PLANT McDONOUGH-ATKINSON
CCR SURFACE IMPOUNDMENTS
(CCR UNIT AP-2, COMBINED CCR UNIT AP-3/4)
COBB COUNTY, GEORGIA
PART A SECTION 5 – CONSTRUCTION QUALITY ASSURANCE PLAN

FOR

Georgia Power

Revision 01 – November 2020

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GOLDER

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1.0 GENERAL

The Construction Quality Assurance (CQA) Plan documents the procedures used to provide CQA and Construction Quality Control (CQC) during the closure of CCR Units AP-1, AP-2, and Combined Unit AP-3/4. Closure construction efforts followed the procedures and requirements outlined in this plan which follow the project technical specifications issued with the closure construction drawings and used during construction. Any future work will also follow this CQA Plan. A construction certification report will be submitted under separate cover.

A. Construction Quality Control (CQC) refers to the Contractor's third-party firm responsible for construction quality control monitoring, testing, and documentation for all work performed during the closure construction of the facility. Resumes and qualifications including experience with projects of similar type, size, and complexity shall be provided to Georgia Power / Southern Company Services for their review and approval.

B. Construction Quality Assurance (CQA) for the construction of the closure and caps shall be provided by personnel specializing in the inspection and testing of soils and geosynthetics. Resumes and qualifications including experience with projects of similar type, size, and complexity shall be provided to Georgia Power / Southern Company Services for their review and approval.

C. Representatives of the CQC and CQA teams shall be required during all closure construction activities except clearing, grubbing, and initial grading and installation of all surface impoundment cap components described in this document.

D. The project team shall consist of the following:

1. DESIGN ENGINEER: Responsible for providing interpretations and clarifications of the Contract Documents, reviewing and approving shop drawings, authorizing minor variations in the work from the requirements of the Contract Documents, rejecting defective work, and providing Certification of the Closure. The DESIGN ENGINEER shall be a registered professional engineer licensed in Georgia.

2. CQC ENGINEER: Responsible for construction quality control monitoring, testing and documentation for all field work performed during the closure construction of the facility. The Contractor shall have the responsibility for obtaining third-party QC testing and CQC ENGINEER or their representative for all work performed.

3. ENGINEERING TECHNICIANS: Responsible for field observations, testing, and inspection. Technicians will be assigned to the project as deemed necessary by the CQC ENGINEER and will be responsible to the CQC ENGINEER. The CQC ENGINEER, Technician, or the CQC ENGINEER'S representative shall be on-site during all closure construction activities except clearing and grubbing and initial grading activities.

4. CQA ENGINEER: Responsible for implementing the quality assurance requirements as stated in the project plans, this CQA Plan and the project objectives; verifying basic data as reasonable and complete; outlining procedures to process data; developing statistical procedures for the analysis of test data; and preparing quality assurance memoranda and quality assurance reports. The CQA ENGINEER shall report to the Owner's Onsite Representative. This CQA ENGINEER shall be a registered professional engineer licensed in Georgia. Reference to the CQA

ENGINEER, for the purpose of this document, shall include the CQA ENGINEER or their representative.

5. AS-BUILT SURVEYOR: As-built certification surveys shall be performed on the components of the closure system by a registered professional land surveyor licensed in Georgia. At a minimum, drawings shall be prepared for the following:

   a. As-built subgrade elevation contours for the subgrade for the geomembrane component of the Final Cover System (top of CCR);

   b. As-built final grade elevation contours.

   c. Overall Unit topographic surveys.

2.0 GRADING AND STRUCTURAL FILL

A. GENERAL

The CQC ENGINEER or their representative shall observe and document all grading activities and test the placement and compaction of in-situ materials and structural fill. The CQA ENGINEER is responsible for certifying that the materials and construction were in accordance with the plans and this CQA Plan.

B. RELATED WORK

The CQC/CQA ENGINEER will reference Section 3 HDPE Geomembrane Liner and Section 4 Geotextile of this CQA Plan for pertinent materials physical properties and construction requirements.

C. SUBGRADES

During closure construction, conformance and performance testing of the subgrade soil materials shall be performed by the CQC ENGINEER. The CQC ENGINEER shall monitor and document proof-rolling of areas that are cut to achieve grade. Material placed to achieve grades indicated on the plans shall be tested by the CQC ENGINEER in accordance with the test methods and frequencies listed herein to verify that the compacted fill materials used by the Contractor comply with this CQA Plan. Areas of proof-rolling or compacted fill that do not conform to this CQA Plan will be delineated and reported to the Contractor. The CQC ENGINEER shall document that these areas are reworked by the Contractor and retested until passing results are achieved.

D. CONFORMANCE TESTING

The CQC ENGINEER shall observe and test the structural fill to ensure they are uniform and conform to the requirements of this CQA Plan. For fill materials obtained from approved borrow areas, visual inspections and conformance tests shall be performed by the CQC ENGINEER prior to the materials being used.

CQC personnel shall observe structural fill materials to ensure they are free of deleterious materials, (e.g., roots, stumps, rocks, and large objects). When necessary, the Visual Manual procedure for the description and identification of soils shall be conducted by the CQC ENGINEER in accordance with test method ASTM D2488.

Prior to receiving structural earth fill or ash fill, the foundation area shall be scarified by harrowing or other suitable means. Structural earth fill materials shall be placed in uniform layers of eight inches, nominal thickness, loose measurement, for one foot beyond the full width of the fill on each side. The thickness of

each layer shall be kept uniform with the necessary grading equipment. Upon completion of compaction, the slopes shall be cut back to the final slope. Particular care shall be used to obtain the required compaction along the edges of the fill slopes.

E. TEST METHODS AND FREQUENCY

All testing shall be conducted in accordance with the CQA Plan. The field testing methods used to evaluate the suitability of soils during their installation, shall be performed by the CQC ENGINEER in accordance with current ASTM test procedures indicated in the table below.

