Coal Combustion Residuals Landfill

Closure Plan

Antelope Valley Station Landfill

Prepared for
Basin Electric Power Cooperative

March 2022

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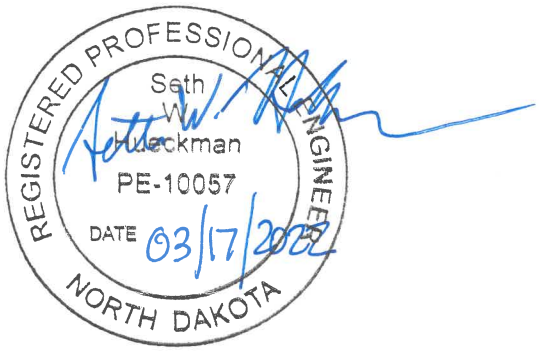
Contents

Certifications

I hereby certify that I have or my agent has examined the facility and, being familiar with the provisions of 40 CFR 257 Subpart D, attest that this Coal Combustion Residuals landfill closure plan has been prepared in accordance with good engineering practice, including consideration of applicable industry standards and the requirements of 40 CFR § 257.102. I certify that the plan and final cover system design is adequate for this facility and that procedures for recordkeeping and reporting have been established.



Seth W. Hueckman
Barr Engineering Co.
ND Registration Number PE-10057

Dated this 17th day of March 2022

Seth W. Hueckman

Digitally signed by Seth W. Hueckman
Date: 2022.03.17 17:14:00 -05'00'

1 Introduction

Antelope Valley Station (AVS) is a lignite coal-fired power plant consisting of two units that generate about 900 megawatts (MW) combined. The power plant, owned and operated by Basin Electric Power Cooperative (Basin Electric), is located approximately eight miles northwest of Beulah in Mercer County, North Dakota. Coal ash from AVS is disposed at the Section 7 Landfill, regulated as a coal combustion residual (CCR) landfill under Permit No. 0160 issued by the North Dakota Department of Environmental Quality (NDDEQ). CCR management is subject to Federal Standards for the Disposal of Coal Combustion Residuals in Landfills and Surface Impoundments per 40 CFR 257 Subpart D.

The existing landfill was first permitted by the North Dakota Department of Health, now NDDEQ, for solid waste disposal in 1995. The existing landfill currently consists of four cells, Cells 1-4. The landfill was permitted with a clay liner system. The first phase of liner construction was completed in 1996 with ash placement beginning the same year. The fourth and final phase of the existing landfill liner construction was completed in 2015. Partial sequential closure has been conducted on areas of the existing landfill that had been filled to final grade, with closure construction occurring in 2003, 2011, 2014, and 2016. Approximately 52 acres of the existing landfill is currently active; including Cell 4 and portions of Cell 1, Cell 2, and Cell 3. Approximately 51 acres of the 103-acre CCR landfill footprint for Cells 1-4 have been closed using an engineered earthen cover system approved by the NDDEQ.

Construction of a lateral expansion is scheduled for 2022. The lateral expansion will include a composite liner constructed with a compacted clay liner overlain by a 60-mil high density polyethylene (HDPE) geomembrane liner. The lateral expansion will consist of four additional landfill cells, Cells 5-8, totaling approximately 128 acres. The existing landfill and lateral expansion are considered to be one CCR unit (Cells 1-8). This closure plan has been developed to satisfy the requirements of 40 CFR § 257.102(b), written closure plan for CCR landfills.

2 Closure Narrative

Closure of the landfill will be accomplished by leaving existing CCR in place and constructing a final cover system compliant with 40 CFR § 257.102(d)(3). A 15 percent maximum closure grade was selected for landfill filling operations to maximize airspace, accommodate settling and subsidence of the CCR material, and to promote surface water run-off from the closed portions of the landfill. Final cover will be constructed in phases as closure grades are reached to limit the amount of open area and the amount of leachate generation during the filling process.

3 Final Cover System Design

Landfill closure will be accomplished with a cover system design with a soil barrier layer for the existing landfill (Cells 1-4) and a cover system design with a geomembrane barrier layer for the lateral expansion (Cells 5-8).

