Coal Combustion Residuals

Run-on and Run-off Control System Plan

Prepared for
Montana-Dakota Utilities Co.
R.M. Heskett Station

October 2016

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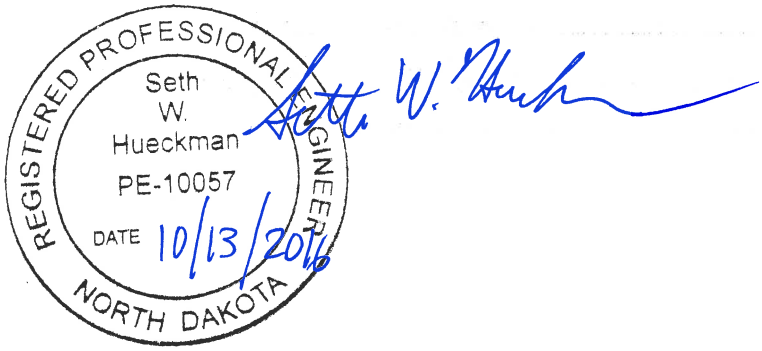
Certifications

I hereby certify that I, or my agent, have examined the facility and, being familiar with the provisions of 40 CFR 257 Subpart D, attest that this Coal Combustion Residuals run-on and run-off control system plan has been prepared in accordance with good engineering practice, including consideration of applicable industry standards and the requirements of 40 CFR §257.81. I certify that the plan is adequate for this facility and that procedures for recordkeeping and reporting have been established.

Revision	Date	Summary of Revisions
0	October 13, 2016	Initial Plan



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

Dated this 13th day of October, 2016

Seth W. Hueckman
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1.0 Introduction

Montana-Dakota Utilities Co. (MDU) operates the R.M. Heskett Station (Heskett), near Mandan, North Dakota. Operations at Heskett results in the production of coal combustion residuals (CCR). CCR management is subject to Federal Standards for the Disposal of Coal Combustion Residuals in Landfills per 40 CFR 257 Subpart D.

This CCR run-on and run-off control system plan has been developed to satisfy the requirements described in 40 CFR §257.81, run-on and run-off controls for CCR landfills, as they apply to MDU's coal ash landfill.

2.0 Objectives

Run-on and run-off controls for CCR landfills, 40 CFR §257.81, requires the owner or operator of an existing or new CCR landfill or any lateral expansion of a CCR landfill to design, construct, operate, and maintain a run-on and run-off control system. In addition, owner or operator must prepare an initial and periodic run-on and run-off control system plan for the CCR unit.

In order to fulfill these objectives, the run-on and run-off control system plan must:

- provide documentation that the run-on control system adequately manages flow onto the active portion of the CCR unit during and following the peak discharge from a 25-year, 24-hour storm;
- provide documentation that the run-off control system adequately collects and controls at least the water volume from a 25-year, 24-hour storm;
- define recordkeeping requirements;
- define reporting requirements; and
- include a certification from a qualified professional engineer.

3.0 Heskett Station Coal Ash Landfill

MDU's coal ash landfill at Heskett was developed in two phases covering approximately 36 acres. Phase I to the north and Phase II to the south were initially designed to act as two adjacent landfills separated by a haul road. Each phase was further divided into slots; each slot covering an area consisting of a single liner construction event. Phase I (Slots 1-5) is lined with a clay liner while Phase II (Slots 6-10) is composite-lined with a clay liner overlain by a 60-mil high density polyethylene (HDPE) geomembrane liner.

Prior to beginning Phase II construction, MDU was granted a permit modification to raise the height of the landfill and place ash fill above the haul road, thereby merging Phase I and II into one continuous landfill. Approximately 25 acres of the combined landfill is closed and capped with a cover system consisting of a clay barrier layer and a cover soil layer. Less than approximately one acre of the Phase I landfill is temporary closed with a cover system consisting of a 12-inch thick clay barrier layer overlain by

a 6-inch thick topsoil layer. The final cover slopes range from 3 percent to nearly 25 percent, but average roughly 10 percent around the perimeter. As of Fall 2013, approximately 11 acres of the landfill is currently active, including Slot 10 and portions of Slot 8 and Slot 9, as shown in Figure 1 of Appendix A.