Soil testing shall be performed to determine their soil type (Unified Classification), grain size distribution, moisture content, Atterberg Limits, and moisture-density relationships. Documentation and reporting of the test results shall be the responsibility of the CQC ENGINEER.

Testing shall be conducted during the course of the Work. The minimum construction testing frequencies are presented in number of tests section. The frequency may be increased at the discretion of the CQC ENGINEER or if variability of the materials is observed. Sampling locations shall be selected by the CQC ENGINEER. The location of routine in-place density tests shall be determined using a non-biased sampling approach.

Laboratory tests for moisture-density relations shall be performed in accordance with ASTM D698. Field tests for density and moisture content shall be performed in accordance with ASTM D1556, ASTM D2922 or ASTM D2937.

NUMBER OF TESTS:

Field density and moisture content tests shall be performed daily in all types of material being placed. At a minimum, one in place density test shall be performed for each lift for each day fill material is placed. At least one field moisture content and density test shall be performed for every 800 cubic yards of structural earthfill or for every 1200 cubic yards of CCR fill.

F. COMPACTION

The CQC ENGINEER shall confirm that structural fill conforms to compaction requirements as follows:

Table 1: COMPACTION REQUIREMENTS FOR STRUCTURAL FILL

Description	General Compaction	Moisture Requirements
Structural Earth Fill	95%	-1% to +3% of Standard Proctor optimum moisture
CCR Fill	95%	-3% to +1% of Standard Proctor optimum moisture

If the moisture content is too low, the moisture content shall be adjusted to within the above limits prior to compaction. Moisture adjustment shall be achieved by sprinkling and disking sufficiently to bring the moisture content within the specified range. Sprinkling and harrowing of the layer shall be done after deposition, but before compaction.

If the moisture content is too high, the Contractor shall be permitted to disk in place or stockpile and disk the fill material to promote drying to bring it back within the allowable moisture range.

Areas of proof-rolling or compacted fill that do not conform to the project requirements will be delineated and reworked/retested by the Contractor until passing results are achieved.

G. PROTECTION OF SUBGRADES AND FILL SURFACES

The CQC ENGINEER shall monitor newly graded areas to verify the Contractor is protecting these areas from traffic and erosion until construction is complete.

The CQC ENGINEER shall monitor all subgrade surfaces. The CQA ENGINEER shall evaluate the suitability of the subgrade prior to fill placement.

The CQC ENGINEER shall inform the Contractor and shall document when the Contractor repairs damaged subgrade areas. The CQC ENGINEER shall retest the repaired areas until passing results are achieved.

H. ANCHOR TRENCH

Anchor trenches shall be excavated to the lines, grades, and widths shown on the project construction drawings, prior to the liner system placement.

The anchor trench shall be left open until seaming is completed.

The geomembrane and Engineered Turf should cover the entire anchor trench floor. Slightly rounded corners will be provided in anchor trenches where the geomembrane enters the trench so as to avoid sharp bends in the geomembrane and Engineered Turf. No loose soil (e.g., excessive water content) will be allowed to underlie the anchored components of the Final Cover System.

The anchor trench shall be backfilled with soil meeting the requirements of structural earth fill with the exception that the maximum particle size shall be limited to one-half (1/2) inch in the largest dimension. The excavated walls of the anchor trench shall be free of angular stones, particles in excess of one-quarter (1/4) inch in maximum diameter, or other foreign matter that could damage the geomembrane.

General fill material placed in anchor trenches will be placed in uniform lifts, which do not exceed 12 inches in loose thickness and are compacted. In-place moisture/density tests may be taken at the discretion of the CQC ENGINEER to evaluate the quality of the backfill. The test results will not be required as part of the final documentation.

Care shall be taken when backfilling the trenches to prevent any damage to the geomembrane or Engineered Turf. If damage occurs, it shall be repaired prior to backfilling and at the Contractor’s expense.

The geomembrane shall be in intimate contact with the anchor trench inside wall and bottom. Intimate contact shall be maintained during backfilling operations. Unacceptable wrinkles, ripples, fish mouths, and/or bunching shall be removed and patched.

The Engineer Turf component shall be in intimate contact with the structured geomembrane. Intimate contact shall be maintained during backfilling operations. Unacceptable wrinkles, ripples, and/or bunching shall be removed and patched.

I. CCR EXCAVATION

"CCR excavation" refers to the process of verifying and documenting that CCR has been excavated from the designated areas within the ash ponds. The ash ponds are known to contain a mixture of fly ash and bottom ash collectively referred to as CCR. In areas identified for excavation, CCR will be excavated until native soils or rock are encountered indicating that the CCR has been six-inch layer of soil will be removed below the verified CCR/soil interface. Areas of CCR removal over concrete, rock, or other substances unable to be undercut by 6 inches will be cleaned but not undercut. For these areas where rock, existing concrete designated to remain, or other similar hard surfaces are present in the excavation area (including the over-excavation zone), the surface will be cleaned to a visually-clean condition through hydraulic or mechanical means such as air or pressure washing. The soils surrounding the hard areas will be removed to the 6-inch over-excavation criterion.

The CCR excavation criteria are described below.

Visual Verification of CCR Excavation Procedure:

The CQA ENGINEER will monitor and document CCR excavation according to the following procedure:

1. Visible CCR will be excavated from the CCR unit footprint down to the interface between the CCR and earthen perimeter dikes and the underlying residuum soil layer, referred to as CCR/soil interface. Visual observations will be used to confirm that all visible CCR has been excavated to the extent practicable from the former CCR unit footprint. The excavated CCR will be managed within the permit boundary by placing it within the AP-3/4 consolidated lined area for final closure.