Closure of Cells 1-4 will consist of placement of a low permeability cover system as follows (from the top down):

- Vegetative cover consisting of 6 inches (minimum) of suitable plant growth material (SPGM) topsoil;
- 36 inches (minimum) of plant rooting zone soil;
- 24 inches of compacted clay soil material with a saturated hydraulic conductivity of 1×10^{-7} cm/sec or less; and
- Buffer layer over the subgrade soils to provide a suitable subgrade for the cover system, if needed.

Closure of Cells 5-8 will consist of placement of a low permeability cover system as follows (from the top down):

- Vegetative cover consisting of 6 inches (minimum) of SPGM topsoil;
- 18 inches (minimum) of plant rooting zone soil or 30 inches (minimum) of plant rooting zone soil if a geocomposite drainage layer is utilized;
- 12 inches of granular drainage material or equivalent geocomposite drainage layer;
- 40-mil (minimum) geomembrane hydraulic barrier layer; and
- Buffer layer over the subgrade soils to provide a suitable subgrade for the geomembrane layer and cover system, if needed.

4 Final Cover System Performance

The following subsections describe the performance for the differing final cover systems for Cells 1-4 and Cells 5-8.

4.1 Final Cover System, Cells 1-4

The final cover design for Cells 1-4 meets the requirements of 40 CFR § 257.102(d) as described below:

(d)(1)(i) Control, minimize or eliminate, to the maximum extent feasible, post-closure infiltration of liquids into the waste and releases of CCR, leachate, or contaminated run-off to the ground or surface waters or to the atmosphere;

The permeability of the final cover system will be less than or equal to the permeability of the bottom liner system and will be graded with up to a 15 percent (maximum) slope to promote surface water run-off. The 24-inch thick clay hydraulic barrier component of the final cover system will control infiltration of precipitation.

(d)(1)(ii) Preclude the probability of future impoundment of water, sediment, or slurry;

The final cover will be constructed with a slope of up to a 15 percent (maximum) and will tie in to the perimeter embankment, thereby promoting surface water run-off from the site.

(d)(1)(iii) Include measures that provide for major slope stability to prevent the sloughing or movement of the final cover system during the closure and post-closure care period;

The final cover will be installed with a vegetated 15 percent (maximum) slope that meets stability requirements.

(d)(1)(iv) Minimize the need for further maintenance of the CCR unit, and;

The final cover will be vegetated to minimize erosion and the need for maintenance.

(d)(1)(v) Be completed in the shortest amount of time consistent with recognized and generally good engineering practices.

Final cover will be constructed in phases as closure grades are reached to limit the amount of open area in the landfill.

(d)(3) Final cover system.

The final cover system for Cells 1-4 is considered a standard final cover design and meets the requirements described in 40 CFR § 257.102(d)(3)(i).

(d)(3)(i)(A) The permeability of the final cover system must be less than or equal to the permeability of any bottom liner system or natural subsoils present, or a permeability no greater than 1x10^{-5} cm/sec, whichever is less.

Cells 1-4 were lined with a 6-inch thick re-compacted clay barrier layer above clay liner quality subgrade materials. The clay barrier layer for Cells 1-4 closure will be constructed to a saturated hydraulic conductivity of 1 x 10^{-7} cm/sec or less which will be less than or equal to the permeability of the bottom clay liner.

(d)(3)(i)(B) The infiltration of liquids through the closed CCR unit must be minimized by the use of an infiltration layer that contains a minimum of 18 inches of earthen material.

A 24-inch thick clay barrier layer with a saturated hydraulic conductivity of 1 x 10-7 cm/sec or less is included in the final cover design for Cells 1-4 closure, which meets the requirement.

(d)(3)(i)(C) The erosion of the final cover system must be minimized by the use of an erosion layer that contains a minimum of six inches of earthen material that is capable of sustaining native plant growth.

