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October 17, 2018

Big Rivers Electric Corporation
Sebree Generating Station
9000 Highway 2096
Robards, Kentucky 42452

Engineer's Certification of Unstable Areas Demonstration
Existing CCR Landfill
EPA Final CCR Rule
D.B. Wilson Generating Station
Centertown, Kentucky

1.0 PURPOSE

The purpose of this document is to certify that the Unstable Areas Demonstration for the D.B. Wilson Generating Station existing CCR Landfill is in compliance with the Unstable Areas demonstration specified in the Final CCR Rule at 40 CFR §257.64 presented below is the project background, summary of findings, limitations and certification.

2.0 BACKGROUND

AECOM performed a site assessment to evaluate the current conditions of the existing CCR landfill in accordance with the unstable area requirements of location restrictions under the USEPA CCR Rule §257.64. As part of the site assessment, AECOM has reviewed available historical information and completed site reconnaissance visits and geotechnical explorations.

3.0 SUMMARY OF FINDINGS

Based upon our review of the available historical data and our engineering analyses, AECOM has concluded that the D.B. Wilson CCR Landfill will meet the CCR Rule requirements for 40 CFR §257.64(a) and § 257.64(b).

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4.0 CERTIFICATION

I, Michael Brian Cole, being a Registered Professional Engineer in good standing in the State of Kentucky, do hereby certify, to the best of my knowledge, information, and belief, that the information contained in this certification has been prepared in accordance with the accepted practice of engineering. I certify, for the above-referenced CCR Unit, that the demonstration regarding the location of the CCR Unit in unstable areas as included in the Unstable Areas Demonstration for Coal Combustion Residuals dated October 17, 2018 meets the requirements of 40 CFR § 257.64(a) and § 257.64(b).

M. Brian Cole
Printed Name

October 17, 2018
Date

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ATTACHMENTS: Unstable Area Demonstration for Coal Combustion Residuals

Big Rivers
ELECTRIC CORPORATION

Your Touchstone Energy® Cooperative

Existing D.B. Wilson CCR Landfill

Disposal of Coal Combustion Residuals (CCR) from Electric Utilites Final Rule
Unstable Areas Demonstration for CCR

October 17, 2018

Prepared by

AECOM

Project Number: 60572400

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1.0 BACKGROUND

1.1 OBJECTIVE

The purpose of this Unstable Areas Demonstration report is to document compliance with 40 CFR 257.64 (a) and (b) of the Environmental Protection Agency Final Coal Combustion Residual Rule (EPA Final CCR Rule). This unstable areas demonstration is based on existing documentation such as construction drawings, record drawings, and any other pertinent data and/or investigations to support historic conditions and operations at D.B. Wilson CCR Landfill at the Big Rivers Electric Corporation (BREC) D.B. Wilson Generating Station.

1.2 RULE REQUIREMENT

According to *§257.64(a)* of the EPA Final CCR Rule, any existing or new CCR landfills, existing and new CCR surface impoundments, and all lateral expansions of CCR units must not be located in an unstable area unless the owner or operator demonstrates that recognized and generally good engineering practices have been incorporated into the design of the CCR unit to ensure that the integrity of the structural components of the CCR unit will not be disrupted.

In accordance with *§257.64(b)* the owner or operator must consider all of the following factors, at a minimum, when determining whether an area is unstable:

- §*257.64(b)(1*) – On-site or local soil conditions that may result in significant differential settling;
- *§257.64(b)(2)* – On-site or local geologic or geomorphic features, and
- *§257.64(b)(c)* – On-site or local human made features or events (both surface and subsurface).

1.3 SITE BACKGROUND

The D.B. Wilson CCR Landfill is used for the placement of coal combustion residual material; currently fly ash, bottom ash and related material. The landfill is raised above adjacent ground to a maximum elevation of approximately 529 feet above mean sea level. The original ground surface within the landfill footprint was irregular and the predominant features were the headwaters of Elk Creek and small stream valleys draining south. Other small tributaries drained west towards the Green River and north towards the Rough River.

