

Coal Combustion Waste
North Dakota Regulatory Perspective

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Introduction

The North Dakota Department of Health, Environmental Health Section is the lead agency in North Dakota for implementing many environmental programs including air quality, safe drinking water, waste water treatment, surface water and ground water quality and waste management. The Division of Waste Management includes the Solid Waste Program, the Hazardous Waste Program and the Underground Storage Tank Program, all approved by the U. S. Environmental Protection Agency for administering appropriate, federally initiated programs.

In the past 21 years, North Dakota developed modern standards and facilities for management of various types of solid waste including coal combustion waste. With eight major coal-fueled energy facilities within the state, North Dakota's requirements address location restrictions, operating criteria, facility design, ground water monitoring and corrective action, closure and post-closure care and financial assurance. The state's Solid Waste Program has worked with the energy industry to investigate and solve past disposal issues and develop long-term solutions. The North Dakota Solid Waste Management Rules for coal combustion waste disposal follow the general model of the Resource Conservation Recovery Act Subtitle D criteria for municipal waste; however, the specific requirements are tailored for North Dakota's geology and the coal combustion waste materials.

Current coal combustion waste disposal sites are carefully constructed with compacted clay liners or composite liners, they control surface water run-on and runoff and have leachate drainage systems. The state's permit process includes a multi-agency review and embraces public review and comment.

Indiscriminate disposal of coal waste into surface mines has not occurred for twenty years; however, many of the permitted landfills are located within carefully constructed facilities that were once part of surface mines. Thick sequences of clay-rich soils associated with North Dakota's coal mines, when properly segregated and conditioned, make excellent material for liner and final cover construction. Other facilities located outside of mine areas have similarly been constructed and/or upgraded to meet modern standards.

While every state in the country has old waste sites that needed upgrading, closure and/or remediation, North Dakota's coal-fired electric plants have discontinued unsuitable waste management practices. In April 2000, when the USEPA was considering regulating coal combustion waste as a hazardous waste through subtitle C of the Resource Conservation and Recovery Act (RCRA), the state of North Dakota informed EPA's administrator Carole M. Browner, that "The states' regulatory program for these power plant wastes meets all the requirements of an effective program and yet does not bridle the industry with unnecessary paper work and regulation."

The Department has also cooperated in developing guidelines and procedures for coal combustion byproduct utilization. As the lead North Dakota agency in promotion of recycling

and waste reduction, the North Dakota Department of Health recognizes that many of these waste products, if properly characterized, utilized and handled can reduce the country's reliance on valuable natural resources, conserve energy and reduce the cost of waste management practices. At the same time, the state's Ash Utilization guidelines place strong emphasis on the protection of human health and the environment.

Background

The Division of Waste Management includes the Solid Waste Program, the Hazardous Waste Program and the Underground Storage Tank Program. The Division of Solid Waste is one of four divisions within the North Dakota Department of Health dealing with environmental issues. The other environmental divisions include Air Quality, Municipal Facilities (water supply and waste water facilities), and the Division of Water Quality. All divisions administer programs approved by the USEPA, some of which are partially funded by the USEPA. All divisions also administer Programs that are not funded by the USEPA.

The Solid Waste Program, receives no federal money for regulating nonhazardous solid wastes including municipal solid waste landfills (Subtitle D of the Resource Conservation Recovery Act), inert waste landfills which deal with construction and demolition waste as well as bottom ash and coal-fired boilers, nonhazardous industrial waste generated through manufacturing and industrial activities, and special waste generated by the energy and oil industries.

The Solid Waste Program oversees approximately 224 permitted disposal facilities and 316 waste transport permits, and responds to spills, emergencies and incidences of public concern regarding solid waste. The 224 permitted disposal facilities include 14 municipal solid waste landfills, 182 inert waste landfills, 20 special waste landfills (17 of which are for the coal industry) and eight surface impoundments, most of which are for the energy industry.

