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**COAL COMBUSTION RESIDUAL CLASS 2
AND CLASS 3 LANDFILL INSPECTION –
CROSS GENERATING STATION**

Pineville, South Carolina



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Executive Summary

This assessment of the stability and functionality of the Cross Generating Station (CGS) coal combustion residual (CCR) Class 2 and Class 3 Landfill is based on a review of available documents and on-site assessment conducted by Santee Cooper engineering staff on November 21, 2017. As detailed in this report, there are several recommendations based on field observations that may help CGS to continue to maintain the landfill in safe condition.

In summary, the CGS CCR Class 2 and Class 3 Landfills were generally found in satisfactory condition. No recognized existing or potential management unit safety deficiencies were noted at the time of inspection within the parameters of design and operation.

Summary of Recommendations

Class 2 Landfill

1. Two locations on the southern slope were observed to have incomplete erosion repairs. Soil was placed over eroded areas, but the areas were not graded back to the design slope nor seeded. These areas should be repaired within 60 days of completion of this report.
2. On the south side, erosion gullies have developed at the drainage ditch. The erosion should be repaired and seeded within 60 days of completion of this report.
3. Erosion was observed at the southwest corner of the landfill at the perimeter ditch. This erosion should be repaired and additional rock should be placed at this site to help prevent future erosion. This repair should be completed within 60 days of completion of this report.
4. A stockpile of rock has been placed on the side of the northern access road and is blocking the road drainage ditch. This section of the stockpile should be removed from the ditch within 60 days of completion of this report.
5. Sediment buildup noted in the Class 2 Landfill perimeter drainage ditch should be cleaned out within 60 days of completion of this report to avoid ponding of water around the toe of the landfill.

6. The perimeter ditch is holding water on the north end and should be regraded to allow for positive drainage. This repair should be completed within 90 days of completion of this report.

Class 3 Landfill

There are no recommendations for maintenance or repairs for the Class 3 Landfill at this time.

This assessment of the Class 2 and Class 3 Landfills at Cross Generating Station reported herein is based on field observations and review of readily available information provided to the inspection team of the subject coal combustion residual (CCR) management unit(s). Qualified Santee Cooper engineering staff performed the field observations and review of pertinent information and made the assessment in conformance with the requirements of Section 257.84 of the Federal Register and in accordance with reasonable and generally accepted engineering practices.

Coal Combustion Residual Class 2 and Class 3 Landfill Inspection – Cross Generating Station

1.0 General Information and Introduction

1.1 Purpose and Scope

The purpose of this report is to fulfill the requirements of Section 257.84(b) of the Federal Register regarding the safety and inspection of CCR storage units. Section 257.84(b) states that “Existing and new CCR landfills and any lateral expansion of a CCR landfill must be inspected on a periodic basis by a qualified professional engineer to ensure that the design, construction, operation, and maintenance of the CCR unit is consistent with recognized and generally accepted good engineering standards.” The inspection must, at a minimum, include:

- i. A review of available information regarding the status and condition of the CCR unit, including, but not limited, to, files available in the operating record (e.g., the results of inspections by a qualified person, and results of previous annual inspections)
- ii. A visual inspection of the CCR unit to identify signs of distress or malfunction of the CCR unit.

The inspection report must also be written by a qualified professional engineer and must address the following:

- i. Any changes in geometry of the structure since the previous annual inspection
 - **The Class 2 Landfill received final receipt of waste in December of 2015. Since then there have been no changes in the geometry of the landfill.**
 - **No changes in the geometry of the Class 3 Landfill beyond normal filling operations**
- ii. The approximate volume of CCR contained in the unit at the time of the inspection
 - **The Class 2 Landfill contains approximately 7,856,203 cubic yards of CCRs (Based on surveys conducted in 2015)**

