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1.0 Introduction

This Quality Control (QC) Manual is provided as a guide to field and laboratory personnel conducting inspections and testing for the Tampa Electric Company (TEC) Big Bend Power Station Economizer Ash and Pyrites Pond System (EAPPS) Closure project near Apollo Beach, FL. This document is intended to assist and aid personnel in aspects of inspection, testing, and reporting on site.

Standard procedures will be used for all activities, and in general, these will be adopted from recognized organizations, such as ASTM International, the American Association of State Highway and Transportation Officials (AASHTO), the American Concrete Institute (ACI), and the Geosynthetic Research Institute (GRI). This manual is a guide for procedures specifications and references frequencies for the various test work. The Technical Specifications together with the latest issue of the Drawings, and this manual are an integrated set of documents. This manual is to be used in conjunction with the Technical Specifications, relevant standards and codes, and the Drawings. Should discrepancies be found to exist between this document and the Drawings or Technical Specifications, the Drawings and Technical Specifications shall supersede the QC Manual.

2.0 Organization and Responsibilities

The Owner is TEC, and all parties shall be under the overall direction of the Owner or its designated Representative/Agent. The Contractor and its subcontractors are responsible for performing the work. Wood Environment and Infrastructure Solutions, Inc. (Wood) is the Engineer for the Economizer Ash & Pyrites Pond System Closure Project (Project) including earthworks, geosynthetics installation, demolition, and erosion protection systems.

A Construction Manager appointed by the Owner will perform all of the construction management functions and ensure that the project is built in accordance with the project documents. Any questions with regard to the associated Design or Technical Specifications associated with the Project shall be addressed to Wood for clarifications in accordance with the established project protocol. TEC and Wood shall approve all changes of the Design or Technical Specifications prior to implementing the change.

A Quality Control company or personnel will be appointed by the Owner to perform testing and inspection services in accordance with the project documents. Quality control functions entail completing and recording (as detailed in this manual) all field inspections and testing (control and record) for the project as well as daily construction activity reports. The completed field inspection and test results are to be submitted to TEC or the designated Construction Management personnel. Testing of the work does not relieve the Contractor of liability for substandard work. Daily construction reports shall be archived and available upon request.

The Contractor is responsible for constructing the project in accordance with the project documents and approved changes. The Contractor is also responsible for setting out the correct lines and grades to ensure that the work is constructed accordingly. The project Surveyor will check lines and grades, at his discretion, and will verify all quantity measurements and calculations.

2.1 Definition of Terms

- “Construction Manager” is defined as the Company or person(s) appointed by TEC to manage the construction work.
- “Contract” is defined as the document executed by the Owner or its authorized representative(s)/agent(s) with the Contractor to complete specified portions of the Work.
- “Contractor” is defined as the party/parties that have executed the contract agreement for the specified Work with the Owner or its authorized representative(s)/agent(s).
- “Drawings” are defined as the Drawings for the Big Bend Power Station Economizer Ash & Pyrites Pond System Restoration & Grading furnished by TEC, the Engineer, or others that apply to the Work.
- “Engineer” is defined as Wood Environment and Infrastructure Solutions, Inc. or any of its authorized representative(s)/ agent(s).
- “Modifications” are defined as changes made to the Specifications or the Drawings that are approved by the Owner and the Engineer in writing, after the Specifications and Drawings have been issued for construction. These also refer to changes to design elements in the field to account for unforeseen conditions. It may be required to submit modifications to the Florida Department of Environmental Protection (FDEP) for review and approval.
- “Owner” is defined as TEC or any of its authorized representative(s)/agent(s).
- “Quality Control (QC)” refers to the systematic inspections and testing completed to control the quality of construction and to ensure conformance with the project specifications. Quality Control services to be performed by a Company or person(s) appointed by CPO.
- “Quality Assurance (QA)” refers to the overview and inspection program consisting of systematic observations, QC document review, and independent testing completed to provide an acceptable level of confidence that the construction conforms to the design. QA is primarily performed on manufacturer supplied QC reports and on geomembrane materials where the Installer is performing QC functions, and on earthworks at lower test frequency than the QC frequency.
- “QC Engineer” refers to the firm that will be complete all the QC on the project. The QC Engineer will have engineer or field technician designated as the lead member in charge of all QC being performed on the project. It is the responsibility of the QC

Engineer to ensure all the testing and inspections specified in the Drawings, Technical Specifications, and this manual are completed and documented. Within this document the terms QC Engineer and QC are interchangeable when discussing roles and responsibilities. Testing and inspections identified as being completed by the QC Engineer may be performed by a qualified designee.