Coal combustion waste is by far the largest waste generated in North Dakota. Approximately 9,900 tons per day of coal waste is generated compared to about 1,400 tons per day municipal solid waste, approximately 100 tons per day industrial waste and about six tons per day of hazardous waste. Coal combustion waste generated in the state includes fly ash, flue gas desulfurization (FGD) waste, coal gasification waste and bottom ash (may also be classified inert waste). The state has eight energy facilities centered in the central part of the state: (1) Basin Electric, Antelope Valley Station north of Beulah, ND; (2) Basin Electric Leland Olds Station near Stanton, ND; (3) Dakota Gasification Company north of Beulah, ND; (4) Great River Energy, Coal Creek Station near Underwood, ND; (5) Great River Energy Stanton Station; (6) Montana Dakota Utilities, Heskett Station north of Mandan, ND; (7) Minnkota Power Cooperative, Milton R. Young Station near Center, ND; and (8) Ottertail Power Cooperative Coyote Station, south of Beulah, ND.

North Dakota currently has four active lignite mines, the Freedom Mine, owned by North American Coal Corporation and is located north of Beulah, ND provides coal to the nearby Basin Electric Antelope Valley Station and the Great Plains Synfuels Plant owned by Dakota

Gasification Company as well as the Leland Olds Station. The Beulah Mine, owned by Dakota Westmoreland Corporation, supplies coal to the nearby Coyote Station as well as by rail to the MDU Heskett Station located near Mandan, ND. The Center Mine, owned by BNI Coal Ltd., supplies coal to the nearby Milton R. Young Station. Finally the Falkirk Mine, owned by North American Coal Corporation, supplies lignite to the Great River Energy Coal Creek Station. Specific information on North Dakota's lignite industry can be found at the North Dakota Lignite Energy Council's web site at www.lignite.com

Disposal facilities exist in both mine settings and non-mine settings. Three plants have waste facilities in both abandoned mine settings and non-mine settings. Three plants have waste facilities in both recent (post-reclamation law sites) mines and non-mine settings. One plant has all its waste facilities in a recent mine. One plant has all its waste facilities in a non-mine setting.

History of Coal Combustion Waste Regulation

In the late 1970's and early 1980's, as new, larger plants and new scrubber technology meant more waste, the North Dakota Department of Health began active regulation of energy wastes as allowed under its 1976 solid waste rules. Coal combustion waste was classified as "residue" and was allowed to be disposed under permits called "special use" permits. In the early 1980's, the North Dakota Department of Health's Solid Waste Program began more active regulation of energy waste and required formal permitted sites for disposal of such materials. The practice of "dumping" in mine spoils ceased in the early 1980's and the Department began evaluating disposal site geology and hydrogeology, began to require increased engineering of sites, and began requiring various operational standards and ground water monitoring for facilities. The Department found some sites were in geologically unsuitable locations and/or had inadequate engineering.

A number of surface impoundments were located on river alluvial plains or in glacial outwash gravel deposits. Other sites in sandy soils or adjacent to nearby alluvial valleys and wetlands posed ground water and surface water contamination hazards. The Department began to work with companies to close or upgrade unsuitable operations or facilities in unsuitable locations. The Department instituted a multi-agency review process utilizing not only the solid waste staff, but the Division of Water Quality within its Department as well as the North Dakota Geological Survey and the North Dakota State Water Commission, and the North Dakota Public Service Commission, who regulated mining activities in the state.

In the 1980's, new landfills and some surface impoundments were constructed under permits for the Department. Clay liners and clay covers began to be utilized for coal waste. Better control of surface water within landfills was instituted. Ground water monitoring of all permitted facilities was initiated. Corrective action and closure of polluting facilities were emphasized.

In 1992, the Department revised its solid waste rules, responding in part to the revisions in the Federal Rules for solid waste disposal facilities, found in 40 CFR Parts 257 and 258. While these rules affected primarily municipal solid waste, the Department's proposed rules revised the

requirements and the regulatory framework for virtually all classes of solid waste management within the state. The rules had a number of revisions in succeeding years, with the latest revision in 1999. The state received significant public interest, including from the energy industry. The rules have been well received.

In 1994 and 1995, the last unlined surface impoundment for fly ash and bottom ash was upgraded with a composite liner and the facility was changed to manage only bottom ash (inert waste). Thus, by the mid-1990's, facilities in North Dakota were up to modern design standards.

