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Belews Creek Steam Station
3195 Pine Hall Rd.
Belews Creek, NC 27009

BELEWS CREEK STEAM STATION

FGD RESIDUAL LANDFILL LINER REPAIR

CONSTRUCTION QUALITY ASSURANCE CERTIFICATION REPORT

March 10, 2011

Prepared by:

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NORTH CAROLINA PROFESSIONAL SEAL 27446 ENGINEER EVAN E ANDREWS
3/10/11

TABLE OF CONTENTS

Page

Table of Contents i

1.0 Introduction 1

2.0 Construction Quality Assurance Activities 2

2.1 General 2

2.2 Liner Damage Survey 2

2.3 Liner Repair 3

1.0 INTRODUCTION

Duke Energy operates the Flue Gas Desulfurization (FGD) landfill constructed in accordance with Sub-Title D Regulations, North Carolina Solid Waste Management Rules 15A NCAC 13B and the General Permit Conditions of Permit # 85-05. This report, prepared by Joyce Engineering, Inc. (JEI) for Duke Energy addresses the quality assurance activities performed in January and February 2011 during FGD residuals landfill geosynthetic liner repairs at the Belews Creek Steam Station.

SEFA Group had retained Shamrock Environmental Corporation (SEC) of Browns Summit, North Carolina to perform the geosynthetic liner damage repairs in January 2011. Shamrock provided personnel and equipment for the liner repairs and Joyce Engineering, Inc. retained by Duke Energy provided construction over sight and quality assurance for the liner repair work. The damage to the liner system consisted of tears in the protective geocomposite and two locations with tear in the geomembrane liner. The liner damage was observed on the north end of Cell 2 slope. No damage was observed in the under lying geosynthetic clay liner (GCL). The geomembrane damage of the liner were patched with new material and extrusion welded to the liner. The damaged geocomposite was fastened with plastic zip ties where the geonet was laid back to its original position. In some areas new geocomposite was fitted to cover the torn and missing geocomposite and zip ties were used to fasten the patch to the existing geocomposite. All repaired areas were covered with 6 oz/sy geotextile that was thermally bonded to the geotextile member of the geocomposite. A total of 11 areas were repaired and covered with the protective geotextile.

SEFA Group had retained Shamrock Environmental Corporation (SEC) of Browns Summit, North Carolina to perform the geosynthetic liner damage repairs to the Cell 1 anchor trench in February 2011. Shamrock provided personnel and equipment for the liner repairs and Joyce Engineering, Inc. retained by Duke Energy provided construction over sight and quality assurance for the liner repair work. The damage to the liner system along the anchor trench consisted of tears in the protective geocomposite and along with tears in the geomembrane liner. Damage was also observed in the under lying geosynthetic clay liner (GCL). The under lying damaged GCL was covered with new material large enough to cover all damaged areas. The geomembrane damage of the liner was patched with new material and extrusion welded to the liner. New Geocomposite fitted to cover the geomembrane and was fastened with plastic zip ties over the repaired geomembrane. Shamrock placed an 18 inch wide strip of 6 oz/sy geotextile to cover the completed repair seam. The geotextile was thermally bonded to the geotextile of the geocomposite.

2.0 CONSTRUCTION QUALITY ASSURANCE ACTIVITIES

2.1 General

Joyce Engineering, Inc. provided Construction Quality Assurance (CQA) activities for the repair work. The following sections describe the specific areas of CQA:

2.2 Liner Damage Survey

Representatives of Duke Energy and Joyce Engineering, Inc. surveyed the extent of damage to the liner system prior to retaining a Contractor for the repair work. The damage to the liner system was observed mostly in the geocomposite. Only two locations were noted with damage through the geomembrane. The damage to the liner was apparently caused by trackhoe bucket teeth and none of them were extensive. Typical tear or puncture was only few inches in length or diameter. Along the anchor trench (picture 4, 5 and 6) the geocomposite, geomembrane as well as the GCL were destroyed. The damage to the anchor trench was consistent with damaged caused by heavy equipment traffic.

1. Typical damage in geocomposite.

2. A row of small puncture holes in the liner.

3. General area in Cell 2 damaged liner.

4. Edge of liner/anchor trench of Cell 1.

2.3 Liner Repair

Shamrock mobilized on January 31, 2011 to the FGD landfill for the liner repair work. The Contractor cleaned each damage area by brushing soil and dust from the area to be worked on. The geocomposite was pulled away to inspect the geomembrane for damage. If the geomembrane was found not penetrated or torn, the geocomposite was laid down to its original position and fastened with zip ties. The zip ties were placed approximately 6 inches apart. The two locations that had cut or tear in the geomembrane were cleaned and a patch was prepared for covering the damage.

5. Geocomposite fastened with zip ties.

6. Geomembrane exposed for repair.

7. Geomembrane patch repair in progress.

8. Extrusion welding the patch.

The Contractor follows the edge of the patch with a hand held grinder (Picture 7) to remove the texturing from the geomembrane and to clean the surface for a fresh HDPE free from contaminants. Next the patch is temporarily thermo bonded to the membrane liner to affix it in place. The patch edges are then cleaned with the grinder to provide a clean surface for welding with the extruder. The extrusion weld follows around the edge of the patch (Picture 8). The weld is approximately 1.5 inches wide to cover the patch edge and the membrane for a strong permanent bond.