- “Site” is defined as the Big Bend Power Station Economizer Ash and Pyrites Pond (EAPP) system site where the Work is to be completed as described in these Technical Specifications and detailed on the Drawings.
- “Specifications” or “Technical Specifications” are defined as this document, all supplemental addenda, and any modifications furnished by the Engineer, which apply to the Work.
- “Surveyor” is defined as the person or entity contracted by TEC either directly or through the Construction Manager or any of its authorized representative(s)/ agent(s) responsible for providing surveying services not required to be provided by the Contractor.
- “Units” – In general, these Specifications and the Drawings refer to English units for sieve sizes, geomembrane thickness, geosynthetic weights, etc. However, in some cases, material may be specified or test results may be expressed in metric units.
- “Work” is defined as the entire completed construction or the various separately identifiable parts thereof required to be furnished as shown on the Drawings and as described in the Specifications and Contract Documents.

3.0 Standard Procedures

Standard procedures are to be followed for sampling, testing and documentation requirements as outlined in the following sections and according to the Technical Specifications related to this project.

3.1 *Surveying and Grade Control*

At least two permanent reference points for horizontal and vertical control will be established outside the area of construction by the Contractor prior to any site grading work. Using these reference points, the Contractor shall provide all horizontal and vertical controls necessary to complete to work to the lines, grades and dimensions shown on the Drawings. The Contractor’s surveying shall be in compliance with the vertical and horizontal tolerances in the Specifications, and shall be conducted under the direct supervision of a Florida registered Land Surveyor. Markings and grade stakes shall be provided as needed by the Contractor to facilitate and expedite inspection of the finished grade for compliance with the dimensions on the Drawings and specified tolerances.

3.2 Training

Qualified personnel are required to perform the quality assurance (QA) and quality control (QC) testing for soils, geomembrane, and geosynthetics on the project. The technicians must be trained to perform the required tests and inspections in accordance with the ASTM, AASHTO and GRI procedures or other applicable standards. The Engineer and/or Owner will approve the qualifications of the technicians prior to being allowed to perform test and inspection work during the project.

Prior to the start of each major work item, responsibilities will be reviewed with the technicians responsible for conducting the inspection and testing. The specific inspection, testing, and reporting requirements will be identified.

3.3 Sampling Procedures

Standard procedures for sampling include proper sample identification, collection, custody, and documentation. All sampling procedures shall be completed in accordance with ASTM, AASHTO, GRI standards. Deviations from sampling procedures shall be approved by Owner and Engineer.

3.3.1 Sample Identification

The following information is to be recorded on the designated sample reporting forms when taking samples:

- Project Number
- Project Name
- Material Type
- Sample Number
- Sample Location
- Date sampled.

3.3.2 Sample Handling

The following procedures for sample handling will be used or modified as appropriate for the sample type and purpose:

- Collect samples in accordance with the Technical Specifications and ASTM, ACI, AASHTO, GRI and/or other applicable standards.
- Collect a representative sample, taking into account the array of tests to be conducted on the sample and the minimum sample size needed to complete each test.
- Transport and handle samples to avoid possible contamination, damage, or disturbance that may impact test results.

- Accept samples only after checking for identification and integrity.
- Retain or dispose of samples as directed by the Engineer.

3.3.3 Chain-of-Custody

It is anticipated that chain-of-custody procedures will not be required during construction activities. The Owner or Engineer in charge will develop a chain-of-custody procedure, if required by the Owner or Engineer.