North Dakota Solid Waste Management Rules for Special Waste

The North Dakota Solid Waste Management Rules, Chapter 33-20 of the North Dakota Administrative Code (NDAC) written pursuant to North Dakota Century Code, Chapter 23-29, includes appropriate standards for various types and sources of solid waste. Coal combustion waste is called “special waste” which is defined in the state law as:

“Special waste means solid waste that is not a hazardous waste regulated under Chapter 33-20.3 and includes waste generated from energy conversion facilities; waste from crude oil and natural gas exploration and production; waste from mineral and/or mining, beneficiation, and extraction; and waste generated by surface coal mining operations. The term does not include municipal waste or industrial waste.”

The criteria for special waste disposal facilities include:

- Location Standards
- Operation Requirements
- Design Requirements
- Ground water Monitoring/Corrective Action Requirements
- Closure/Post-closure Requirements
- Financial Assurance Requirements

Location Standards

Section 33-20-04.1-01 NDAC, general location standards for solid waste management facilities states, “No solid waste management facility may be located in areas which result in impacts of human health or environmental resources or in an area which is unsuitable because of reasons of topography, geology, hydrogeology or soils. Sites for new or for lateral expansions of land treatment units, surface impoundments closed with solid waste in place, municipal waste landfills, industrial waste landfills and special waste landfills must minimize, control or prevent the movement of waste or waste constituents with geologic conditions and engineered improvements. Sites should be underlain by materials with low permeability to provide a barrier to contaminate migration.”

This section further states: “The following geographic areas or conditions must be **excluded** in the consideration of a site:

- (1) Where the waste is disposed within an aquifer;
- (2) Within a public water supply designated wellhead protection area;
- (3) Within a 100-year flood plain;
- (4) Where geologic or man-made features, including underground mines, may be the result in differential settlement and failure of a structure or other movement on the facility;
- (5) On the edge of or within channels, ravines, or steep topography whose slope is unstable due to erosion or mass movement;
- (6) Within woody draws; or
- (7) In areas designated as critical habitats for endangered or threatened species of plant, fish or wildlife.”

Section 33-20-04.1-01 NDAC also describes some **avoidance** areas, which should not be used for developing solid waste facilities. Avoidance areas include sites over or immediately adjacent to glacial drift aquifers; sites within 1000 feet from a down gradient drinking water supply well; sites closer than 200 feet from surface water or a wetland; final cuts of surface mines; and sites closer than 1000 feet from parks.

The listing of final cuts of surface mines as an avoidance area does not necessarily preclude use of final cuts. The state has some facilities that have been constructed in final cuts of surface mines, however, the primary concern of these sites was separation of disposed waste from any unremoved lignite seams, which locally can be ground water aquifers and sources of drinking water. Unremoved coal can be a pathway for leachate migration. Some final cut sites have been permitted where adequate clay is backfilled to elevate the base of the disposal operation well above the top of any unremoved coal seam and a clay liner is used to minimize the potential for leachate migration. All permitted sites are carefully engineered and monitored.

Operation Requirements

Chapter 33-20-04.1 NDAC, the general performance standards also contain many of the operation requirements for solid waste facilities.

Requiring trained operators for solid waste facilities ensures that the people actually operating the facility know what is necessary to maintain the facility in compliance with the state’s solid waste management rules and to minimize impacts on the environment. The state emphasizes that without adequately trained operators, many of the safety, siting or design features can be

rendered useless if facility operators are not aware of the basic principals and requirements to properly operate the system.

Storm water run on/runoff controls and the surface water requirements are designed to minimize the potential for surface water and ground water degradation. Simply put, keeping the landfill area as dry as possible, keeping water out of the site, and controlling any water that runs off of the waste or off any contaminated areas are crucial elements in solid waste facility design and operation. A solid waste management facility may not cause a discharge of pollutants into waters of the state unless such discharge is in compliance with the requirements of the North Dakota Pollutant Discharge Elimination System (NDPDES) pursuant to state rules.