Following the patch welding the weld is subjected to a vacuum test for the inspection of seam quality. The welded bead will be lightly brushed with a soap solution and the "vacuum box" is placed over the seam. A motor is activated to create a vacuum inside the box. The operator inspects for bubbles from the weld which indicate a hole in the weld. If soap bubbling is found the section of the weld needs repair and re-welding. After the vacuum test a new piece of geocomposite was fitted over the repair area and fastened with the zip ties.

9. Extrusion welding a patch on membrane.

10. Vacuum testing patch extrusion weld.

11. Geotextile final covering repaired area.

12. Geotextile covering repairs.

Shamrock mobilized on February 18, 2011 to the FGD landfill for the anchor trench liner repair work (Picture 13). The Contractor cut away the damaged geocomposite and geomembrane along with some of the damaged GCL. Following the removal of the damaged sections of geocomposite, geomembrane and GCL an irregular shaped area of damage measuring approximately 43 feet long by eight feet at its widest point had been uncovered. The contractor then cleaned and prepared it for a replacement section of GCL by shoveling away excess dirt and rock (Picture 14). A 32 ft section of GCL was laid in place to cover the area of the GLC that had been damaged. Approximately 1ft of the GCL was tucked under the existing undamaged edge of

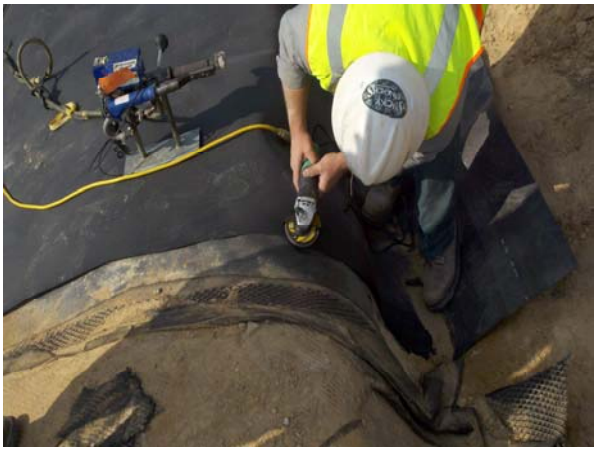
the geomembrane to ensure all of the damaged area was covered with new material (Picture 15). Following the placement of the GCL the contractor then cut a patch of the geomembrane in the same shape as the newly replace GCL (Picture 16). The patch measured approximately 35 ft long and 8 ft wide at its widest point. The Contractor then followed the edge of the patch with a hand held grinder to remove the texturing from the geomembrane and to clean the surface for a fresh HDPE free from contaminants (Picture 17). Upon discovering the contractor did not have enough of the right size rod to properly weld the geomembrane in place, the patch was temporarily tack welded in five places with a WEG 332 Extrusion Welder to affix the geomembrane liner to in place (Picture 18).

13. Anchor trench damage.

14. Exposed anchor trench ready for repair.

15. Replacement GCL in place.

16. Geomembrane patch laid and cut to size.



17. Grinding to clean edges of geomembrane. 18. Tacking geomembrane patch in place.

Shamrock mobilized again on February 21, 2011 to the FGD landfill to finish the anchor trench liner repair work. The edges of the patch were extrusion welded (Picture 19). In addition to the large patch, a small 6 inch square was used to patch a puncture in the geomembrane (Picture 20). Welds around the large patch and the small patch were approximately 1.5 inches wide to cover the patch edges and the membrane for a strong permanent bond.

19. Extrusion welding the patch. 20. Extrusion welding 6 inch patch.

Following welding of the patches the weld was then subjected to a vacuum test for the inspection of seam quality. The welded bead was lightly brushed with a soap solution and the "vacuum box" was placed over the seam (Picture 21). A motor was activated to create a vacuum inside the box (Picture 22). The operator inspects for bubbles from the weld which indicates a hole in the weld. If soap bubbling was found the section of the weld the segment of the weld needs repair and re-welding.

21. Preparing the seam for vacuum test.

22. Vacuum testing the weld.

After the contractor vacuum tested the weld a new piece of geocomposite measuring approximately 44 feet was fitted over the entire repaired area. The geocomposite was then fastened with zip ties approximately 12 inches apart (Picture 23). The seam of the repaired area was covered with 6 oz/sy geotextile that was thermally bonded to the geotextile of the geocomposite (Picture 24). In addition to the seam, 2 other areas approximately 2 foot square each where the geonet was exposed were covered with the 6 oz/sy geotextile and thermally bonded to the geotextile of the geocomposite. Immediately following completion of the geosynthetic materials repair the contractor covered the geotextile with approximately 2 inches of soil to protect repair area. After Shamrock had completed the repair work, SEFA placed soil over the repaired areas to cover the geosynthetic materials.

23. Zip-tied geocomposite netting.

24. Geotextile covering repair seams.

END