3.4 Testing Documentation

Proper documentation shall be maintained for testing activities and shall be in accordance with the procedures described below. The following procedures do not preclude other requirements that may be outlined elsewhere or be required to ensure proper documentation for record of construction. Changes to testing documentation require approval by Owner and Engineer, prior to implementation.

3.4.1 Test Records

A record of all tests performed shall be maintained by the QC Engineer. Individual test data and results will be recorded on a standard form applicable to the test being performed.

The location of all tests will be recorded and accurately described. The location description will include a physical description in relation to the project site (e.g. Station 5+00, elev. +4.5' etc.) so that the test location can be readily identified. Where possible this description should include such information as Northing, Easting, and Elevation. A plan indicating the positions of all tests and "Work Acceptance Report" detailing inspection of specific areas will be maintained by the QC Engineer.

For Geomembrane installation, the QC Engineer will maintain a record of all destructive and non-destructive tests performed and submitted by the Liner Installation QC Supervisor. For seam testing, the record will include the name of the seam operator, time, date, seam identification, and sample identification number. The record will indicate if the sample seam test passed or failed, and if it failed, it will indicate the corrective action taken and the retest results.

The QC Engineer will provide the Owner and Engineer with copies of all test records performed and submitted by QC personnel, the Liner Installer, and all other parties performing tests related to the construction activities within one week of completion.

3.4.2 Corrections to Documentation

Entries on all documents are to be in indelible ink. If an error is made on a document assigned to one individual, that individual may make corrections by crossing a single line through the error and entering the correct information. The erroneous information must not be obliterated. The correction is to be dated and initialed.

If an error is made on a general document or another person makes a change on an assigned document submitted by another, the above procedure is to be used and the entry dated and initialed by the person making the correction or entry.

No documents are to be destroyed or thrown away, even if they are illegible, contain inaccuracies, or are replaced by another document.

3.5 Work Approval Documentation

As circumstances require, the QC Engineer shall provide written acceptance of the quality and/or condition of work before subsequent work by the Contractor can take place. For these cases, the following general procedures will be used:

- The Contractor will notify the Owner and QC Engineer in writing of the area or work requiring approval.
- The QC Engineer will perform all necessary inspections and tests, in such a manner that will cause the least delay to the work.
- The QC Engineer will inform the Owner of the test results, if required, in writing on the "Work Activity Inspection Form." The written approval will contain a clear description and plan of the work approved. If the work is rejected, the reasons for doing so will be clearly set out.
- The Contractor will perform any tasks required to bring the work within the required testing limits as defined by the Technical Specifications and approved by the QC Engineer and Owner. The contractor will notify the Owner and QC Engineer that re-inspection or testing is required. This procedure will continue until the work meets the required specification.

3.6 Control of Non-Conformance

When materials or workmanship does not conform to the Technical Specifications, Drawings, or good craftsmanship, a "Non-Conformance Form" will be issued to the Contractor or Supplier. This form is to be signed by both the QC Engineer and the Owner. This document will describe the material or work which is not in conformance, the nature of the non-conformance and the required corrective action. Non-conforming materials shall be clearly marked, identified, and segregated from conforming materials to prevent unauthorized use. A copy of the signed non-conformance document shall be issued to the contractor/supplier.

The Contractor will be required to retest the Non-Conformance as specified for the original construction. The Engineer may request additional testing beyond the limits of the Non-Conformance area or unit to verify Non-Conformance impact on adjoining constructed elements.

3.7 Change Pre-Approval

Proposed changes in quality, manufacture or construction defined as “or equal/equivalent” must be pre-approved by the Owner in writing. Requests for use of equivalent materials are to be submitted by the Contractor to the Owner for review of each request in light of the requirements of the Technical Specifications and the intentions of the design.

As soon as reasonably possible, the Owner will inform the Contractor and Engineer in writing of the acceptance or rejection of the proposed equivalent material. The Owner will not approve “equal/equivalent” materials without approval by the Engineer. The owner shall clearly state reasons for rejection.