A 42-inch thick erosion layer, consisting of 36-inch thick (minimum) plant rooting zone soil and 6-inch thick (minimum) SPGM topsoil capable of sustaining native plant growth is included in the final cover design, which exceeds the minimum of six inches of earthen material required.

(d)(3)(i)(D) The disruption of the integrity of the final cover system must be minimized through a design that accommodates settling and subsidence.

Ash will be placed in lifts uniformly across the landfill to allow for settlement and subsequent backfilling of areas where differential settling and subsidence is observed. Construction of the final cover system will not commence until suitable cover subgrade is observed. As a result, minimal differential settlement and subsidence is expected following final cover construction so that performance of the clay barrier layer or cover system as a whole will not be affected.

4.2 Final Cover System, Cells 5-8

The final cover design for Cells 5-8 meets the requirements of 40 CFR § 257.102(d) as described below:

(d)(1)(i) Control, minimize or eliminate, to the maximum extent feasible, post-closure infiltration of liquids into the waste and releases of CCR, leachate, or contaminated run-off to the ground or surface waters or to the atmosphere;

The permeability of the final cover system will be less than or equal to the permeability of the bottom liner system and will be graded with up to a 15 percent (maximum) slope to promote surface water run-off.

(d)(1)(ii) Preclude the probability of future impoundment of water, sediment, or slurry;

The geomembrane hydraulic barrier component of the final cover system will preclude infiltration of precipitation. The final cover will be installed with up to a 15 percent (maximum) slope and will tie into the perimeter embankment, thereby promoting surface water run-off from the site.

(d)(1)(iii) Include measures that provide for major slope stability to prevent the sloughing or movement of the final cover system during the closure and post-closure care period;

The final cover will be installed with a vegetated 15 percent (maximum) slope that meets stability requirements.

(d)(1)(iv) Minimize the need for further maintenance of the CCR unit, and;

The final cover will be vegetated to minimize erosion and the need for maintenance.

(d)(1)(v) Be completed in the shortest amount of time consistent with recognized and generally good engineering practices.

Final cover will be constructed in phases as closure grades are reached to limit the amount of open area in the landfill.

The final cover system for Cells 5-8 closure is considered an *alternative final cover system design* and meets the requirements described in 40 CFR § 257.102(d)(3)(ii).

(d)(3)(ii)(A) The design of the final cover system must include an infiltration layer that achieves an equivalent reduction in infiltration as the infiltration layer specified in paragraphs (d)(3)(i)(A) and (B) of this section.

Geomembrane hydraulic barriers of equivalent performance will be used in the Cells 5-8 liner system and the final cover system proposed.

(d)(3)(ii)(B) The design of the final cover system must include an erosion layer that provides equivalent protection from wind or water erosion as the erosion layer specified in paragraph (d)(3)(i)(C) of this section.

The total depth of final cover will be a minimum of 36-inches thick. If a geocomposite drainage layer is utilized, a 36-inch thick minimum erosion layer consisting of 30-inch thick (minimum) plant rooting zone soil and 6-inch thick (minimum) SPGM topsoil capable of sustaining native plant growth will be included in the final cover system. If a 12-inch thick drainage layer is utilized, a 24-inch thick minimum erosion layer consisting of 18-inch thick (minimum) plant rooting zone soil and 6-inch thick (minimum) SPGM topsoil capable of sustaining native plant growth will be included in the final cover system. Both final cover designs included for Cells 5-8 exceed the minimum of six inches of earthen material required.

(d)(3)(ii)(C) The disruption of the integrity of the final cover system must be minimized through a design that accommodates settling and subsidence.

Ash will be placed in lifts uniformly across the landfill to allow for settlement and subsequent backfilling of areas where differential settling and subsidence is observed. Construction of the final cover system will not commence until suitable cover subgrade is observed. As a result, minimal differential settlement and subsidence is expected following final cover construction so that performance of the geomembrane cover layer or cover system as a whole will not be affected.