Similarly, solid waste facilities must comply with the state's air quality rules. Fine particulate waste such as fly ash, can create dust problems which must be controlled. Some power plants utilize a pug mill to add adequate moisture to such waste so as to control dust emissions. Some facilities moisten the surface of the ash. In some special cases, incompatible wastes have been mixed resulting in emissions. When these cases arise, the Department has pursued appropriate actions with the regulated community.

The operating rules also require control of access to the site, which is not normally a problem with special waste facilities that are located in rural industrial settings. Most power plants and mines have adequate gates and fences. Solid waste facilities are also required to have signs at the entrance or in a nearby location for pertinent information so that employees or contractors know who to contact in the event of an emergency, or should there be problems evident at the facility. Solid waste facilities regulated by the state are also required to be routinely inspected by the owner/operator.

A "Plan of Operation" to be approved as part of the permit review process must describe how the facility will be operated. The Plan of Operation includes a description of waste acceptance and handling procedures, inspection activities, contingency actions, leachate removal system operation and maintenance, safety procedures, implementation of closure activities and a description of what waste will be accepted at the facility as well as what types of waste will not be accepted at the facility.

Solid waste management facilities are required to keep records detailing the facility's operation, any compliance problems or deviations from the operation's plan, as well as records on ground water and surface water monitoring, facility inspection logs, construction and closure activities, etc. Solid waste management facilities are required to submit an annual report to the Department.

The operation requirements also require facilities to have access to adequate equipment to operate the facility, in addition to waste and earth moving equipment and construction equipment which includes pumps and other devices needed in the daily operation. Facilities must have adequate access roads so that waste transportation equipment can arrive safely at the site and have adequate cover material to conduct covering activities as required in their operation. Solid

waste facilities must maintain appropriate earthen material on or near the site unless removal is authorized by the Department. Periodic surveying/inspection is necessary to ensure proper filling in accordance with the plan.

The North Dakota Solid Waste Management Rules emphasize orderly landfill development through “Sequential Partial Closure,” which means bringing discrete, usually adjacent portions of a disposal facility to elevation and grade in an orderly, continually progressing process as part of the operations of the facility for facilitating closure. This requirement helps keep waste as consolidated as possible thus minimizing surface water and eventual ground water pollution, reducing leachate generation, reducing dust and overall, reducing operation requirements thereby reducing the cost of operating waste management facilities.

Solid waste management facilities must carefully control run-on and runoff from waste management areas to avoid concentration of water on or in waste and thus reduce the amount of leachate generated. The state has found leachate in some landfills to be quite high in total dissolved solids and in some facilities it may have a high pH and contain heavy metals. Leachate removal systems, if required for specific landfills, must be operated and maintained as necessary and landfills cannot accept excessive amounts of liquids unless approved by the Department.

Finally, the operation requirements for solid waste management facilities require suitable plant growth material (SPGM), which is normally the soil A and upper B horizons, must be identified and quantified in a soil survey before facility construction. SPGM must be removed and stock piled and maintained for later use in closure. North Dakota state law requires a registered professional soil classifier be used to perform soil classification and survey activities.

Design Requirements

Subsection 2 of Section 33-20-4.1-01 general location standards states:

“Sites for new or for lateral expansions of land treatment units, surface impoundments closed with solid waste in place, municipal waste landfills, industrial waste landfills, and special waste landfills must minimize, control or prevent the movement of waste or waste constituents with geologic conditions and engineered improvements. Sites should be underlain by materials by materials with a low permeability to provide a barrier to contaminant migration.”

Most sites are located in geologically suitable areas. Landfills and surface impoundments for special waste also have engineered clay liners composite liners. Clay liners are generally 4 feet thick and are constructed in 6-inch layers with each layer compacted and tested. Increasingly, composite liners, with a thinner layer of clay (usually 2 feet) overlain by a synthetic layer (high density polyethylene or “HDPE”) are being utilized. The hydraulic head on a surface impoundment is such that waste constituents can migrate through even a 4-foot compacted clay liner in a relatively short amount of time. Most surface impoundments have composite liners.

