ROY S. NELSON PLANT

CCR Rule Siting Criteria Demonstration of Compliance With Unstable Areas Location Restriction §257.64

PREPARED IN COMPLIANCE WITH THE EPA FINAL RULE FOR THE DISPOSAL OF COAL COMBUSTION RESIDUALS TITLE 40 CODE OF FEDERAL REGULATIONS PART 257

October 2018

CCR UNIT
WESTLAKE, LA

DEMONSTRATION OF COMPLIANCE WITH UNSTABLE AREAS LOCATION RESTRICTION §257.64

Prepared for
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Prepared By:
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O**ctober 2018**

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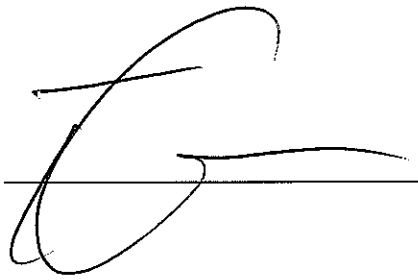
Appendices

PROFESSIONAL ENGINEER CERTIFICATION

I hereby certify, as a Professional Engineer in the State of Louisiana, that the information in this document was assembled under my direct supervisory control.

I hereby certify, as a Professional Engineer in the State of Louisiana, that the demonstration of compliance with the Unstable Areas location restriction provided herein meets the requirements of 40 CFR §257.64.



10/16/2018

Terry Elnaggar, P.E.

Date

1.0 INTRODUCTION

Entergy Louisiana LLC (Entergy), operates a Coal Ash Disposal Landfill (CCR Unit or CADL) for the disposal of coal combustion residuals (CCR) at the Roy S. Nelson Plant located in Westlake, Louisiana. The site receives CCR generated from the combustion of coal at the Nelson Plant. Management of the residuals at the CCR Unit is performed pursuant to national criteria established in Title 40 Code of Federal Regulations (40 CFR) Part 257 (CCR Rule), published by the United States Environmental Protection Agency (EPA) on April 17, 2015. In accordance with §257.64 of the CCR Rule, Entergy must demonstrate that the CCR Unit is not located in an unstable area. Per the CCR Rule, an "unstable area" is defined as "*a location that is susceptible to natural or human-induced events or forces capable of impairing the integrity of some or all of the structural components responsible for preventing releases from a CCR unit.*" This document is intended to demonstrate that the CCR Unit is located on a stable area.

2.0 EXISTING CONDITION

2.1 CCR Unit

The CCR Unit is an existing CCR landfill under the CCR Rule that has been in operation and accepting CCR prior to and after the effective date of October 19, 2015. The CCR Unit is comprised of 15 cells designed to receive CCR. The structural components meet both the LDEQ regulations and the CCR Rule requirements. Analysis for structural components are representative of the conditions of all 15 cells. Entergy applied for and obtained a solid waste permit modification from LDEQ for that project and that permit application is the source for much of the information considered in this demonstration.

2.2 Soil Conditions

Geotechnical tests were performed on representative samples collected from soil borings. Test results are found in the Hydrogeology Report (See Attachment E of Appendix VII of the LDEQ Solid Waste Permit Electronic Document Management System (EDMS) No. 10195559). Geotechnical tests included determination of natural water content, liquid and plastic limits (Atterberg Limits), sieve analysis, percent passing the No. 200 sieve, vertical permeability, unconfined and triaxial compression tests and density test. Additionally in 2015, cone penetration testing (CPT) and an updated slope stability analysis was performed.

Information on soil types and subsurface soil conditions at the CADL site were obtained from the 1979 reconnaissance study (nine borings) and the 1980 soil study (includes 20 borings). The CADL is underlain by the Upper Clay unit which is the confining unit for the Lower Sand unit. The Upper Clay unit is composed of silty and sandy clays ranging in consistency from stiff to very stiff with low to medium plasticity. The depth of the Upper Clays are between 35 and 50 feet.

The Lower Sands and Silts are present beneath the Upper Clays. The sands are generally fine grained, silty and very dense.

2.3 Geological Features

The CCR Unit is underlain by stable thick wedge-shaped Cenozoic deposits of clay, silt, sand and gravel. These Cenozoic sediments are greater than 10,000 feet thick at the site, (Harder 1960) and have southward dip at the surface from 10 feet per mile north of the site to 50 feet per mile south of Lake Charles (Hodges 1963).

