RUN-ON AND RUN-OFF CONTROL SYSTEM PLAN SIOUX ENERGY CENTER SCL4A

Sioux Energy Center
8501 North State Route 94
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I. Introduction

Ameren Missouri has evaluated the Sioux Energy Center's ("Sioux") CCR landfill SCL4A in accordance with operating and design criteria requirements set forth below:

§257.81, Run-on and Run-off Controls for CCR Landfills.

For this initial assessment, Ameren Missouri retained the engineering firm Reitz & Jens, Inc. to evaluate Sioux's Run-on and Run-off Control System Plan for the permitted Ameren Missouri Sioux Utility Waste Landfill (UWL). The objective of this assessment is to determine if the existing plan meets the requirements of §257.81. These requirements state that a CCR landfill must be designed, constructed, operated and maintained with a run-on control system to prevent flow onto the active portion of the CCR unit during the peak discharge from a 24-hour, 25-year storm, and a run-off control system from the active portion of the CCR unit to collect and control at least the water volume resulting from a 24-hour, 25-year storm.

II. Background

Sioux UWL is a permitted utility waste landfill in St. Charles County, Missouri. The UWL is permitted by the Missouri Department of Natural Resources (MDNR) Solid Waste Management Program (SWMP) under State of Missouri Solid Waste Disposal Area Construction Permit Number 0918301. The permitted footprint for disposal of utility waste covers approximately 183.5 acres which will be developed in three phases and includes an approximate 19.6 acre Recycle Pond. Phase II includes the development of SCL4A, which has a disposal area of approximately 14.5 acres that drains to the previously developed Recycle Pond. Construction of SCL4A was complete in 2013.

III. Run-on and Run-off Control System Plan

SCL4A contains a perimeter berm constructed around the entire disposal area that will function as a flood protection dike. The top of the perimeter berm will be at elevation 446.0 feet, approximately 5 feet higher than the reported Base Flood Elevation at the UWL site. The only Run-on to SCL4A is from precipitation falling within the perimeter berm.

Stormwater management will change throughout the operating life and closure of the UWL Phases I, II and III. The UWL is designed to contain and reuse all process water and stormwater falling within the footprint of the UWL so that neither the process water or stormwater is discharged during the 24-

hour, 25-year design storm[1]. Factors that add or subtract significant quantities of water from the UWL include direct precipitation; evaporation and evapotranspiration; leachate from consolidation of the deposited CCR; reuse for CCR moisture conditioning and dust control; and discharge and/or reuse of process water for the Energy Center's WFGD scrubber.

A. Stormwater Runoff Controls

During operation, the SCL4A may have inactive and active areas. Stormwater in active disposal area will be controlled by a system of perimeter berms, let down channels, side slope bench drainage ways and perimeter ditches; all ultimately conveying runoff to the Recycle Pond. All drainage structures in the UWL are designed to collect and control water during the 24-hour, 25-year or greater storm. Some of the stormwater falling into active portion of SCL4A that infiltrates into the CCRs will ultimately drain to the leachate sumps where it will be removed by pumping to the Recycle Pond. Water that accumulates in the Recycle Pond is either reused in the Sioux Energy Center's WFGD scrubber or used for dust suppression and CCR moisture conditioning within the UWL in a closed-loop system.

During the initial, active operation of SCL4A, stormwater runoff may temporarily pond on the CCRs with the UWL. Landfill operations will maintain slopes on active areas to minimize ponding. Temporary collection basins will be located within the active disposal area and temporary pumps used to pump accumulated runoff to the perimeter ditch or directly to the Recycle Pond to minimize the amount of stormwater that infiltrates into the waste. After the elevation of in-place CCR exceeds the bottom of the perimeter ditch, the CCRs will be graded to maintain slopes on active landfill areas to avoid ponding, except in temporary collection basins. Ultimately, the perimeter ditch will convey stormwater from the side slopes, let down structures, and side slope benches to the Recycle Pond. These structures are described below, starting at the top of the UWL.

Small perimeter berms on top of SCL4A near the slope break line will be maintained to direct stormwater runoff from the top of the UWL to designated letdown structures located around the UWL top perimeter. The let down structures will convey the runoff in a controlled manner from the top of the UWL to the perimeter ditch. Let down structures have been sized to minimize the number of drainage channels that must be constructed and maintained around the perimeter of the UWL. Side slope benches and letdown structures are designed to carry stormwater from the upper portion of the UWL slopes to the perimeter ditch and ultimately after closure to the surrounding ground surface around the completed UWL.

During operations, the active disposal area may have both closed areas and active areas. Temporary structures consisting of ditches or berms are used to control flows during the on-going landfill operations. All stormwater that comes in contact with CCRs in the active areas will be managed within the active disposal area as described above and conveyed to the Recycle Pond.

[1] Huff, F.A. and J.R. Angel. (1992). "Rainfall Frequency Atlas of the Midwest." Bulletin 71, Midwestern Climate Center and Illinois State Water Survey.

Management of surface water runoff after closure is addressed by dividing the closed UWL into distinct drainage areas to control runoff quantities and velocities from the final UWL surface. Stormwater falling on closed UWL sections will be conveyed to the outside toe of the perimeter berm where it will be discharged. The side slope benches and letdown structures define individual drainage areas for the final contours of the landfill.

Surface water structures are designed to manage flow rates, quantities and velocities resulting from the 25-year, 24-hour rainfall event. Runoff volumes were calculated using the Rational Method. Stormwater diversion structures, capacities and velocities were calculated using Manning's Equation for open channel flow. The perimeter ditch used to convey stormwater to the Recycle Pond was modeled using both Bernoulli's Equation and Manning's Equation.

Erosion of the final cover, side slope benches, stormwater letdown structures, and perimeter ditches were evaluated using North American Green's Version 4.31 Erosion Control Materials design software following the Revised Universal Soil Loss Equation. The software conservatively evaluates channel erosion using the maximum shear strength method outlined in the Federal Highway Administration's HEC #15 and the United States Agricultural Department's Ag Handbook #667. All drainage structures will be protected from erosion using one of several possible materials: an erosion control mat, limestone riprap, or other manufactured erosion control product.

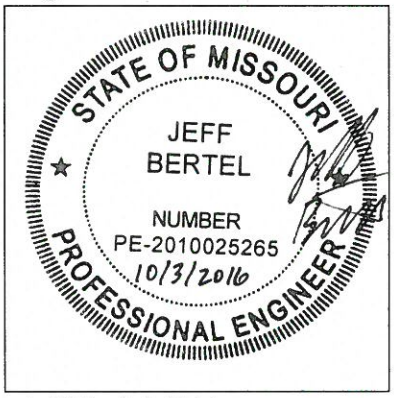
Engineering support for the Run-on and Run-off Control System Plan is contained in the facilities operating record and in the application for the MDNR SWMP State of Missouri Solid Waste Disposal Area Construction Permit Number 0918301.

1. Engineering Certification – Run-on and Run-off Control System Plan

The 2016 Run-on and Run-off Control System Plan was evaluated for the existing CCR landfill SCL4A at the Sioux Energy Center. The initial Run-on and Run-off Control system Plan meets or exceeds the requirements of 40 CFR 257.81. The engineering support for this certification has been placed in the operating record.

CCR Unit	Run-on and Run-off Control System Plan meets or exceeds the requirements of 40 CFR 257.81.
SCL4A	Yes

Engineer's Seal



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