Recently, the Heskett Station in Mandan, ND evaluated its landfill lining system and found it would save space and money by utilizing a composite liner. Working with the state, MDU found that a composite system consisting of an HDPE layer underlain by 6 inches of compacted clay would result in less potential leachate migration than a simple 4-foot compacted clay liner. The savings in 3 ½ feet of volume in the landfill should result in substantial savings for the company.

The Heskett Station landfill utilizes sand from their fluidized bed as part of a drainage or leachate collection layer in the landfill. Some other special waste landfills in North Dakota utilize bottom ash, a sand-like glassy material as a drainage layer above the liner system to keep the waste dry.

The state has found that the engineering and quality assurance/quality control measures are critical in construction. Obtaining low hydraulic conductivity from compacted clay is different from compaction for roads and structures. For compacted clay liners or for the compacted clay portion of a composite liner, soil characterization, moisture control (2-5% wet of optimum) and compaction is critical. Quality assurance/quality control testing, on each 6-inch lift, is also critical for liner construction. The solid waste program has developed "*Guideline 5 - Quality Assurance for Construction of Landfill and Surface Impoundment Liners and Caps and Leachate Collection Systems*" (copies available by request or reference the Department's web site) for facility construction and documentation. Liners must also be adequately protected after construction and during operation to ensure integrity.

Ground water Monitoring/Corrective Action Requirements

All special waste facilities permitted in North Dakota have ground water monitoring programs. The first phase of monitoring is detection monitoring, which requires semiannual monitoring of at least one upgradient and two downgradient monitoring wells. More wells and/or increased sampling may be required as part of the permit. The ground water parameters include general water parameters plus appropriate heavy metals. The state does not require analysis for volatile organics or other organic constituents from coal-fired plants as such materials are not found in the waste. The owner/operator of a solid waste facility is required to perform an annual statistical analysis of its ground water monitoring results to determine if a statistically significant increase has occurred.

In the event of a statistically significant release, the owner/operator must notify the Department and must evaluate the nature and extent of the release. The owner/operator must also evaluate potential remedial measures and, when requested, conduct a public meeting to be held with interested and affected persons. Assessment monitoring may be conducted on an increased scheduled and for an increased number of parameters than detection monitoring. Similarly, additional wells may be necessary to determine the nature and extent of a potential release.

Based on the assessment of any ground water release, appropriate corrective action measures may be necessary. The corrective action measures must be adequate to attain the ground water protection standards as negotiated with the Department and must control sources of the release.

Closure/Post-closure Requirements

All solid waste facilities must have a closure plan approved by the Department as part of the permit process. The final cover of all facilities must be designed and constructed to ensure the quality and integrity of the final cover. Sites must be designed and closed to minimize erosion and optimize drainage so that surface water cannot infiltrate the buried waste material. The final cover on landfills and surface impoundments closed with waste in place must have a minimum slope of at least 3 percent and may be allowed up to 15 percent. Solid waste facilities can be closed with steeper slopes above 15 percent if they can demonstrate that soil loss can be carefully controlled. State rules do not allow closed landfill slopes to exceed 25 percent grade.

Recent experience shows that closing landfills with closure slopes approaching 20-25 percent is difficult due to erosion. Given the finite amount of soil cover over a closed solid waste management unit, the state's rules do not allow closed solid waste management units to be used for cultivated crops, heavy grazing, buildings or any other use which might disturb the protective vegetative in soil cover. For slopes exceeding 15 percent up to 25 percent, steeper slopes must be justified as being stable; erosion cannot exceed one 100th of 1 percent of the final cover per year.

Solid waste management owners/operators must conduct post-closure activities required as part of their permit and the solid waste rules for a minimum of 30 years after closure of the facility. Owners/Operators must maintain the final cover and leachate collection systems and continue to monitor ground water and surface water. If contamination, excessive erosion, leachate buildup or other problems arise the owner/operator is required to conduct corrective action as necessary. The post-closure period can be extended by the Department as necessary.