- **The Class 3 Landfill contains approximately 133,656 cubic yards of CCRs (Based on a survey conducted in 2017)**
- iii. Any appearances of an actual or potential structural weakness of the CCR unit, in addition to any existing conditions that are disrupting or have the potential to disrupt the operation and safety of the CCR unit
- **Some maintenance items noted on Class 2 Landfill as discussed in the Executive Summary and Sections 4.2 and 5.3.1; however, landfill is safe for continued operation**
 - **No maintenance items noted on Class 3 Landfill**
- iv. Any other change(s) which may have affected the stability or operation of the CCR unit since the previous annual inspection
- **No other changes noted on the Class 2 Landfill that impact the stability or operation of the landfill**
 - **No other changes noted on the Class 3 Landfill that impact the stability or operation of the landfill**

2.0 Description of Coal Combustion Residual Management Units

2.1 Location and General Description

The Cross Generating Station (CGS) is located on the east bank of the Diversion Canal in Berkeley County, South Carolina, approximately 5.2 miles northeast of Cross, South Carolina. CGS is located on Cross Station Road, Pineville, South Carolina, 29468. Lake Marion is northwest of CGS, and Lake Moultrie is southeast of the station.

CGS currently has a single operational CCR landfill (the Class 3 Landfill), which entered operation at the end of 2015. Final receipt of waste for the Class 2 Landfill was December 2015. Table 2.1 below shows a summary of the size and general dimensions of the CCR management units at CGS as well as their current capacity:

Table 2.1: Summary of Landfill Dimensions and Size

	Class 2 Landfill	Class 3 Landfill (Cell 1B-1)
Base Width (ft)	1500	800
Base Length (ft)	3000	1600
Side Slopes H:V	3:1	-
Approximate Current Storage Volume (cy)	7,856,203	133,656

2.2 Type of CCRs Currently Stored in Landfill

The Class 2 Landfill accepted flue gas emissions (FGD) control residuals, bottom ash, fixated fly ash, and boiler slag during operation. The Class 3 Landfill began accepting flue gas emissions (FGD) control residuals, bottom ash, fixated fly ash, and boiler slag when operation was initiated in December 2015. All materials are carefully compacted using tracked bulldozers and a vibratory roller where needed to ensure that the landfill space is used efficiently and to minimize the risk of settlement and/or slope instability.

2.3 Principal Project Structures

2.3.1 Class 2 Landfill

The CGS Class 2 Landfill is regulated under SCDHEC's Solid Waste Management regulations. It was originally permitted in 1982 and began receiving CCRs in 1984. The original permit allowed placement of material up to elevation 120 feet (NGVD 1929), which is approximately 38 feet above grade. A consent agreement in 2011 allowed Santee Cooper to continue placement of material above this elevation, with a maximum top elevation of 210 feet (NGVD 1929). All placement operations ceased in 2015 and closure was completed within six months after final placement.

The Landfill is approximately 1500 feet wide at its base and 3000 feet long. The side slopes are 3:1 (horizontal to vertical), with terraces to prevent excessive storm water runoff velocity built approximately every 20 vertical feet. Storm water is routed from the slopes to these terraces and then through downdrains at each end of the landfill, helping to minimize erosion on the slopes.

The entire top deck of the Class 2 landfill, as well as the eastern and western sides, is covered with Class 3-grade landfill liner. This liner serves as permanent cover/closure for the Class 2 side slopes under the authorization of the Class 3 construction permit. The northern and southern ends of the landfill are both covered with a more traditional clay cap and vegetative cover.

2.3.2 Class 3 Landfill

A Class 3 landfill is being constructed immediately adjacent to the eastern and western slopes of the closed Class 2 landfill. For this reason, the east and west slopes and the top deck of the Class 2 landfill are covered with a HDPE liner capable of serving as the bottom liner for the Class 3 landfill.

The Class 3 Landfill cell (Cell 1B-1) is approximately 800 feet wide at its base and 1600 feet long. This cell is the only operational cell of the Class 3 landfill at this time and as a result is the only cell analyzed in this report. Subsequent reports will include other cells as they enter service.