4.0 Inspections

Quality control inspections for the construction of the project components and facilities shall be performed according to the guidelines outlined in the following sections. The following requirements do not preclude other guidelines or requirements that may be outlined elsewhere or be required to ensure proper documentation for a record of construction.

4.1 Earthworks

The QC Engineer will inspect all excavated and stripped areas. The QC Engineer will give approval on the “Work Activity Inspection Form” prior to commencement of work being started in excavated areas.

In general, inspections are required for, but not limited to, the following earthworks activities:

- General fill
- Structural fill
- Topsoil

All required earthworks testing shall be done in accordance with the associated ASTM, AASHTO, and/or other specified procedures.

4.1.1 Fill Placement

Inspections are required to document compliance with the technical specification including the following:

- Moisture conditioning
- Spreading and layer thickness
- Surface finish
- Compaction.
- Fill material acceptance including gradation, maximum particle size, and organic content
- Proofrolling of finished surface.

The completed fill area shall be approved in writing by the QC Engineer and Owner and acknowledged by the Contractor prior to further work taking place. If the approval is contingent upon repairs (exceptions) being completed on the work, the inspecting Engineer/Technician and the Contractor shall sign off on the form that the exceptions have been completed. The next sequence of work can proceed thereafter.

4.2 HDPE Geomembrane

If after the Contractor's initial inspection of the exposed liner of the berm to be reconfigured, it is agreed with the Owner and Engineer that the new liner pieces are necessary, to seam to the existing liner, the following Sections 4.2.1 through 4.2.9 shall apply to this work.

4.2.1 Geomembrane Manufacturer Quality Control

The Geomembrane used for the Project shall be as designated on the Drawings and shall be High Density Polyethylene (HDPE) Geomembrane.

Quality Control testing shall be carried out by the manufacturer to demonstrate that the geomembrane material meets the Technical Specifications. Prior to delivery of the Geomembrane liner materials to the project site, the following product data/certifications shall be provided to the Owner by the manufacturer.

- Resin data including the following:
 - Certification stating that the resin meets the project specification requirements and that it is all from the same manufacturer.
 - Statement certifying no reclaimed polymer is added to the resin

- Copy of quality assurance/quality control certificates issued by resin supplier
- Geomembrane roll/extrudate rod and bead material:
 - Copy of quality assurance/quality control certificates issued by the geomembrane manufacturer and the third-party independent quality assurance tester.
 - Certification that the geomembrane material delivered to the project complies with the project specifications.
 - Certification that extrudate rod or bead is from one manufacturer, is the same resin type, and was obtained from the same resin supplier as the resin used to manufacture the geomembrane rolls.

The Engineer shall request a copy of the above product data/certifications from the Owner and verify that the property values for the material supplied by the resin and geomembrane manufacturers meet all the Technical Specifications, that the measurements of the properties by the manufacturer are properly documented, and that the test methods employed are in accordance with the Technical Specifications.

4.2.2 Geomembrane Delivery Inspections

Upon arrival of the Geomembrane materials at the site, the QC Engineer shall immediately receive (via the Owner) a copy of the bill of lading of all Geomembrane materials and accessories delivered. All materials received on the site shall be immediately logged in on the "Log of Geosynthetic Received." Upon unloading of the Geomembrane, the QC Engineer shall verify that the materials delivered:

- Meet the Technical Specifications
- Match those that are listed on the bill of lading
- Rolls of material are clearly identified and correlate to the test sheets provided by the manufacturer

Geomembrane minimum value specifications can be found in the Technical Specifications, any discrepancies shall be brought to the immediate attention of the Owner, and the materials shall be inspected for any visible damage or defects that shall be noted in the log. Materials damaged during unloading shall be noted as such.

4.2.3 Geomembrane Storage

Geomembrane materials shall be stored at a site near the work place that is free of hazards. Materials should be stored on a smooth surface free of sharp objects and in an area, which will remain in a relatively dry condition at all times. The extrusion

rod/beads shall be stored in a dry and covered condition. The QC Engineer shall note any material damage while in storage.