2. The CCR/soil interface surface will be surveyed.

3. A minimum of 6 inches of soil beneath the soil/CCR interface will be excavated within the AP-3/4 footprint, provided its removal is feasible and is above rock. This surface will be referred to as the bottom of excavation. The excavated material will be managed in a similar way as described above. The bottom of excavation surface will be surveyed and confirmed to be a minimum of 6" below the CCR/soil interface where excavation below the bottom of CCR is practical (i.e. outside of rock and concrete areas).

3.0 GEOMEMBRANE FLEXIBLE MEMBRANE LINER (FML), ENGINEERED TURF & SAND BALLAST (CLOSURE TURF™) COVER SYSTEM

The CQA ENGINEER shall certify the materials and installation are in accordance with the plans, specifications, and this CQA Plan.

A. MATERIAL

1. The geomembrane will be a minimum 40 mil Linear Low Density Polyethylene (LLDPE) liner supplied and installed by firms approved by Georgia Power / Southern Company Services.

2. Seams for providing watertight joints will be extrusion or double hot wedge fusion seams using techniques approved by the CQA ENGINEER.

3. In areas where specified by the DESIGN ENGINEER, the textured material shall have an interface shear resistance (friction angle plus cohesion) with contiguous liner components as required in the specifications or as directed by the DESIGN ENGINEER. In areas with a specified interface shear strength, the strength will be determined by direct shear testing conducted at normal loads as listed in the specifications or as directed by the DESIGN ENGINEER (at a frequency of two (2) per unit.)

4. Manufacturer Quality Control shall confirm the material meets the minimum physical properties for the nominal thickness of the LLDPE geomembrane (40 mil, 50 mil, or 60 mil as applicable) as listed in the latest version of GRI-GM17, "Test methods, test properties and testing frequency for linear low density polyethylene (LLDPE) smooth and textured geomembrane".

5. Closure Turf™ shall be used as the final cover system for Combined Unit 3/4. HydroTurf® Cover System and HydroBinder® shall be used where specified in the drawings. Both the Closure Turf™ and HydroTurf® Cover systems shall be installed by the same installer. ArmorFill™ E shall be used at transitions between Closure Turf™ and HydroTurf® when specified in the drawings.

6. The Engineered Synthetic Turf layer consists of two polypropylene 3.0 oz/sq yd woven geotextiles tufted with polyethylene yarns, standard height of 1.25”, overlying the geomembrane at locations shown on the drawings. The polyethylene yarn shall conform to the color selected by the owner per color coding provided by the manufacturer. See Table 2 of this Plan for Engineered Synthetic Turf specifications.

7. For HydroBinder® specifications, see Table 3 of this Plan.

8. The structured geomembrane and the Engineered Turf (or textured liner and Engineered Turf) must be purchased as a system from the same supplier to ensure desired performance.

9. The sand infill for the Engineered Turf ballast shall consist of grain size distributions that are shown in Table 4 of this Plan. Optimum infill sand for ClosureTurf™ would be a medium particle size sand meeting ASTM C33 for fine aggregates. In Q2 2020, revised specifications for sand infill were released by the product manufacturer. All infill material shall meet ASTM C33 specifications when installed prior to Q2 2020, and all infill material shall meet the revised sand infill specifications when installed after Q2 2020, unless otherwise approved by the Purchaser.

10. Sand infill for the Engineered Turf ballast installed after Q2 2020 shall meet the fine aggregate angularity requirements of ASTM C 1252 / AASHTO T304 “Standard Test Methods for Uncompacted Void Content of Fine Aggregate (as Influence by Particle Shape, Surface Texture, and Grading), Method A.” The Method A uncompacted void content shall be greater than or equal to 40%.

11. Sand infill for the Engineered Turf ballast installed after Q2 2020 shall be tested in accordance with ASTM C128 / AASHTO T 84 “Standard Test Method for Relative Density (Specific Gravity) and Absorption of Fine Aggregate. Bulk oven-dry specific gravity shall be greater than or equal to 2.6.

12. The HydroBinder® infill for the Engineered Turf ballast shall consist of the proprietary cementitious product and meet the requirements as shown in Table 3 of this Plan. All cementitious infill mix design shall meet ASTM C387 specifications for high strength mortars unless otherwise approved by the Purchaser.

Table 2: ENGINEERED TURF COMPONENT

Property	Frequency	Test Method	Minimum Average Value
CBR Puncture	Once per 100,000 sf	ASTM D 6241	900 lbs (MARV)
Tensile Product (MD/XD)	Once per 100,000 sf	ASTM D 4595	1000 lb/ft min. (MARV)
Rainfall Induced Erosion	N/A	ASTM D 6459	<0.45% Infill Loss 6 in/hr
Aerodynamic Evaluation	N/A	GTRI Wind Tunnel	120 mph with max. uplift of 0.12 psf
DuraTurf Fiber UV Stability	N/A	ASTM G147	>60% retained tensile strength @ 100 yrs (projected)
Backing system UV Stability (Exposed)	N/A	ASTM G154 Modified Cycle 1, UVA340	110 lb/ft retained tensile strength @ 6500 hrs (projected)
Steady State Hydraulic Overtopping (ClosureTurf with HydroBinder)	N/A	ASTM D7277 ASTM D7276	5 ft overtopping resulting in 29 fps velocity & 8.8 psf shear stress for Manning N Value of 0.02
Full Scale Wave Overtopping Test – Cumulative Volume (ClosureTurf™ with HydroBinder™)	N/A	CSU Wave Simulator	165,000 ft^3/ft
Full Scale Wave Overtopping Test – Max. Avg. Wave Overtopping Discharge (ClosureTurf w/ HydroBinder)	--	CSU Wave Simulator	4.0 ft^3/s/ft
Transmissivity w/ underlying structured geomembrane, Normal Stress @ 50 psf & 0.33m^2/sec gradient	NA	ASTM D4716	2.5 x 10^{-3} m^2/sec, min.
Internal Friction of combined components	N/A	ASTM D5321	35˚, min.