Financial Assurance Requirements

Solid waste disposal facilities are required to have financial assurance as specified in Chapter 33-20-14 NDAC. The owner/operator must ensure that funds are adequate to cover the costs of closure and post-closure care and that the funds will be available in a timely fashion whenever needed until the owner/operator is released from the financial assurance requirement by the Department. A detailed estimate must reflect the cost of hiring a third party to close the largest area of a solid waste management unit ever requiring final cover at any time during the active life of the facility. Financial assurance provisions must be adjusted annually for inflation or for design changes. Financial assurance may be required for corrective action during the facilities active operation or during the post-closure period if necessary.

Five mechanisms for financial assurance are allowed under the ND Solid Waste Management Rules. These mechanisms include: (1) trust fund; (2) surety bond; (3) letter of credit; (4) insurance; and (5) financial test and corporate guarantee.

Solid Waste Permit Process

The state's review process (see attached flow diagram), includes a preliminary evaluation to screen sites that are not intrinsically suited for development as solid waste facilities before significant time and effort has been spent on design and site investigation work. Preapplications utilize existing information such as county ground water and geologic studies, soil surveys, topographic maps, aerial photographs, nearby surface water and well information, etc.

The multi-agency site suitability review required under the state rules includes review by two divisions in the North Dakota Department of Health, the Divisions of Waste Management and Water Quality. In addition, the North Dakota Geological Survey and the North Dakota State Water Commission review sites for site suitability. Finally, for sites located within mined areas, the North Dakota Public Service Commission, Division of Mined Land Reclamation reviews proposed facilities for site suitability and for accordance with the mine plans.

The Department coordinates issues with local planning, zoning and health officials interested in such issues. The permit process includes opportunities for public comment. An applicant for a solid waste management facility must publish a notice for a new or renewed permit twice in the local newspapers. After a thorough review, if the facility appears acceptable and in accordance with the state rules, the Department prepares a review document and draft permit and publishes a notice in the local county paper and nearby daily newspapers. A 30-day public comment period is allowed to receive testimony. If sufficient interest is expressed by the public, the Department will conduct a hearing and receive testimony.

Coal Combustion By-Product Utilization

The Department has worked with a number of energy companies as well as with some food processors utilizing coal as a fuel to develop beneficial uses for coal combustion by-products or ash. The Department's attached "*Guideline 11 - Ash Utilization for Soil Stabilization, Fill-In Materials and Other Engineering Purposes*" is a straightforward 4-page document which summarizes the Department's approach to product utilization. In essence, the proposed uses for coal combustion by-products must reasonably demonstrate that the proposed use will not adversely impact to the environment. The project's potential impact to surface water, ground water, air and soil quality should be evaluated.

Background information on the source, quality and quantity of ash as well as appropriate analysis must be provided. The Department is pleased to review existing information, especially leach testing information, however, some leach methods are more appropriate than others. One primary Department interest is determined what initial runoff might be from a site should a heavy rainfall event occur. Trying to simulate actual natural conditions in a laboratory is difficult, however, we have utilized a synthetic precipitation leachate procedure Method 1312, modified by reducing the solution to a solid ratio to 4:1. The Department also found good results with the ASTM Method D-3987 modified utilizing a solution to a solid ratio of 4:1. The Department has also reviewed results utilizing the synthetic ground water test and other methods that attempt to

simulate a waste's interaction with the environment. The Department finds it beneficial to try to model or conduct a laboratory simulation before the trial project to try to replicate field conditions.

The beneficial reuse of coal combustion byproducts is gaining acceptance in North Dakota. For many years, fly ash is a commonly used admixture for cement, especially the fly ash generated by the Coal Creek Station located near Underwood, ND.

Ash is routinely used to as a partial replacement of cement by the North Dakota Public Service Commission Abandoned Mine Lands program for grout filling of abandoned mined projects. MDU-Heskett Plant has received approval to utilize some of their waste as an admixture for a controlled flowable fill in engineering settings. One or two sugar beet companies have been approved to utilize some of their ash for stabilization of sugar beet piling sites and other stabilization projects. Stabilization of mine roads and other roads has also been studied. The Department is recently evaluating the use of coal combustion products for stabilization of livestock feedlots

Use of bottom-ash, a sand-like product, for winter traction and now replacing salt and sand has been accepted in North Dakota and other states. Bottom ash is also being marketed for abrasives and sand blast medium.