The landfill abuts the Class 2 Landfill and consists of lined cells with a geocomposite drainage net and sand drainage layer to facilitate removal of leachate water from the landfill into the leachate pond to the south of the landfill. Placement of CCR in the Class 3 Landfill began in December 2015.

3.0 Summary of Relevant Reports and Incidents

3.1 Summary of Reports on the Safety of CCR Units

Furnished reports of weekly inspections conducted by CGS personnel, indicated no major structural or operational problems at the CGS Class 2 Landfill or the CGS Class 3 Landfill. No significant deterioration was indicated in the documentation reviewed.

4.0 Field Observations

4.1 Project Overview and Significant Findings

Santee Cooper qualified engineering staff performed the inspections on November 21, 2017. The site visit began mid-morning. Weather conditions during the visit were approximately 65 degrees Fahrenheit, and cloudy.

The overall condition of the CCR Class 2 Landfill was satisfactory with no significant findings noted. Similarly, the CCR Class 3 Landfill was found to be in satisfactory condition with no significant findings noted.

4.2 Class 2 Landfill

4.2.1 Crest/Operating Area

The crest of the Class 2 Landfill was generally found to be in satisfactory condition. The crest has been covered with Class 3-type landfill liner. No significant areas of concern were noted during the field inspection.

4.2.2 Outside Slopes – Northern and Southern Side Slopes

The northern and southern side slopes of the Class 2 CCR landfill are covered with a clay cap and vegetative cover in accordance with SCDHEC regulations. The condition of the cap and vegetative cover on the northern and southern slopes was found to be generally satisfactory with isolated areas of minor erosion and loss of grass cover. There were two areas on the south side that have, what seems like, incomplete erosion repairs. No obvious signs of slumps, slides, bulges, tension cracks, seepage, or animal burrows were observed on the slope.

4.2.3 Outside Slopes – Eastern and Western Sides

The eastern and western slopes of the Class 2 CCR Landfill are covered with Class 3-type landfill liner. These slopes were found to be in generally satisfactory condition, as the

liner protects the slopes from erosion resulting from rainfall. No obvious signs of slumps, slides, bulges, tension cracks, seepage, or animal burrows were observed.

4.2.4 Stormwater Conveyance Structures

Stormwater on the Class 2 CCR Landfill is directed to benches built approximately every twenty (20) vertical feet. Downdrains are built into each bench on the northern and southern ends of the landfill which convey stormwater into a perimeter drainage ditch at the toe of the landfill. Heavy sedimentation was noted in the perimeter drainage ditch in multiple locations. On the north side of the perimeter ditch water is ponding.

4.2.5 Roads/Ramps/Other Infrastructure

There are two (2) access ramps at the Class 2 CCR Landfill. The northern ramp runs from the northeast corner to the west, entering the top of the landfill on the northwestern side. Minor surface erosion in several places on the northern access ramp was observed. A stockpile of rock was placed on the access road and interferes with the roads drainage route. A second ramp runs from the southwest corner towards the north. The access road surface was found to be in satisfactory condition.

4.3 Class 3 Landfill

4.3.1 Operating Area, Liner, and Leachate Collection System

The operating area of the Class 3 landfill was found to be in satisfactory condition upon inspection. The sand drainage layer placed above the Class 3 liner was found to be in satisfactory condition. The drainage layer and associated leachate collection pump system appeared to be in good condition and functioning as designed, as no ponding was noted in the Class 3 landfill cell.

4.3.2 Outside Slopes

The outside slopes of the Class 3 Landfill cell were found to be in satisfactory condition. No obvious signs of slumps, slides, bulges, tension cracks, seepage, or animal holes were observed on the slope.