Table 3: ENGINEERED TURF HYDROBINDER INFILL & BALLAST

Component	Details
Product	80 lb. bags or 3000 lb. bulk super sacks
Cement	Portland Cement Brand meeting ASTM C150, Type I or II. Only one brand used throughout project.
Cementitious Infill Mix	ASTM C387 for high strength mortars. Min. 28 day compressive strength of 5000 psi.

Table 4A: ENGINEERED TURF INFILL & BALLAST SAND (BEFORE Q2 2020)

ASTM C33 Sand Infill Gradation Requirements	
Sieve	Percent Passing
3/8 in. (9.5mm)	100
No. 4 (4.75 mm)	95 – 100
No. 8 (2.36 mm)	80 – 100
No. 16 (1.18 mm)	50 – 85
No. 30 (600 µm)	25 – 60
No. 50 (300 µm)	5 – 30
No. 100 (150 µm)	0 - 10

Table 4B: ENGINEERED TURF INFILL & BALLAST SAND (Q2 2020 AND ONWARD)

PROPERTY	TEST PROCEDURE	MINIMUM PHYSICAL PROPERTIES
Material Loss Upon Flow	ASTM D 6460	0.1 inches at flow conditions equal to 0.8 psf
Specific Gravity	ASTM C128	2.6
Fine Aggregate Angularity – Minimum Uncompacted Void Content	ASTM C1252 Method A	40
Gradation	**ASTM C136 or D6913**	**% Passing**
3/8 in. (9.5mm)	---	100
No. 4 (4.75 mm)	---	90 to 100

No. 8 (2.36 mm)	---	50 to 85
No. 16 (1.18 mm)	---	25 to 65
No. 30 (600 µm)	---	10 to 45
No. 50 (300 µm)	---	0 to 30
No. 100 (150 µm)	---	0 to 10
No. 200 (75 µm)	---	0 to 3

B. MANUFACTURER AND INSTALLER

1. The Geomembrane and Engineered Turf Installer will submit the following as obtained from the Product Manufacturers to the CQA ENGINEER:

    a. Production Certification including project references

    b. Testing Program of Compound Ingredients

    c. Material Certifications

    d. Test Data for Materials

    e. All of the above submittals will be reviewed and retained by the CQA ENGINEER

2. The Geomembrane and Engineered Turf Installer will submit the following to the CQA ENGINEER prior to the installation:
    a. Qualifications of Geomembrane and Engineered Turf Installer Superintendent and Foreman

    b. Resumes of Contractor field crews

    c. Proposed geomembrane panel layout drawings

3. The Engineered Turf Installer will submit the following prior to installation:
    a. The ClosureTurf™ and HydroTurf® installer shall be an experienced and trained installer and be able to provide documentation that they have manufacturer's approval status. The ClosureTurf™ and HydroTurf® installation contractor shall also utilize a licensed installer for the sand infill installation of ClosureTurf™ and the HydroBinder® for the HydroTurf® if not licensed to install the infill themselves.

    b. Copy of Installer's Letter of Approval or License issued by the Manufacturer shall be provided to the Purchaser.

C. GEOMEMBRANE INSTALLATION

1. An initial CQA meeting will be held prior to installation. The Geomembrane Installer, CQC ENGINEER or representative, CQA ENGINEER or representative, and an Owner representative will be in attendance. The following issues will be discussed and agreed upon by all parties and shall be included in a report in the CQA documentation.

    a. Testing of welds

b. Characteristics of "good" weld, and

c. Repair procedures

2. The CQC or CQA ENGINEER or their representative will sample rolls from each shipment of geomembrane at the manufacturing plant prior to shipment to the site. The minimum number of rolls to be sampled for each shipment will be determined by computing the cube root of the total number of rolls delivered in the shipment and rounding this value upward to the nearest integer with at least one sample per each manufacturer's lot. For instance, if 40 rolls of geomembrane are delivered in a shipment, at least four rolls will be sampled.

3. The random samples must be representative of the material supplied and exclude the outer wrap of geomembrane if signs of scuffing or other damage is observed. Samples should be full roll width and at least 2 feet long.

4. The laboratory testing of the samples selected by the CQA representative shall be directed by the CQA ENGINEER and shall confirm conformance with the following properties:

   a. Thickness (ASTM D5199 for smooth sheet) (ASTM D5994 for textured sheet)

   b. Density (ASTM D1505)

   c. Carbon Black Content (ASTM D1603 or ASTM D4218)

   d. Tensile Properties (GRI GM-13)

   e. Tear Resistance (ASTM D1004)

5. The CQA ENGINEER or their representative will measure geomembrane thickness of each roll made for the project at the manufacturing plant prior to shipment. Material that does not fall within acceptable thickness criteria will be rejected.

6. The CQA ENGINEER or their representative will mark all areas where grinding is considered to be excessive. The location and repair method for the excessive grinding will be recorded in the daily field reports.

7. Overheating of the geomembrane will be monitored by the CQA ENGINEER or their representative. At the discretion of the CQC ENGINEER, coupons will be cut from the end of the extrusion seams and the bottom side of the seam will be observed for visible warping or deformation. The location and repair method of overheated areas will be recorded in the daily field reports. The method of repair will be determined in the field by the CQA ENGINEER.

8. During seaming, the CQA ENGINEER or their representative will observe the seams for the following:

   a. Proper preparation,

   b. Grinding technique, where applicable, and

   c. Overheating

9. The CQC ENGINEER or their representative will observe the geomembrane during the coolest part of the day to check for slack. Any areas where excessive "trampolining" occurs will be marked by the CQA ENGINEER for repair by the Geomembrane Installer.