4.2.4 Geomembrane Acceptance

The QC Engineer shall neither accept nor allow the installation of any materials that do not meet the Technical Specifications. Materials that are not acceptable shall be clearly marked as such by the QC Engineer. The QC Engineer shall notify the Owner and Engineer immediately upon determination of any material that is not acceptable and the governing reasons. The Geomembrane manufacturer shall be notified by the Owner as soon as possible of the deficiencies of the materials that do not meet the Technical Specifications. Materials that do not meet the Technical Specifications and that are subsequently rejected shall be segregated from other materials or be removed from the workplace to preclude accidental inclusion in the project.

4.2.5 Geomembrane Deployment

Deployment of the Geomembrane shall be in a systematic and planned fashion.

Inspections are required for the following:

- Correct direction of deployment
- Correct amount and shingling of overlap
- Amount of Geomembrane deployed
- Prevention of “trampolines”
- Prevention of water from entering between panels
- Acceptability of air vents, if needed
- Temporary anchorage
- No open holes or seams at end of day

The QC Engineer shall record any remarks concerning deployment along with the time and weather on the “Geosynthetic Panel Deployment Log.”

The QC Engineer shall re-inspect any prepared surface that may have been damaged after deployment has taken place to ensure that the prepared surface still meets the Technical Specifications. This may include removal of deployed panels. Re-inspection will be recorded on the “Work Activity Inspection Form.”

4.2.6 Geomembrane Field Panel Identification

The panel layout plan shall be prepared by the Liner Installer and approved by the Engineer. Immediately after deployment takes place, the Liner Installer shall give each panel an identification code. This identification shall be consistent with the layout plan. The identification should contain at least the following information:

- Panel layout code
- Roll Number
- Date of deployment

This information shall be marked on each panel with a non-toxic indelible material and be clearly visible. This data will be recorded by the QC Engineer on the “Geosynthetic Panel Deployment Log.”

4.2.7 Geomembrane Field Panel Inspection

After deployment, field panels are to be inspected for defects or damage. The Liner Installer shall ensure that there are no visual defects, sharp protrusions, or other objects that may affect the integrity of the installation. The Liner Installer is responsible for keeping the surface of the Geomembrane free from rocks or other sharp objects that may puncture the geomembrane.

The QC Engineer shall visually inspect the Geomembrane after installation for defects, holes, tears, or protrusion of sharp objects. Any observations by the QC Engineer requiring the attention of the Liner Installer will be submitted to the Installer. This does not relieve the Liner Installer of liability or from any responsibilities in meeting the requirements of the Technical Specifications or guidelines. For testing frequencies, test methods and reporting procedures, see the Technical Specifications.

Inspections are required for the following:

- Striations
- Roughness
- Pinholes
- Bubbles
- Holes
- Blisters
- Pockets of raw material
- Foreign material contamination.

All defects or damaged areas that require repair shall be identified by circling the defect or area. Panels that have excessive defects as determined by the QC Engineer shall be removed. The Liner Installer shall document removal or cutting of the Geomembrane liner required for repairs and submit the records to the QC Engineer.

Field panels shall be checked for proper thickness. Thickness should be checked on the leading edge and one side of the panel as a minimum. A micrometer should be used to check thickness. Thickness shall meet the requirements of the Technical Specifications. All information concerning inspection of field panels shall be recorded on the “Geosynthetic Panel Deployment Log.”

4.2.8 Geomembrane Deployment Schedule and Progress Reports

Deployment of the Geomembrane shall take place within an acceptable period as agreed by both the Liner Installer and the Owner. The speed of deployment shall consider the seaming rate and the deterioration of prepared surface with time.

The Liner Installer shall record on a daily basis the identification number, location, date, and roll number of each panel deployed. Daily progress reports shall be submitted to the Owner.

The Owner and QC Engineer shall check these daily reports against their records to ensure completeness. The exact location of each panel deployed shall be surveyed for the as-built records.

4.2.9 Geomembrane Seams and Welding

Control of Geomembrane seam welding shall follow the Technical Specifications, industry-accepted standards and the following guidelines. Seaming strength minimum values can be found in the Technical Specifications.