Based on boring locations plotted on the USGS maps of Buhler, LA and Westlake, LA, the top of the "200-foot" sand is found at the Nelson Site at depths between 150 and 250 feet, and averages approximately 15 feet thick.

The "500-foot" and "700-foot" sands are extensive, and in some places hydraulically interconnected. The top of the "500-foot" sand at the site is found at a depth of approximately 300 feet below ground surface.

3.0 LOCATION RESTRICTIONS

Because the CCR Unit is an existing CCR landfill, it is not subject to the location restrictions in §257.60 - §257.63.

3.1 §257.64 Unstable Areas

Section 257.64(b) provides that the facility owner or operator must consider all of the following factors, at a minimum, when determining whether an area is unstable:

(1) On-site or local soil conditions that may result in significant differential settling;

(2) On-site or local geologic or geomorphologic features; and

(3) On-site or local human-made features or events (both surface and subsurface).

3.1.1 §257.64(b)(1) On-site or local Soil Conditions that may result in significant differential settlement

Geotechnical analysis was performed by Pivotal for the CCR Unit and included as Attachment 19 in Solid Waste Permit Electronic Document Management System (EDMS) Document Number 10195559. The analysis determined that strains in the base liner geomembranes and other geosythetics due to settlement of the base of the landfill will be negligible. Also included are calculations confirming strength and stability of leachate piping, earthquake bearing capacity and stability of the final slope.

The potential for differential settlement at the CCR Unit has been investigated and reported as Attachment 19 in Solid Waste Permit EDMS Document Number 10195559. The geotechnical analysis, called Foundation Settlement, had the objective to calculate the consolidation settlement of the soils beneath the landfill base liner. The analysis concluded that:

1. Maintaining a base slope of 1% along leachate collection lines and 2% elsewhere will ensure positive drainage
2. Strains in the base liner geomembranes and other geosynthetics due to settlement of the base of the landfill will be negligible, under the assumed conditions.

The slope stability has been investigated. From the geotechnical analysis (found in Attachment 19 in Solid Waste Permit EDMS Document Number 10195559), the final slope of the CCR Unit was confirmed to be 3:1. These calculations took into account the characteristics of the final cover, in-situ unit density of the cover soil as well as Factors of Safety for both static forces and peak ground acceleration (seismic activity). Maintaining a maximum side slope of 3:1 ensures that structural integrity for the unit will be maintained.

The peak ground acceleration (PGA) is the maximum horizontal acceleration of the ground due to seismic activity. The geotechnical analysis used a PGA value of 0.04334g (where "g" is the acceleration due to gravity perpendicular to the ground surface). From the USGS Seismic Design Map (Peterson 2008), the CCR Unit is located in a region that could experience PGA of 0.04g. The chosen value of 0.04334g is in line with the USGS guidance.

The bearing capacity of the CCR Unit to maintain structural integrity through a seismic event of the given PGA was determined (See Attachment 19 of the Solid Waste Permit EDMS Document Number 10195559). The bearing capacity of the foundation soils was calculated assuming that general shear failure will control the calculations, since the CCR Unit is a relatively non-rigid foundation on the subgrade soil relative to its size. The Factor of Safety determined was 1.8 (greater than the baseline value for this calculation). The CCR Unit has
a sufficient bearing capacity.

From these conclusions, neither on-site nor local soil conditions will result in significant differential settlement. The existing conditions will not tear the liner system or affect the integrity of the CCR Unit.

3.1.2 §257.64(b)(2) On-site or local geologic or geomorphologic features

The CCR Unit is underlain by thick wedge-shaped Cenozoic deposits of clay, silt, sand and gravel. These Cenozoic sediments are greater than 10,000 feet thick at the site, (Harder 1960) and have southward dip at the surface from 10 feet per mile north of the site to 50 feet per mile south of Lake Charles (Hodges 1963).

Based on boring locations plotted on the USGS maps of Buhler, LA and Westlake, LA, the top of the "200-foot" sand is found at the Nelson Site at depths between 150 and 250 feet, and averages approximately 15 feet thick (See Section 522 of the Solid Waste Permit EDMS Document Number 10195559).