10. The CQC ENGINEER or their representative will mark all areas where the geomembrane indicates a protrusion from the compacted soil liner. The method of repair will be determined in the field by the CQA ENGINEER.

D. TEST/TRIAL SEAMS

1. The CQA ENGINEER or their representative will document and verify that the Geomembrane installer performs a test seam for each welding machine in use every 4-5 hours, or at a minimum prior to start of construction work, and at midday. At least one test seam shall be made for each machine in use for each seam. Should any post production test seam fail, the immediate prior production seam shall be sampled for destructive testing in accordance with Section F.

    a. The date, time, and equipment, as well as welding temperature, and seaming parameters will be recorded for each test seam.

    b. A minimum of five (5) specimens for peel and for shear from each sample will be tested for the properties listed in the latest version of GRI-GM19, "Standard Specification for Seam Strength and Related Properties of Thermally Bonded Polyolefin Geomembrane " in accordance with test method ASTM D6392. Testing will be performed in the field by the Geomembrane Installer under full-time observation by the CQA ENGINEER or their representative.

    c. Untested portions of the test seam will be retained for the project record and future testing as required.

2. All test seams must pass the field testing before production seaming is performed by the Geomembrane Installer.

E. FIELD DESTRUCTIVE TESTING

1. The Geomembrane Installer will obtain approximately 12" x 36" samples of field seams, suitable for testing, at an average frequency of one sample per maximum 500 cumulative linear feet of weld. The date, time and equipment, and seam number will be marked on each sample and recorded by the CQA ENGINEER.

2. Samples retained will be tested in the field by the Geomembrane installer. A minimum of five (5) specimens from each sample for peel and for shear will be tested for the properties listed in latest version of GRI-GM19, "Standard Specification for Seam Strength and Related Properties of Thermally Bonded Polyolefin Geomembrane " in accordance with test method ASTM D6392.

3. The CQA ENGINEER or Georgia Power may require additional random samples to be taken for testing in areas which visually appear defective and not in accordance with project requirements.

F. NON-DESTRUCTIVE TESTING

1. The Geomembrane Installer is responsible for the completion of non-destructive testing of the entire length of all field seams, verifying that said seam is air tight. Said testing can be a vacuum test, pressure test, or approved equal and will be described by the Geomembrane Installer and verified by the CQA ENGINEER in advance.

2. The CQA ENGINEER or their representative will observe all non-destructive testing on a full time basis.

G. DESTRUCTIVE LABORATORY TESTING

1. Destructive seam samples will be laboratory tested by the CQC ENGINEER. Testing frequency shall be a minimum average frequency of one (1) sample per 500 linear feet of field seam.

    a. Test samples will be at least 12" x 36" inches. A minimum of five (5) specimens will be tested for the properties listed in the latest version of GRI-GM19, "Standard Specification for Seam Strength and Related Properties of Thermally Bonded Polyolefin Geomembrane" in accordance with test method ASTM D6392. These test samples shall be taken at the same locations as the contractor's destructive testing samples.

    b. All laboratory specimens will be conditioned for a minimum of one (1) hour prior to testing at the Standard Atmosphere for Testing Geosynthetics, that is, air maintained at a relative humidity of 65 ±5 percent and a temperature of 21 ±2ºC(70±ºF).

    c. Peel tests will be performed on both sides of a double-wedge fusion seam.

2. The load and elongation at failure will be measured for each specimen. The CQC ENGINEER will describe the type of failure for each specimen and record the presence of any debonding, delamination, foreign material in the bond area, etc.

3. The average values of each set of five specimens for peel and for shear must meet the specifications, and four of the five specimen tests must meet the specifications for the seam to be considered a passing seam. If the average of the five specimens is adequate, but one of the specimens is failing, values for the failing specimen must be at least 80 percent of the values required for the seam for the sample to pass. A maximum of one non-film tear bond failure out of five tests is acceptable provided the destructive sample meets strength requirements discussed above. If unresolved discrepancies exist between the CQC ENGINEER's and Contractor's test results, the archived sample may be tested by the CQC ENGINEER. Samples which do not pass the shear and peel tests will be resampled from locations at least 10 feet on each side of the original location. These two re-test samples must pass both shear and peel testing. If these two samples do not pass, then additional samples will continue to be obtained until the questionable seam area is defined.

4. Seams represented by a failing destructive field or laboratory test sample shall be cut out and replaced or covered with a cap strip and the seam bounded by supplemental passing field and laboratory destructive test samples at both ends.

5. The CQC ENGINEER will verify and document that the strength and other properties of the geomembrane seams meet or exceed the requirements set forth in the latest version of GRI-GM19, "Standard Specification for Seam Strength and Related Properties of Thermally Bonded Polyolefin Geomembrane".

H. ENGINEERED TURF DEPLOYMENT

1. After geomembrane installation, including required documentation, has been completed, the geomembrane surface shall be cleared of all significant deposits of stones, soil and debris that could damage the geomembrane or impede the hydraulic function between the stud side of the structured geomembrane and the Engineered Turf component. Any soil or debris washed down to the toe of slope during cleaning procedures shall be physically removed from the geomembrane surface without damage to the geomembrane.
2. The Engineered Turf shall be deployed without damage to the geotextile component and minimal loss of the synthetic grass component.
3. Deployment equipment shall not damage the Engineered Turf geotextile, cause synthetic grass loss, or damage underlying geomembrane by handling, trafficking, leakage of hydrocarbons, or by other means.
4. The Engineered Turf shall be deployed smooth and free of tension, stress, folds, wrinkles, creases, and free of contaminants such as soil, grease, fuel, etc.
5. The Engineered Turf shall be deployed with the synthetic grass blades pointing towards the top of the slope on side slopes greater than 12%.
6. Engineered Turf shall be secured with sand bag anchoring at the top of the slope and then rolled down the slope.
7. Seaming operations shall be performed using a 4-inch overlap and fastened with heavy-duty textile stitching machine. A prayer type seam is to be constructed using a Nulong sewing machine or equivalent. Stitching operations shall be performed such that the woven geotextiles are not exposed.
8. Sewing shall occur between the 1st and 2nd row of stiches to avoid exposure of the black geotextile after flipping the panel.
9. After seaming operations, the ends of the Engineered Turf panels shall be permanently anchored in the perimeter and bench roadways.
10. Construction equipment on the deployed Engineered Turf shall be minimized to reduce the potential for geosynthetic material puncture.
11. Equipment travel on exposed structured geomembrane is prohibited. Small equipment such as generators shall be placed on scrap geomembrane material (rub sheets) above geosynthetic materials in the CLOSURETURF™ Final Cover System.