4.3.3 Stormwater Conveyance Structures

Stormwater on the Class 3 CCR Landfill is managed by collecting and pumping all stormwater from the sand drainage layer above the Class 3 liner through HDPE outlet pipes and into the on-site leachate pond. Stormwater is directed to the pump inlets by proper grading of the drainage layer. The HDPE conveyance pipes from the pump intakes to the leachate pond appeared to be in satisfactory condition at the time of inspection.

4.4 Adequacy of Maintenance, Operating, and Surveillance Procedures

4.4.1 Adequacy of Maintenance Procedures

Overall, maintenance of the Class 2 and Class 3 CCR Landfills appears to be adequate. No major maintenance issues were noted during the field inspection or in the weekly inspection reports completed by CGS personnel and reviewed by the inspection team. Some minor maintenance of storm water control structures is warranted as noted in the Recommendations section and the Field Observations section.

4.4.2 Adequacy of Operating Procedures

Based on field observations and discussions with CGS personnel, the operating procedures for the Class 2 and Class 3 CCR Landfills appear to be adequate.

4.4.3 Adequacy of Surveillance Procedures

CGS personnel complete daily informal inspections and weekly formal inspections on the Class 2 and Class 3 CCR Landfills in accordance with good engineering practice and Section 257.84 of the Federal Register. These inspections are being properly documented and should continue as they are currently being conducted.

5.0 Conclusions and Recommendations

Conclusions are based on visual observations from a one-day site visit on November 21, 2017, and review of technical documentation provided to the inspector.

5.1 Conclusions Regarding the Structural Soundness of the Management Unit(s)

Based on a review of the engineering data provided and the observations of the inspection team during the site visit, the CGS Class 2 Landfill appears to be structurally sound under static loading conditions. The slopes of the landfill also appear to be structurally sound under moderate seismic loading conditions. The factor of safety associated with the stability of the Class 2 Landfill should also continue to increase as construction and filling of the adjoining Class 3 Landfill continues.

Based on a review of the engineering data provided and observations during the inspection, the CGS Class 3 Landfill appears to be structurally sound under static loading conditions. Design documents appear to be soundly engineered and existing infrastructure, including liner, drainage layers, and storm water/leachate management systems appeared to be in acceptable condition.

5.2 Conclusions Regarding Field Observations

The Class 2 Landfill liner appeared to be in good condition and is adequately covering those portions of the landfill abutting the expansion. The visible (not covered by Class 3 liner) portions of the perimeter slopes were observed to have no signs of overstress, significant settlement, shear failure, or other signs of instability. Storm water controls on the landfill also appear to be generally adequate at this time. There are no apparent indications of unsafe conditions or conditions needing emergency remedial action. Some minor maintenance is needed (see Section 1.4.1). The Class 3 Landfill was similarly found to be in good condition, with no maintenance or repair recommendations at this time.

5.3 Recommendations

A number of minor maintenance concerns were noted during the field inspection. These items were as follows:

5.3.1 Class 2 Landfill

1. Two locations on the southern slope were observed to have incomplete erosion repairs. Soil was placed over eroded areas, but the areas were not graded back to the design slope nor seeded. These areas should be repaired within 60 days of completion of this report.
2. On the south side, erosion gullies have developed at the drainage ditch. The erosion should be repaired and seeded within 60 days of completion of this report.
3. Erosion was observed at the southwest corner of the landfill at the perimeter ditch. This erosion should be repaired and additional rock should be placed at this site to help prevent future erosion. This repair should be completed within 60 days of completion of this report.
4. A stockpile of rock has been placed on the side of the northern access road and is blocking the road drainage ditch. This section of the stockpile should be removed from the ditch within 60 days of completion of this report.
5. Sediment buildup noted in the Class 2 Landfill perimeter drainage ditch should be cleaned out within 60 days of completion of this report to avoid ponding of water around the toe of the landfill.
6. The perimeter ditch is holding water on the north end and should be regraded to allow for positive drainage. This repair should be completed within 90 days of completion of this report.

5.3.2 Class 3 Landfill

There are no recommendations for maintenance or repairs for the Class 3 Landfill at this time.