The "500-foot" and "700-foot" sands are extensive, and in some places hydraulically interconnected. The top of the "500-foot" sand at the site is found at a depth of approximately 300 feet below ground surface (See Section 522 of the Solid Waste Permit EDMS Document Number 10195559).

The USGS 7.5 Minute Geological Quadrangle of Buhler, LA (Heinrich 2015) shows that there are neither salt domes nor faults near the CCR Unit. From this map, the nearest fault is approximately one mile away. Confirmation of no salt domes within one mile of the CCR Unit is found on the map provided by New Orleans Geological Society (McLindon 2019).

This map is contributing to the **Louisiana Coastal Geohazards Atlas** to be published by Louisiana Geologic Survey and New Orleans Geologic Society in mid-2019.

Based on an investigation of the CCR Unit site geology (See Section 522 of the Solid Waste Permit EDMS Document Number 10195559), neither karst terrain nor its characteristic physiographic features (sinkholes, vertical shafts, sinking streams, caves, seeps, large springs and blind valleys) are present at the CCR Unit.

3.1.3 §257.64(b)(3) On-site or local human-made features or events (both surface and subsurface)

The land around the CCR Unit is generally flat. Due to the relatively flat terrain around the CCR Unit, it does not interact with areas of mass movements, such as landslides, avalanches, debris slides and flows, solifluction, block sliding and rock fall.

The top of the "200-foot" sand is found at the CCR Unit site at depths of between 150 and 250 and averages approximately 15 feet thick. However, the "200-foot" sand has not been identified in some of the deep drill holes in the northern part of the Nelson Site along the Houston River. The "500-foot" and "700-foot" sands are extensive and in some places hydraulically interconnected. The top of the "500-foot" sand at the Nelson Site is found at a depth of approximately 300 feet below ground surface. Near-surface Recent sands and shallow Pleistocene sand strata are seldom pumped in the vicinity of the Houston River in central Calcasieu Parish, as they are thin, discontinuous, and tend to be contaminated by saltwater (found in Attachment 19, Appendix VII, Section 1.1 in Solid Waste Permit EDMS Document Number 10195559). Unstable conditions at the CCR Unit due to excessive ground water drawdown are not foreseeable.

4.0 CONCLUSIONS

Based on the assessment described above, the CCR Unit, including all fifteen cells, is not located in an unstable area and therefore meets the location restriction requirements under §257.64.

5.0 REFERENCES

Harder, Alfred H. "The Geology and Ground Water Resources of Calcasieu Parish, Louisiana," U.S. Geological Survey Water Supply Paper, 1488, 1960.

Heinrich, Paul, and McCulloh, Richard, "Buhler 7.5 Minute Quadrangle Geologic Quadrangle." Published by Louisiana Geological Society.1:24,000 scale Surface Geology. Published in 2015, https://www.lsu.edu/lgs/maps/24k-Geology/buhler-24k-geology.pdf

Hodges, Jr., A. L. S. M. Rodgers, and A. H. Harder. "Gas and Brackish Water in Fresh-Water Aquifers, lake Charles Area, Louisiana," LA Department of Conservation, LA Geological Survey, and LA Department of Public Works, Water Resources Pamphlet No. 13, 1963.