4.0 Run-on Control System

The purpose of a run-on control system is to prevent surface water from offsite areas from flowing onto the active landfill area. Run-on control for the Heskett landfill is accomplished through site grading. Appendix A contains figures of the site. Figure 1 shows the closed, temporary closed, and active portions of the landfill. Figure 2 shows contours for the landfill area with flow arrows for surface drainage. The Heskett landfill is elevated above the surrounding topography. Adjacent offsite areas slope away from the landfill, which prevents run-on to the active landfill area. The closed portion of the landfill is graded to drain offsite. These measures prevent clean water from offsite areas from draining to the active landfill area and becoming ash-contact water.

5.0 Run-off Control System

The purpose of a run-off control system is to prevent water that has come into contact with ash from draining offsite. Ash-contact water or leachate generated from the active landfill is controlled within the lined limits of the landfill and ultimately drains to the evaporation pond through two leachate collection pipes located on the northwest corner (Phase I) and southwest corner (Phase II) of the pond.

Precipitation events typically produce minimal observed surface run-off from the approximately 11 acres of active landfill. Instead water quickly infiltrates and is stored in the dry, generally coarse-grained ash. For larger precipitation events, like the design storm, some surface run-off is expected. Water on the surface of the landfill would flow to the perimeter where the exposed drainage layer above the geomembrane liner would quickly infiltrate the run-off. Perimeter ditches are also used along the berms at the edge of the active landfill to keep ash-contact water from draining off of the lined limits of the landfill.

Water that infiltrates into the ash and perimeter drainage layer percolates down to the base of the landfill and is collected in leachate pipes that drain to the evaporation pond. This process occurs over weeks and months, creating a base flow into the pond that is not large enough for the pond to accumulate water over the long term. The observed discharge from the leachate pipes is insignificant relative to the rate and volume of run-off that would drain to the pond from other areas during the design storm event.

Site hydrology was calculated using the SCS run-off curve number method in HydroCAD version 10.0. The design storm for the run-off control system is the 25-year, 24-hour storm event and has a rainfall depth of 3.87 inches (reference: NOAA Atlas 14). The run-off volume for the active landfill area is approximately 3.5 acre-feet. The run-off volume draining to the evaporation pond is approximately 1.2 acre-feet. Hydrology calculations are in Appendix B.

The evaporation pond is 5 feet deep and has an approximate storage volume of 5 acre-feet. The evaporation pond does not have a structural outlet. If the water level in the pond exceeds elevation 1680 it will overtop the pond and flow north to Rock Haven Creek. The normal water depth in the pond is typically around elevation 1676 or less (less than a foot of water) based on MDU site observations. The starting water surface elevation in the pond would need to be roughly elevation 1679 before the 25-year design rainfall event would overtop the pond embankment. If water in the pond is observed near elevation 1678, the plant will need to take measures to draw down the pond water to ensure that there is adequate storage to contain the design rainfall event.

6.0 Recordkeeping

Run-on and run-off controls for CCR landfills, 40 CFR §257.81 (c)(3), states, *"The owner or operator of the CCR unit must prepare the initial run-on and run-off control system plan no later than October 17, 2016."* The plan is considered complete when it is placed in the MDU facility operating record.