4.2.9.1. *Seam Layout and Overlap*

Horizontal field seams on slopes shall be kept to a minimum. Horizontal seams on steep slopes shall be avoided where possible by cutting the liner at a 45-degree angle. Generally, horizontal seams are to be no closer than 10 feet (3 meters) from the toe of the slope. Horizontal seams shall be made by lapping the uphill material over the downhill material. Panels shall be shingled in a manner that prevents water from running beneath the liner.

The Geomembrane field panel layout shall be inspected for proper overlap prior to seaming. Field joints shall have a minimum overlap of 4 to 6 inches (100 to 150 mm) for double-wedge welding seams and minimum 6 inches (150 mm) for extrusion welding seams. Overlaps shall be made to minimize shear stress and for seepage between the synthetic membrane in the event of seam failure.

4.2.9.2. *Geomembrane Seaming Equipment*

Only approved techniques listed in the Technical Specifications shall be employed in the seaming of Geomembrane materials. Alternative seaming techniques are not permitted unless approved by the Owner after consulting with the Engineer. All seaming equipment shall be equipped with gauges for monitoring working temperatures and speed of travel, if applicable.

4.2.9.3. Seam Identification

The field seam identification number shall be compatible with the panel identification system.

4.2.9.4. Seam Preparation

Prior to seaming, the Liner Installer shall clean the immediate area to be welded of all dust, dirt, moisture, and foreign material. Failure to properly clean the liner prior to welding shall be sufficient reason for the QC Engineer to stop welding operations. Seams are to be aligned with the fewest possible wrinkles. All fish mouths shall be properly prepared for seaming.

4.2.9.5. Weather Conditions and Seaming

Seaming shall not take place during inclement weather. The QC Engineer shall have the final authority to determine if weather conditions warrant halting or postponing of operation. These conditions include, but are not limited to, the following:

- Precipitation of any kind including condensing fogs.
- Areas of ponded water.
- Periods of excessive wind.
- Extreme heat or cold, unless seaming techniques are shown to produce acceptable and consistent results.

4.2.9.6. Trial Seams and Inspection

Trial welds shall be completed to verify the performance of the welding equipment and operator prior to performing production welds. No welding equipment or operator shall perform production welds until equipment and operator have successfully completed a trial weld. The following procedures shall be followed for trial welds:

- Make trial welds under the same surface and environmental conditions as the production welds, i.e., in contact with subgrade and similar ambient temperature.
- Minimum of two trial welds per day per welding apparatus – one made prior to the start of work and one completed at mid-shift or for every 5 hours of seaming operations.
- Cut five 1-inch-wide-by-6-inch-long (25-mm-wide-by-150-mm-long) test strips from the trial weld.
- Quantitatively test specimens for peel adhesion and then for bonded seam strength (shear).

- Trial weld specimens shall pass when the results shown in the Technical Specifications are achieved in both peel and shear tests and:
 - The break, when peel testing, occurs by separation in the plane of the sheet (SIP), not through adhesion failure separation (AD).
 - The break is ductile.
- Repeat the trial weld, in its entirety, when the trial weld samples fail in either peel or shear as defined in the Technical Specifications.

All trial seam data is to be recorded on the “Geosynthetic Start-Up Trial Weld/Seam Log.” Trial seams shall meet the following specifications:

- Clearly marked with sample identification number.
- Three feet-long for extrusion and 10 feet-long for wedge seaming.
- One foot wide after seaming.
- Same overlap as required in field seaming.
- Seam centered along the long axis of the sample.
- Seam allowed to cool naturally to ambient temperature.

The Liner Installer shall complete destructive testing using a calibrated tensiometer that shall be witnessed by the QC Engineer. Calibration of the tensiometer shall be completed before the start of the project. The Liner Installer shall provide a copy of the calibration certificate to the QC Engineer (via the Owner) after each calibration. Results of the tests shall be recorded by the Liner Installer.

4.2.9.7. *Field Seams and Inspection*

The Contractor shall have at least one master welder who will provide direct supervision over other welders as necessary.