I. ENGINEERED TURF SEAMING

1. Seaming of the Engineered Turf shall be in accordance with this plan and the manufacturer's recommendations.
2. Seaming of the Engineered Turf component will be performed by sewing. At no point shall a seam be heat bonded if the sewing method can be applied.
3. Seaming operations shall be performed using a 4-inch overlap and fastened with heavy-duty textile stitching machine. A prayer type seam is to be constructed using a Nulong sewing machine or equivalent. Stitching operations shall be performed such that the woven geotextiles are not exposed. Sewing shall occur between the first and second row of stiches to avoid exposure of the black geotextile after flipping the panel.
4. In the bench areas, seams for the Engineered Turf shall be located no more than 5 ft. inboard of the outside edge of the bench.
5. After seaming operations, the ends of the Engineered Turf panels shall be permanently anchored in the perimeter and bench roadways.
6. Construction equipment on the deployed Engineered Turf shall be minimized to reduce the potential for geosynthetic material puncture. Equipment travel on exposed structured geomembrane is prohibited. Small equipment such as generators shall be placed on scrap geomembrane material (rub sheets) above geosynthetic materials in the Final Cover System.
7. The placement shall be observed by the third-party QC ENGINEER and the Purchasers Representative.
8. For short sections (around penetrations, patches, and/or corners), the synthetic turf seaming may be completed by using a 4-inch (min) overlapped seam which is fastened by heat-bonding. This can be accomplished by using a hand-held Leister (followed by a press wheel), DemTech 4-inch, single-wedge welder Model No. VM-20/4/A, and/or a Varimat V2 (or equal) leistering machine.
9. Since the temperature, pressure and speed controls of the DemTech 4-inch single-wedge welder Model No. VM-20/4/A and the Varimat V2 leistering machine are variable and can be increased / decreased depending on weather and environment conditions, the temperature and speed shall be confirmed with a trial seam.
10. Field testing of heat bonded seams shall consist of a visual inspection done every hour.
11. The visual inspection of the field seams shall include observation of the geotextile backings in order to confirm that it is not melting. If it is melting, then the machine is too hot. Observe and feel the seam in order to confirm that there is a stiff, inner core which is continuous along the weld. All seams shall be verified that they are continuous by running their fingers along the seam. If there is any penetration of their fingers into the seam, the Installer will need to use a hand-held Leister at the location of the penetration in the seam in order to weld it continuously. The seam will need to be re-inspected.

J. ENGINEERED TURF FIELD TRIAL SEAMS

1. All Turf field trial seams shall be made in accordance with this plan and the manufacturer's recommendations.

2. Field trial seams shall be made in accordance with the manufacturer's recommendations and the project Specifications. The Contractor shall submit a copy of the proposed testing procedures for the Purchaser's review.

3. Field trial seams shall be conducted, per seaming apparatus and per seamer, on the turf to verify that seaming conditions are satisfactory. Trial seams shall be conducted at the beginning of each seaming period, at least once every four hours for each seaming apparatus and personnel used that day. Additional field trial seams may be requested by the Purchaser's Representative.

4. All trial seams shall be made in contact with the underlying material as it will be done in the field.

5. Thread used for trial seam stitching shall be the same as used during deployment.

6. Field trial seaming shall be conducted under the same ambient temperature and conditions as the production seams.

7. The quality of the trial seams for heat bonding shall be confirmed by visual observations.

8. Visual observations shall ensure that the geotextile backings are not melting.

9. Observe and feel the welded trial seam in order to confirm that there is a stiff, inner core continuous along the weld.

10. Observe and confirm that the welds may not be pulled or peeled apart.

11. All heat bonded seams shall be continuous. The continuity shall be confirmed by the CQC ENGINEER by running his fingers along the seam. If there is any penetration of their fingers into the seam, the installer shall use a hand – leister at the location to weld the seam. The seam shall be re-inspected by the CQC ENGINEER.

12. The trial seams for heat bonding shall also have a peel test performed. The CQC ENGINEER shall grab the geotextile backings of the top overlapped piece on the seam at one location. The geotextile backing is then to be pulled up. For a passing seam, the tufts of the upper synthetic turf shall pull out through the geotextile backings since they are heat bonded to the tufts of the lower synthetic turf piece. If the tufts do not pull out of the geotextile backings and the seam pulls apart, the seam would fail the test most likely because there was not enough heat.

13. Sewn trial seams shall be inspected to ensure that the woven geotextiles are not exposed and that the sewing has occurred between the first and second row of stiches.

14. Sewn trial seams should not be capable of being pulled apart by hand using vice grips. If this occurs during trial weld procedures, adjustments to the sewing machine may be required before proceeding.

15. Prepare trial seams that are at least 10-foot long by 1-foot wide after seaming with the seam centered lengthwise. Seaming of the Engineered Turf shall be in accordance with this plan and the manufacturer's recommendations.

K. SAND BALLAST INFILL

1. The sand layer will be a minimum 1/2 inch thick. The sand shall be worked into the Engineered Turf layer as in-fill between the synthetic yarn blades. The physical characteristics of the sand layer will be evaluated through visual observation (and laboratory testing if deemed necessary by the CQC

ENGINEER) before construction and visual observation during construction. Additional testing during construction will be at the discretion of the CQC ENGINEER.