After October 17, 2016, MDU will maintain a copy of the most recent version of the run-on and run-off control system plan in the facility's operating record. According to 40 CFR §257.81 (c)(2), MDU *"must amend the written run-on and run-off control system plan whenever there is a change in conditions that would substantially affect the written plan in effect."* In addition, MDU *"may amend the written run-on and run-off control system plan at any time provided the revised plan is placed in the facility's operating record."* If the plan is updated, the new version of the run-on and run-off control system plan will be put in the operating record *"as it becomes available"* in accordance with 40 CFR §257.105 (g). Additionally, MDU will *"prepare periodic run-on and run-off control system plans every five years." "The deadline for completing a subsequent plan is based on the date of completing the previous plan."* The plan is considered complete when it *"has been placed in the* [MDU] *facility operating record."*

MDU will retain a copy of each file *"for at least five years following the date of each occurrence, measurement, maintenance, corrective action, report, record, or study,"* in accordance with 40 CFR §257.105 (b). Figure 4, in Appendix A, is a flow chart describing the process for reviewing or amending run-on and run-off control system plan.

7.0 Reporting

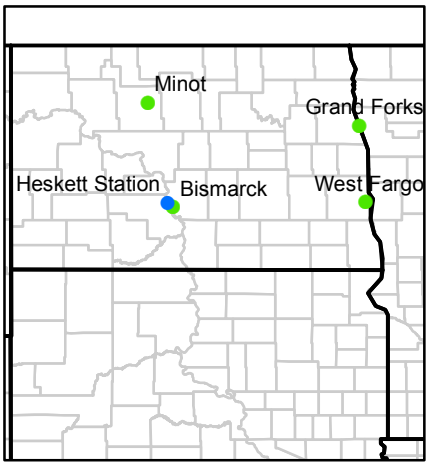
When the initial plan, and successive amendments to the plan, are placed in the operating record they will be made publicly available on the MDU CCR web site in compliance with 40 CFR §257.107 (g)(3), Publicly Accessible Internet Site Requirements. Additionally, to comply with 40 CFR §257.106 (g)(3), Notification Requirements, MDU will *"notify the State Director… when [the Run-on and Run-off Control System Plan] has been placed in the operating record and on the owner or operator's publicly accessible internet site."* Notification to the State Director will be made to ccr.solidwaste.reports@nd.gov as requested by the North Dakota Department of Health.

8.0 References

NOAA Atlas 14 Point Precipitation Frequency Estimates: North Dakota. National Weather Service. http://hdsc.nws.noaa.gov/hdsc/pfds/pfds_map_cont.html. Accessed July 26, 2016

Appendix A

Figures



Heskett Station
Active CCR Landfill Limits
Closed CCR Landfill Limits
Temporarily Closed CCR Landfill Limits

N

0 1,000
Feet

BARR

Heskett Station
CCR Landfill
Montana-Dakota Utilities Co.
Mandan, North Dakota

FIGURE 1 - SITE AREA

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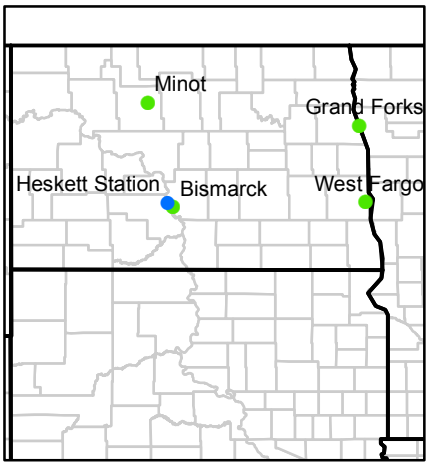