A site location plan of the D.B. Wilson Station is supplied as **Figure 1**. An aerial photograph of D.B. Wilson CCR Landfill is shown in **Figure 2**. This demonstration is for Phase II of the landfill, which is an existing CCR landfill under the CCR Rule. Phase I lies to the east of the transmission line. It is an inactive landfill under the CCR Rule, and hence exempt from the requirements of CFR 257.64.

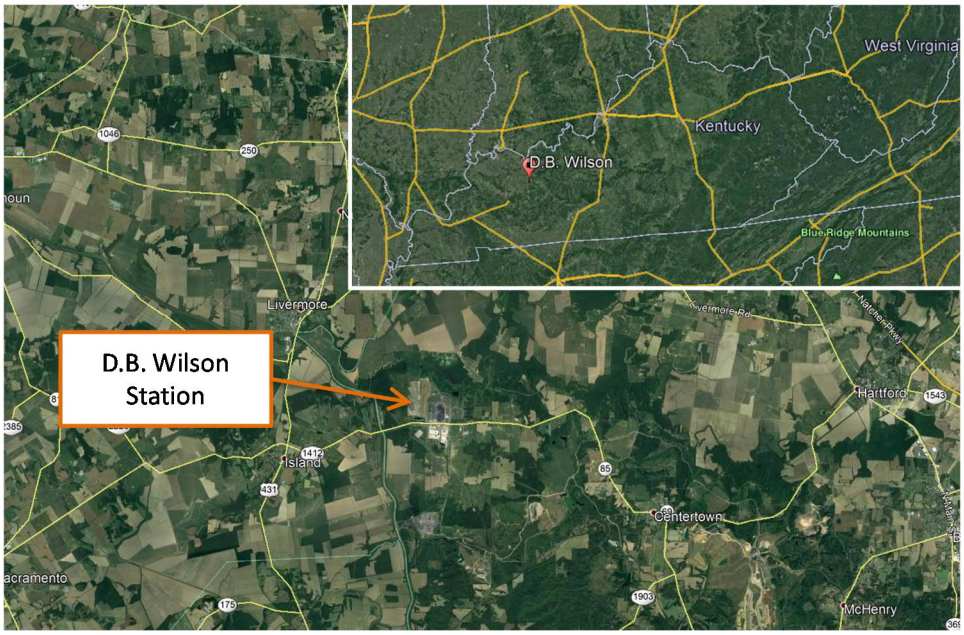

Figure 1: Big Rivers D.B. Wilson Site Location

Figure 2: Landfill Site Overview

2.0 SITE ASSESSMENT

2.1 SITE RECONNAISSANCE AND DATA REVIEW

AECOM engineering staff conducted detailed site reconnaissance as part of the site assessment to visually monitor existing conditions. Where practical, existing conditions were visually compared with available design and construction records. During the field reconnaissance at the D.B. Wilson CCR Landfill, AECOM did not observe any structural safety conditions that required immediate action. AECOM noted the landfill and associated structures and conduits appeared to be well maintained and routinely inspected by Station staff.

2.2 SUBSURFACE INVESTIGATIONS

AECOM performed a geotechnical exploration in August 2018, consisting of eight (6) soil borings drilled around the perimeter of the D.B. Wilson CCR Landfill. AECOM subcontracted the drilling to Geotechnology Inc. An AECOM geotechnical specialist observed and logged the soil borings.

The borings were advanced with a CME 850 ATV mounted drill rig using 3.25-inch inside diameter hollow stem augers to SPT refusal in weathered bedrock, which occurred at depths ranging from about 35.9 to 95.4 feet bgs. In boring B-2, NQ size rock core tools were used to advance the hole into shale bedrock from a depth of 65.3 feet to 75.3 feet.

Soil samples were obtained under the direction of the AECOM geotechnical specialist using a 2-inch outer diameter split spoon sampler driven with an automatic hammer in accordance with the standard penetration test (ASTM D-1586). Thin-walled 3-inch diameter Shelby tube (ASTM D1587) samples were obtained in cohesive materials. The soil samples were contained in a thin-wall sleeve.