2. The sand may be spread using low ground pressure equipment and a pull-behind spreader bar. Rotary brush equipment may be used to evenly distribute the sand infill into the synthetic grass matrix. The sand spreading operation shall be done in front of deployment equipment travel to improve the bearing capacity of the cover system below. Use of rotary brush equipment shall be performed in a manner that does not result in removal of the synthetic grass blades from the underlying woven geotextile.

3. Conveyor systems and/or blower equipment may be used to spread and place the sand in-fill on slopes too steep for equipment contact. These deployment systems shall not be used during wind speed conditions higher than 15 miles per hour. Dust generation may be mitigated by maintaining the sand infill at a moisture content sufficient to control dust but not impede the placement operation.

4. Contractor shall explain in detail in the pre-construction meeting the method of sand deployment to be used. The method shall be approved by the Purchaser. For slopes steeper than 3H:1V the sand infill shall be placed using long reach conveyors belts or using water or air express blower methods. The sand layer may be placed using any appropriate equipment capable of completing the work and should only receive minimal compaction required for stability.

5. Sand ballast infill shall completely cover the double-layer woven geotextile of the Engineered Turf component. Areas of exposed geotextile or thin layering of sand ballast unsatisfactory to the requirements of Table 1, shall receive additional sand ballast. If the cause of poor sand ballast placement and resulting geotextile exposure is wrinkles in the underlying structure geomembrane, the Engineered Turf component shall be pulled back from the geomembrane component, the geomembrane wrinkle removed and the geomembrane shall be repaired per the requirements of this Plan and the project specifications.

6. The CQC ENGINEER shall verify that a minimum thickness of ½ inch of sand is placed on the Turf. Frequency will be 20 measurements per acre of final cover installed.

7. The Contractor shall provide to the Purchaser the grain size distribution, from the source of the sand infill/ballast, for every 1500 cy of material.

L. HYDROBINDER INFILL INSTALLATIONS

1. Installation of the HydroBinder™ infill for the HydroTurf® shall be performed by a licensed installer.

2. The HydroBinder™ infill layer shall be a minimum 7/8-inch thick (dry). The desired thickness will be achieved prior to the hydration process. At grade breaks and drainage benches, the thickness of the HydroBinder™ shall be a minimum of 1.25 inches.

3. If weep holes are required for draining the internal drainage layer through the Engineered Turf, remove the HydroBinder™ in the areas of the weep holes prior to hydration or block the weep hole locations prior to infilling. Blocks may consist of pipe, dowels, etc. Weep hole diameters shall be one (1) inch and be located at the toe of slope on 2 ft. centers.

4. The infill shall be installed into the HydroTurf® while it is in a dry state. The HydroTurf® shall be dry. If the HydroTurf® is wet from rain or dew, the installer shall wait until it is dry. The installer may attempt to speed up the drying process by using a blower. In addition, the infill shall not be installed in inclement, wet or rainy weather, or the threat of inclement weather. Also, the infill shall not be installed in freezing temperatures.

5. The infill shall be worked into the Engineered Turf layer between the synthetic yarn blades so that the tuffs are in an upright position. The physical characteristics of the infill layer will be evaluated through visual observation (and laboratory testing if deemed necessary by the CQC ENGINEER) before construction and visual observation during construction. Additional testing during construction will be at the discretion of the CQC ENGINEER.

6. The hydration process must occur the day of the infill placement.

7. Personnel access on the HydroTurf® shall be prohibited for 24 hours following the hydration of the HydroBinderTM.

8. The infill shall be thoroughly hydrated, however, care must be taken to avoid displacement of the non-hydrated infill. The Installer shall not overhydrate the infill so that water begins to run-off and cause erosion of the cement infill. The objective is to soak the area to start the hydration process but not to inundate with water beyond saturation.

9. Once hydration is completed as described, backfill and compaction of the anchor trenches should take place.

10. The HydroBinderTM shall be at minimum performance levels within 24 hours listed in Table 3 of this Plan. HydroBinderTM not meeting the performance levels will be removed and replaced.

11. The infill may be spread using low ground pressure equipment and a pull-behind spreader bar. Rotary brush equipment may be used to evenly distribute the infill into the synthetic grass matrix. The infill spreading operation shall be done in front of deployment equipment travel to improve the bearing capacity of the cover system below. Use of rotary brush equipment shall be performed in a manner that does not result in removal of the synthetic grass blades from the underlying woven geotextile. In addition, hand spreading and rakes maybe be used to spread the infill material. If rakes are used, only plastic rakes shall be allowed.

12. Conveyor systems and or blower equipment may be used to spread and place the infill on slopes too steep for equipment contact. These deployment systems shall not be used during wind speed conditions higher than 15 miles per hour. Dust generation may be mitigated by maintaining the infill at a moisture content sufficient to control dust but not impede the placement operation.

13. Contractor shall explain in detail in the pre-construction meeting the method of infill deployment to be used. The method shall be approved by the Purchaser. For slopes steeper than 3H:1V the infill shall be placed using long reach conveyors belts or using water or air express blower methods. The infill layer may be placed using any appropriate equipment capable of completing the work and should only receive minimal compaction required for stability.

14. HydroBinderTM infill shall completely cover the double-layer woven geotextile of the Engineered Turf component. Areas of exposed geotextile or thin layering of infill unsatisfactory to the requirements of this Plan shall receive additional infill. If the cause of poor infill placement and resulting geotextile exposure is wrinkles in the underlying structure geomembrane, the Engineered

Turf component shall be pulled back from the geomembrane component, the geomembrane wrinkle removed and the geomembrane repaired per the requirements of this Plan. The Engineered Turf shall be re-deployed and ballasted with infill satisfactory to the requirements of this Plan.