- The welding equipment shall be capable of continuously monitoring and controlling the temperatures in the zone of contact where the machine is actually fusing the material to ensure changes in environmental conditions will not affect the integrity of the weld.
- The seam area shall be cleaned of dust, mud, moisture, and debris immediately ahead of the welding apparatus.
- The seam overlaps shall be aligned consistent with the requirements of the welding equipment being used. A 4- to 6-inch (100- to 150-mm) overlap is commonly suggested.
- Seaming shall not proceed when adverse weather conditions jeopardize the integrity of the geomembrane installation.
- Cold weather installation shall require special precautions and procedures as outlined in the Specifications.

- Extrusion welding apparatus shall be purged of heat-degraded extrudate before welding.
- The double-wedge fusion welding process shall be used unless alternate methods are approved by the Engineer. Extrusion welding will be permitted to weld short seams, to repair small areas, where double-wedge welding is not feasible, and where test samples have been removed.

Field seams shall be inspected by the QC Engineer to verify that the Liner Installer complies with the Technical Specifications and the following guidelines.

Inspections are required for the following:

- Correct centering of the weld in fusion seaming.
- Water and air blisters in the weld in fusion seaming.
- Proper adhesion of the extrusion bead in fusion seams.
- Overgrinding of the synthetic membrane panel adjacent to the extrusion seams. If the overgrind is greater than 10 percent of the panel thickness, an extrusion bead shall be placed over the overgrind.
- Poor workmanship.
- Insufficient overlap.
- Lack of extrudate in the extrusion seam bead.

The QC Engineer may also reject any portion of a seam for any additional reason that may cause the seam to not meet the Technical Specification. The HDPE field seaming technician shall mark next to each seam his or her initials, the date of seaming, the time, machine number, welding temperatures and, if applicable, preheat and machine speed and indicate with arrows the start and finish points of the seaming.

4.2.9.8. Seaming and Panel Deficiencies

Any deficiency found in the HDPE geomembrane seams or panel shall be indelibly marked by the Engineer. The following terms may be used to describe the action required to correct the deficiency:

- B - Bead
- P - Patch
- Leak - Leak
- IO - Insufficient Overlap
- Bridge - Bridge
- DS - Destructive Sample Fusion Weld
- DX - Destructive Sample Extrusion Weld

Further markings shall be used to identify the repair or destructive sample number. Bead repairs do not need to be recorded. Insufficient overlaps shall be patched and bridges shall be cut and patched as required. All holes, leaks, and areas where destructive samples have been taken shall be patched. Patching materials shall be of the same material type and thickness as the material being repaired. A patch shall be a minimum of 6 inches (150 mm) or larger in all directions than the area requiring repair and is to have rounded corners. All double wedge seam intersections shall be properly prepared and capped. All repairs shall be logged as required on the Installers Geosynthetic Field QC Logs. Capping shall be used in the repair of fusion welds.

Any material on the support layer that may cause damage shall be removed and the area repaired. All repairs shall be non-destructively tested. Repairs shall be inspected by the QC Engineer for deficiencies prior to panel acceptance and seam acceptance.

5.0 Material Testing

Content-appropriate forms are to be used for the tests described in this section. When reference is made to an external test procedure, i.e. ASTM or other, the relevant test procedure documentation is considered to be an integral part of this manual. If these external test procedures reference or require other additional external procedures, they also are considered to be an integral part of this document.

The tests required are divided into two categories:

- Control tests
- Record tests

Control tests are used to determine that materials comply with the specifications prior to placement and to determine other parameters, such as optimum moisture content and maximum dry density, so that the requirements of the Technical Specifications are achieved. The frequency of control tests can be reduced when material characteristics are relatively constant and consistent.

Record tests are performed, generally after placement of the materials, to determine that the materials meet the requirements as set forth in the Technical Specifications.