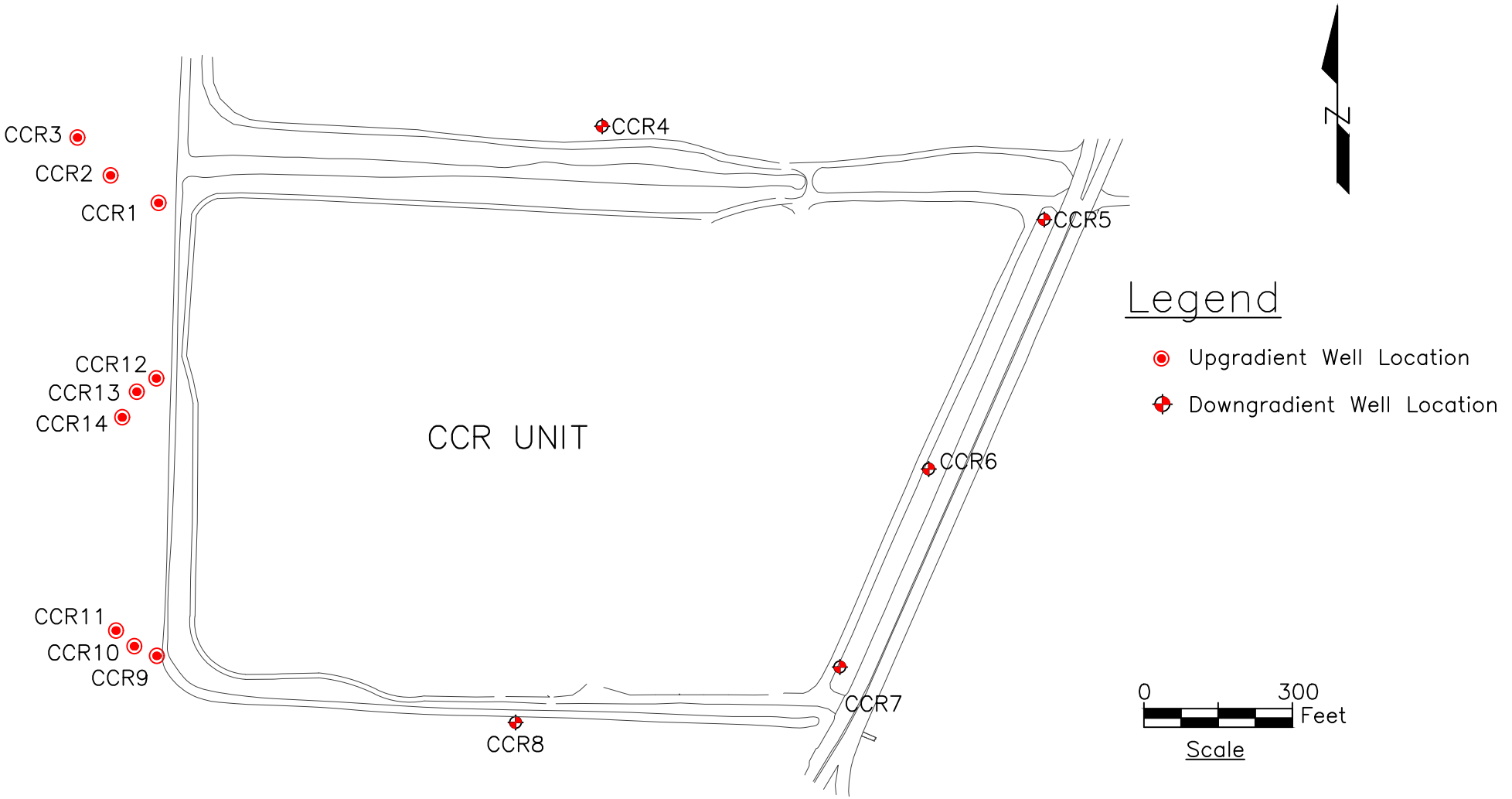
Louisiana Department of Environmental Quality (LDEQ), Electronic Document Management System (EDMS) Document Number 10195559, Major Modification Application – Nelson Coal Ash Disposal Landfill.

McLindon, Christopher, et al, "Louisiana Coastal Geohazards Atlas," Louisiana Geological Society and New Orleans Geologic Society, Draft provided via email communication and prior to the anticipated publication timeframe of mid-2019.

Petersen, Mark D., Frankel, Arthur D., Harmsen, Stephen C., Mueller, Charles S., Haller, Kathleen M., Wheeler, Russell L., Wesson, Robert L., Zeng, Yuehua, Boyd, Oliver S., Perkins, David M., Luco, Nicolas, Field, Edward H., Wills, Chris J., and Rukstales, Kenneth S., 2008, Documentation for the 2008 Update of the United States National Seismic Hazard Maps: U.S. Geological Survey Open-File Report 2008–1128, 61 p.

USEPA, 2015. 40 CFR Parts 257 and 261, Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals from Electric Utilities; Final Rule. April 17, 2015. 201 pp.

APPENDIX A SITE MAP



CCR UNIT
SITE MAP

ENTERGY LOUISIANA, LLC
ROY S. NELSON PLANT
HOUSTON RIVER ROAD, WESTLAKE, LOUISIANA

DATE	DESCRIPTION REVISIONS	BY

SCALE: AS NOTED	DRAWN BY: B.S.
DATE: JAN 06/16	CHECKED BY: T.E.

A
APPENDIX