5 Closure Procedures and Methods

5.1 Final Cover Construction

Partial sequential closure will be completed for areas that are filled to final grade and when it is sensible to mobilize construction equipment and crews to implement closure of a reasonably sized area. Areas to be closed during each final cover construction event will be determined in conjunction with preparation of construction plans and specifications. For areas filled to final grade, final cover will be placed as soon as practical, factoring in the timing constraints imposed by late fall, winter and early spring weather conditions. Construction of the final cover system will proceed as follows:

1. Grade and smooth ash fill subgrade surface as needed;
2. Place, grade and smooth surface buffer soil layer (if buffer layer is needed);
3. Install geomembrane cover and drainage material (Cells 5-8) or compacted clay soil material (Cells 1-4);
4. Place plant rooting zone soil;
5. Place SPGM topsoil layer;
6. Install permanent stormwater run-off controls (if needed); and
7. Seed, fertilizer and mulch.

Once the final cover SPGM layer has been placed and the seedbed has been prepared, seeding will generally be performed along the contour using a grass seed drill. Climatically adapted, shallow-rooted native vegetation seed would typically be drilled to a depth of one inch or less. In some situations, a broadcast seeder would be used, followed by light harrowing and/or a mulched cover. Depending on the planting season, a nurse crop of rye or oats may also be utilized. The closed landfill will not be used for cultivated crops, heavy grazing or any other use which might disturb the protective vegetative and soil cover.

Closure activities will be carried out by a qualified earthwork contractor and geomembrane installer. Construction plans and specifications will be prepared for each phase of closure to direct the contractor's work.

The construction of the various components of the final cover will be tested and documented in accordance with the testing requirements presented in the facility's Construction Quality Assurance Manual. A closure construction documentation report will be prepared and submitted to the NDDEQ after completion of an incremental closure event. The report will be signed by a professional engineer, registered in the state of North Dakota, stating that to the best of their knowledge and according to their records, cover construction has been completed in accordance with the approved plans, specifications, and permit requirements except for any deviations that have been noted in the report.

5.2 Final Closure

A notification of closure will be prepared within 30 days after completion of the last final cover construction event. The notification will include the certification by a qualified professional engineer

verifying that closure has been completed in accordance with the closure plan as required by 40 CFR § 257.102(f)(3). The notification will be complete when it has been placed in the facility's operating record as required by 40 CFR § 257.105(i)(8).

A notation will be recorded on the deed to the property following complete closure of the landfill to notify any potential purchaser that: (i) The land has been used as a CCR unit; and (ii) Its use is restricted under the post-closure care requirements (40 CFR § 257.104(d)(1)(iii)). A notification stating that the notation has been recorded will be prepared within 30 days after filing the deed with the appropriate local official. The notification will be complete when it has been placed in the facility's operating record as required by 40 CFR § 257.105(i)(9).

6 CCR Inventory and Maximum Closure Area Estimates

Cells 1-4 and Cells 5-8 will contain approximately 36 million cubic yards (mcy) of CCR, which is the estimated maximum inventory of CCR expected on-site over the active life of the CCR unit. The largest area of the CCR unit requiring final cover at any time during the CCR unit's life is estimated to be 60 acres.

7 Estimated Closure Schedule

As of November 2020, the CCR unit has an estimated remaining capacity of approximately 23 mcy, which equates to approximately 40 years of remaining capacity. The remaining life of the facility (filled to maximum capacity in 2060) may vary depending on factors such as ash content of coal, diversion of CCRs for beneficial use, and electrical generation rates, among others. Since sequential partial closure is periodically completed on the CCR unit, it is anticipated that the final area requiring final cover would be 20 acres or less. This relatively small area would easily be closed in one construction season.

8 Recordkeeping & Reporting

Basin Electric will maintain a copy of the most recent version of the closure plan in the facility's operating record in accordance with 40 CFR § 257.105, Recordkeeping Requirements, and the plan will be made publicly available on the Basin Electric CCR web site in compliance with 40 CFR § 257.107, Publicly Accessible Internet Site Requirements. Notification will be sent to State Director (solidwaste@nd.gov) in compliance with 40 CFR § 257.106, Notification Requirements.