Heskett Station

Flow Arrows

Active CCR Landfill Limits

Closed CCR Landfill Limits

Temporarily Closed CCR Landfill Limits

10-foot Contour

2-foot Contour

Feet

0 150 300 600

BARR

Heskett Station
CCR Landfill
Montana-Dakota Utilities Co.
Mandan, North Dakota

FIGURE 2 - SITE DRAINAGE

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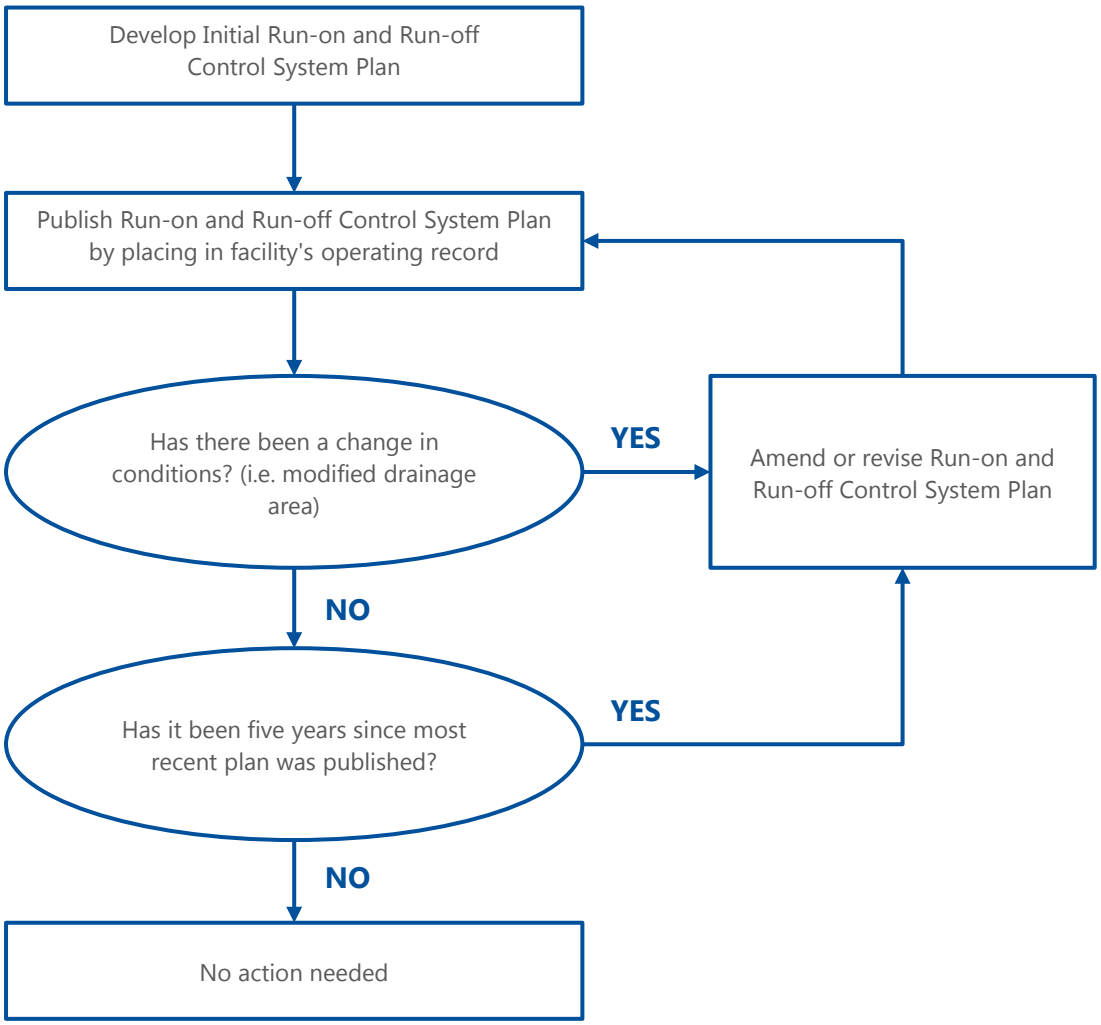


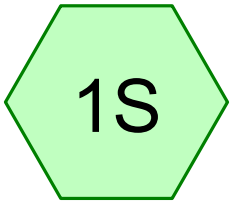
Figure 3: Process for Maintaining Run-on and Run-off Control System Plan

Appendix B

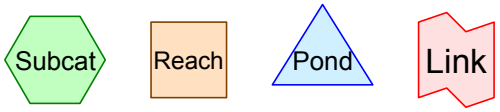
HydroCAD Report

Direct Pond Drainage Area

Evaporation Pond



Active Landfill Drainage Area



Routing Diagram for Heskett Hydrology
Prepared by Barr Engineering Co., Printed 9/29/2016