The boring was logged in the field based upon recovered samples, cuttings, and drilling characteristics. The boring log was subsequently modified as appropriate based on laboratory tests. Upon completion, the borings were backfilled to the existing ground surface with cement bentonite grout. Representative soil samples were selected for soil classification in accordance with the USCS soil classification systems.

Laboratory tests performed on samples recovered from the borings included natural moisture content (ASTM D- 2216), Atterberg limits (ASTM D-4318), sieve analysis (ASTM D-1140), and consolidated undrained triaxial testing (ASTM D4767).

2.3 SITE GEOLOGY

Based on review of geologic and mine maps, the site was previously surface mined, and the landfill is underlain primarily by mine spoils. Underground mines are not present below the site.

In areas where surface mining did not occur, alluvial deposits associated with the Green River typically occur above bedrock in the lower topographical areas. Loess and residual soils typically occur above bedrock in the upland areas.
Alluvial deposits are comprised of silt, clay, sand, and gravel. Silt and clay may be in part of lacustrine origin in lower valleys of large streams. Sand is very fine to coarse, well to poorly sorted; consists mainly of subrounded to rounded quartz grains. Gravel is described as medium-brown to gray in color, comprised of iron-stained sandstone, quartz, coal, black shale and small amounts of pyrite. Unit includes slope wash along valley sides and at heads of tributary streams.

3.0 FOUNDATION CONDITIONS

The foundation conditions are summarized below based on the boring logs and laboratory data from the 2018 exploration by AECOM.

3.1 SITE SPECIFIC SOIL AND ROCK CONDITIONS

3.1.1 COVER MATERIALS

Based on the conditions encountered in the borings and knowledge of the site, the landfill cover varies from 1 to 1.5 feet thick. The cover material consists of topsoil, typically characterized as lean clay (CL) with roots and organics.

3.1.2 POZ-O-TEC (CCR)

The landfill contents consist of dry stacked Poz-O-Tec, which is a combination of fly ash and scrubber sludge, fixated with lime (CCR). Based on SPT N-values recorded in the CCR, the consistency ranged from very soft to hard with a typical consistency of stiff to very stiff. Based on laboratory results and field observation, the CCR is mainly characterized as non-plastic silt (ML). Moisture content test results ranged from about 10 to 16 percent.

3.1.3 MINE SPOILS/NATIVE SOILS

Soil material recovered from the standard penetration tests were classified by observation or laboratory testing as lean clay, silt, poorly graded sand, silty sand, silty clayey sand, and well graded gravel designated as CL, ML, SP, SM, SC-SM, and GW, respectively, in accordance with the Unified Soil Classification System.

Mine spoils primarily comprised of lean clay (CL), with varying amounts of sand and weathered rock fragments and cobbles were encountered in the borings below the surface materials and CCR. The thickness of the mine spoils ranged from about 14 to 65.3 feet and was underlain by native clay soils in Borings B-1, B-3 and B-5, and weathered shale in Borings B-2, B-4 and B-6. The native clay soils were encountered at depths ranging from about 15 feet bgs in Boring B-1, and 45 feet bgs in Borings B-3 and B-5.

The SPT N-values recorded in the mine spoils and native soils ranged from 2 to 37 bpf, indicating very soft to hard consistency. Natural moisture content test results ranged from about 5 to 18 percent. Atterberg Limits tests performed on the clay mine spoils and native soils indicated liquid limit values ranging from 26 to 33, and plasticity index values ranging from 8 to 14.

3.1.4 BEDROCK

A highly weathered shale unit was encountered below the mine spoils and native soils in each boring. NQ size rock coring tools were used at Boring B-2 to advance 10 feet and obtain intact rock cores of the underlying bedrock. The rock core run had 90 percent recovery, and Rock Quality Designation (RQD) was 50 percent.

