aid, basic safety issues, emergency procedures, and accident reduction. Employees must receive training about proper operation and maintenance of a landfill. Employees must have good knowledge regarding the conditions of approval issued by the department for the facility they are operating, as well as landfill laws and regulations.

Heavy Equipment Management

Heavy equipment is used to perform tasks at a landfill such as waste compaction, maintenance of roadways inside and outside of landfills, and spreading of daily cover. It is essential to have a good working knowledge about operation and maintenance of this equipment.

A comprehensive review of heavy equipment management is beyond the scope of this manual. However, an effective maintenance program consists of start-up checks, shutdown procedures, record keeping of equipment performance, and routine maintenance. Usually a pre-operating checklist consists of checking fluid levels, checking radiator screen and air filters for clogging, and checking tracks for wear,

damage or freezing. Pre-operating check out, attention to gauges and warning lights, and record keeping are all part of maintenance program for heavy equipment.