15. For areas with exposed geotextile due to wrinkles and isolated small voids, a UV resistant coating shall be applied to the exposed area and additional infill material shall be applied immediately to the coating and hydrated. The UV coating product shall be manufactured by Quikrete product #8640, Sakrete product #60205006, or approved equivalent.

16. The CQC ENGINEER shall verify that a minimum thickness of 7/8-inch of infill (dry) is placed on the synthetic Turf. At grade breaks and drainage benches, the thickness of the HydroBinderTM shall be a minimum of 1.25 inches. Frequency shall be one test per 100 linear feet of ditch and twenty (20) measurements per acre of final cover installed. Thickness measurements shall be taken using a caliper or equivalent device. The CQC ENGINEER shall also inspect to confirm full hydration by excavating with a small tool into the infill.

17. The Contractor shall provide to the Purchaser the manufacturers certifications for the HydroBinderTM infill properties listed in Table 3 of this Plan. Upon delivery, or as determined by the Purchaser and/or the Purchaser's Representative, a representative sample of the HydroBinderTM mix shall be taken by the Purchaser for verification of the compressive strength.

18. The sand infill layer will be a minimum 1/2 inch thick. The sand shall be worked into the Engineered Turf layer as in-fill between the synthetic yarn blades. The physical characteristics of the sand layer will be evaluated through visual observation (and laboratory testing if deemed necessary by the CQC ENGINEER) before construction and visual observation during construction. Additional testing during construction will be at the discretion of the CQC ENGINEER.

19. The sand may be spread using low ground pressure equipment and a pull-behind spreader bar. Rotary brush equipment may be used to evenly distribute the sand infill into the synthetic grass matrix. The sand spreading operation shall be done in front of deployment equipment travel to improve the bearing capacity of the cover system below. Use of rotary brush equipment shall be performed in a manner that does not result in removal of the synthetic grass blades from the underlying woven geotextile.

4.0 GEOTEXTILE

A. GENERAL

1. The CQA ENGINEER shall certify the materials and installation are in accordance with the plans, specifications, and this CQA Plan.

B. MATERIAL

1. The geotextiles for use as protection (or cushioning) materials shall conform to Table 5. The required values for all properties in Table 5 are to be minimum average roll values (MARV) except UV resistance which is a minimum value.

2. The finished geotextile shall be free from such defects that would affect the specific properties of the geotextile or its proper functioning.

3. General manufacturing procedures shall be performed in accordance with the Manufacturer's internal quality control guide and/or documents.

4. Geotextiles shall be subject to sampling and testing by the Purchaser to verify conformance with this Plan. Sampling shall be in accordance with the most current version of ASTM D4354. In the absence of Purchaser's sampling and testing, verification may be based on Manufacturer's certifications as a result of testing by the Manufacturer of quality assurance/quality control samples. If the results of any test do not conform to the requirements of this Plan, retesting to determine conformance or rejection should be done in accordance with the manufacturing protocol as set forth in the manufacturer's quality manual.

Table 5: REQUIRED PROPERTIES, TEST METHODS AND VALUES FOR GEOTEXTILES USED AS CUSHIONING MATERIALS

Property	Test Method	Frequency[3]	Unit	Value
Mass/Unit Area[1]	ASTM D5261	Lot	oz/yd^2	16
Grab Tensile Strength	ASTM D4362	Lot	lb	370
Grab Tensile Elongation	ASTM D4362	Lot	%	50
Trap. Tear Strength	ASTM D4533	Lot	lb	145
Puncture (pin) Strength or Puncture (CBR) Strength	ASTM D4833 ASTM D6241	Lot Lot	lb lb	170 900
UV Resistance[2]	ASTM D7238	Lot	%	70

[1]All values are MARV except UV resistance which is a minimum value.
[2]Evaluation to be on 2.0 inch strip tensile specimens after 500 lt. hrs. exposure.
[3]Sampling frequency shall be by lot, defined as the shipment quantity of the product or a truckload of the product, whichever is smaller.

5. The Manufacturer shall provide to the Purchaser a certificate stating the name of the Manufacturer, product name, style number, chemical composition of the filaments or yarns, and any other pertinent information to fully describe the product.

6. The Manufacturer is responsible for establishing and maintaining a quality control program to assure compliance with the requirements.

7. Documentation describing the quality control program shall be made available upon request.

8. The Manufacturer's certificate shall state that the finished product meets MARV requirements of this Plan as evaluated under the Manufacturer's quality control program. A person having legal authority to bind the Manufacturer shall arrest to the certificate.

9. Either mislabeling or misrepresentation of materials shall be reason to reject those products.

10. The geotextiles shall be clearly labeled showing the Manufacturer or supplier name, style, and roll number. Each shipping document shall include a notation certifying that the material is in accordance with the Manufacturer's certificate.

11. Each roll shall be wrapped with a material that will protect the geotextile, including the ends of the roll, from damage due to shipment, water, sunlight, and contaminants. The protective wrapping shall be maintained during shipment and storage.

C. GEOTEXTILE MANUFACTURER AND INSTALLER

1. The Geotextile Installer will submit the following as obtained from the Product Manufacturers to the CQA ENGINEER:

    a. Production Certification

    b. Material Certifications

    c. Test Data for Materials

    d. All of the above submittals will be reviewed and retained by the CQA ENGINEER

5.0 CERTIFICATION

A professional engineer will provide certification that the final closure cover system, access roads, ditches, and other associated ancillary facilities for the Plant McDonough CCR Unit closures were constructed according to the approved drawings and this CQA Plan. Said certification shall have the seal of a professional engineer registered in the State of Georgia. Upon EPD concurrence with the closure construction report certification statement, EPD will acknowledge the start of post closure monitoring and care.