Time span=0.00-30.00 hrs, dt=0.05 hrs, 601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Active Landfill Runoff Area=11.000 ac 100.00% Impervious Runoff Depth=3.87"
Tc=10.0 min CN=100 Runoff=53.40 cfs 3.547 af

Subcatchment 2S: Direct Pond Drainage Runoff Area=4.618 ac 24.27% Impervious Runoff Depth=2.17"
Tc=10.0 min CN=83 Runoff=15.19 cfs 0.837 af

Pond 3P: Evaporation Pond Peak Elev=1,676.85' Storage=1.762 af Inflow=15.19 cfs 0.837 af
Primary=0.01 cfs 0.012 af Secondary=0.00 cfs 0.000 af Outflow=0.01 cfs 0.012 af

Total Runoff Area = 15.618 ac Runoff Volume = 4.384 af Average Runoff Depth = 3.37"
22.39% Pervious = 3.497 ac 77.61% Impervious = 12.121 ac

Summary for Subcatchment 1S: Active Landfill Drainage Area

Runoff = 53.40 cfs @ 12.17 hrs, Volume= 3.547 af, Depth= 3.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 25-YR Rainfall=3.87"

	Area (ac)	CN	Description
*	11.000	100	Total precipitation volume
	11.000		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, TR-55 Guidance minimum = 0.1hr**

Summary for Subcatchment 2S: Direct Pond Drainage Area

Runoff = 15.19 cfs @ 12.18 hrs, Volume= 0.837 af, Depth= 2.17"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 25-YR Rainfall=3.87"

	Area (ac)	CN	Description
	3.497	77	Brush, Fair, HSG D
*	1.121	100	Pond High Water Area
	4.618	83	Weighted Average
	3.497		75.73% Pervious Area
	1.121		24.27% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, TR-55 Guidance minimum = 0.1hr**

Summary for Pond 3P: Evaporation Pond

Inflow Area = 4.618 ac, 24.27% Impervious, Inflow Depth = 2.17" for 25-YR event
Inflow = 15.19 cfs @ 12.18 hrs, Volume= 0.837 af
Outflow = 0.01 cfs @ 0.00 hrs, Volume= 0.012 af, Atten= 100%, Lag= 0.0 min
Primary = 0.01 cfs @ 0.00 hrs, Volume= 0.012 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Starting Elev= 1,676.00' Surf.Area= 0.956 ac Storage= 0.936 af
Peak Elev= 1,676.85' @ 24.25 hrs Surf.Area= 0.990 ac Storage= 1.762 af (0.826 af above start)
Flood Elev= 1,680.00' Surf.Area= 1.121 ac Storage= 5.086 af (4.150 af above start)

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= 95.0 min (900.0 - 805.0)

Volume	Invert	Avail.Storage	Storage Description
#1	1,675.00'	5.145 af	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
1,675.00	0.916	0.000	0.000
1,676.00	0.956	0.936	0.936
1,677.00	0.996	0.976	1.912
1,678.00	1.037	1.017	2.929
1,679.00	1.079	1.058	3.986
1,680.00	1.121	1.100	5.086
1,680.05	1.200	0.058	5.145

Device	Routing	Invert	Outlet Devices
#1	Primary	1,675.00'	**Evaporation**
			Head (feet) 0.00 0.01 5.00
			Disch. (cfs) 0.000 0.005 0.005
#2	Secondary	1,680.00'	**100.0' long x 20.0' breadth Top of Pond Embankment**
			Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60
			Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=0.01 cfs @ 0.00 hrs HW=1,676.00' (Free Discharge)
↑—**1=Evaporation** (Custom Controls 0.01 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=1,676.00' (Free Discharge)
↑—**2=Top of Pond Embankment** (Controls 0.00 cfs)