3.1.5 SUBSURFACE WATER

Groundwater was measured immediately during and after completion of the advanced borings. Water levels measured in boreholes drilled along the northern and western toe of the landfill typically indicated free water at depths ranging from about 14 to 20 feet bgs. Water levels were measured on the eastern side of the landfill to depths of 31 to 56 feet bgs. Groundwater levels are anticipated to vary in response to seasonal climatic cycles and/or intense rainfall events.

3.2 NATURAL UNSTABLE AREAS

Based on review of historical data and observations in the borings performed during the geotechnical exploration, mine spoils and native soil was encountered below the CCR materials. The native soils, primarily consist of lean clay (CL). Some isolated layers of poorly graded sand (SP) were encountered in two borings with thickness of about 3 feet. The SPT N-values recorded within the native clay soils typically ranged from 2 to 37 bpf, indicating very soft to hard consistency.

Boring B-6 performed in the southeast corner of the landfill footprint indicated a subsurface consisting of approximately 78 feet of sand and 10 feet of gravel overlaying weathered shale. The relative density of the sand and gravel layers was loose to very dense, with SPT N-values of 5 bpf to 50 blows per 2-in. of penetration.

Considering the typically stiff to very stiff consistency of the clayey native soils, and an average SPT N-value of 40 for the sand layer and 45 for the gravel layer, natural unstable areas were not encountered during the explorations performed at the site.

3.2.1 LIQUEFACTION POTENTIAL

Based on the conditions encountered in the borings during the 2018 AECOM exploration, Mine spoils primarily comprised of lean clay (CL), with varying amounts of sand and weathered rock fragments and cobbles were encountered in the borings below the surface materials and CCR. Although sandy materials were encountered in pockets in the mine spoils, these materials are

typically very dense and likely samples of sandstone cobbles and boulders pulverized during split spoon sampling. Therefore we anticipate that largescale, liquefaction and associated slope failures are very unlikely. Critical cross-sections at the landfill were found to have factors of safety that exceed the CCR Rule required FS of 1.2 for the post-earthquake loading condition, as summarized in **Table 1** below.

Table 1. Results of Post-Earthquake Global Slope Stability Analysis

Loading Condition	Target FOS Criteria	Section A	Section B	Section C	Section D
Post-Earthquake	FS ≥ 1.2	3.44	2.29	3.21	2.50

The results of these analyses indicate the structural components of the landfill are anticipated to retain stability.

3.3 MAN MADE UNSTABLE AREAS

As previously discussed in Section 3.1, the cover material is comprised of fill materials described as lean clay (CL). Additionally, the landfill is partially underlain by mine spoils consisting of clean clay (CL) with pockets of poorly graded sand (SP). The CCR material consists of dry-stacked Poz-O-Tec. During the field investigation, the CCR materials were observed to be well compacted during construction as shown by SPT tests. Based on the SPT N-values and strength characteristics of the CCR materials, man-made unstable areas are not present at the landfill.

3.3.1 SETTLEMENT

Considering the type of construction and documented performance of the D.B. Wilson CCR Landfill, traditional one-dimensional consolidation settlement is not a significant concern in performance. Most primary settlement of the completed landfill portions should have been completed with negligible amounts of additional settlement caused by completion of the landfill. Observations by AECOM and others indicate that additional secondary consolidation-type settlement is not significant, and no significant distress appears to have been observed or reported along the slopes of the D.B. Wilson CCR Landfill.

4.0 REMEDIAL ACTION

No record or knowledge of historical structural instabilities have been identified for D.B. Wilson CCR Landfill. This CCR unit is subject to Big Rivers' inspection program. Based on the history of structural stability and ongoing observations of the CCR unit, no remedial actions are recommended for D.B. Wilson CCR Landfill.

5.0 CONCLUSIONS

Based upon our review of the available historical data and our engineering analyses, AECOM has concluded that the D.B. Wilson CCR Landfill will meet the CCR Rule requirements for Unstable Areas found in 40 CFR §257.64 (a) and (b).

6.0 REFERENCES

- USGS (2016). "Topographic Quadrangle Map, Robards Quadrangle, Kentucky"; United States Geological Survey 7.5 minute Series; scale 1:24,000.