Tests will be performed according to the methods and frequencies shown in the relevant Technical Specifications. The tests will be performed at least the minimum number of times as indicated in the tables. (Note: Test frequency represents total combined Control and Record tests to be completed.) The Owner, QC Engineer, or Engineer may increase the number of tests required, however any reduction in the minimum testing frequency requires the approval of the Owner after consultation with the Engineer.

5.1 Earthworks

The earthworks shall be installed in strict accordance with the Technical Specifications and to the lines and grades shown on the Drawings. The test methods and frequencies applicable to laboratory and field-testing are detailed in the Technical Specifications. All tests shall be recorded on the appropriate forms. Different test numbering systems will be established for each type of material.

5.1.1 Laboratory Testing

The QC Engineer will perform laboratory testing on each earthworks material in accordance with the Technical Specifications and the testing frequencies identified in the relevant Technical Specifications. As described above, record and control tests shall both be performed on the materials in order to confirm the suitability of the materials before use and to confirm materials used meet the requirements set forth in the Technical Specifications.

The QC Engineer will individually consider each test which fails to meet the requirements in the Technical Specifications and recommend an appropriate course of action. This may involve re-sampling, retesting, reanalysis, or some combination of these. Modifications to the Technical Specifications or acceptance of materials not meeting Technical Specifications require the approval of the Engineer and Owner.

Laboratory testing shall be performed in accordance with the following ASTM test methods.

- ASTM D2216 Moisture Content
- ASTM D422 Particle Size Analysis of Soils
- ASTM D698/D1557 Laboratory compaction – Standard and Modified Effort
- ASTM D2974 Organic Matter Content

5.1.2 Field Density Testing

The QC Engineer will individually consider each record test which fails to meet the requirements in the Technical Specifications and recommend an appropriate course of action. This may involve re-sampling, retesting, reanalysis, or some combination of these. In every case, all documentation associated with the original test and the recommended remedial work will be clearly cross-referenced so that the entire sequence of activities may be completely reconstructed.

Nuclear method, and sand and water replacement field density test procedures will be performed to ensure that earthworks material is placed in accordance with the Technical Specifications. These methods for determining the in-place density and unit weight of soil is to be performed in accordance with the following ASTM test methods.

- ASTM D6938 Nuclear Method

- ASTM D1556 Sand-Cone Method
- ASTM D5030 Water Replacement Method

5.1.2.1. Nuclear Density Method

The primary method for determining the density of soil and aggregate materials is the nuclear density method. Nuclear density testing is useful as a rapid, non-destructive technique for the in-place determination of soil and aggregate at or near the surface. The methods and equipment required for this testing must be performed in accordance with ASTM D6938. This equipment must only be used, calibrated, and maintained by those staff specifically trained and designated for this work.

5.1.2.2. Sand and Water Replacement Methods

The secondary methods for determining the density of soil and aggregate materials are the sand-cone and water replacement methods. These methods can be used as a confirmation test for testing performed by the nuclear density method. The sand-cone method is to be used for materials without appreciable amounts of rock or gravel in excess of 1-1/2 inches. The water replacement method is to be used if the material being tested typically contains particles larger than 3 inches.

The material being tested must be sufficiently cohesive to maintain stable sides during testing. It must not deform or slough while digging the hole or pouring the sand. In general, these test methods are limited to materials in an unsaturated condition and are not recommended for soft, friable, or seeping materials.

5.2 Geomembrane Testing

Field testing of Geomembrane will include destructive and non-destructive testing of wedge and extrusion welded seams according to the following sections.

5.2.1 Geomembrane Destructive Seam Testing

Peel and shear seam strength testing shall be carried out on samples of seams removed from the installed panels. For these tests, the following procedures shall be followed:

- Coupon sampling of all field seams, including patches and repair areas, shall be taken by cutting perpendicular to the seams a sample approximately 36 by 12 inches (900 by 300 mm). This sample shall be cut into three 12 by 12-inch (300 by 300-mm) samples and labeled with the date and location, and individually marked "Owner Sample," "QA/QC Sample," and "Lab QA/QC Sample." The frequency and location shall be determined by the QC Engineer but shall not be less than one sample per 500 feet (150 meters) of field seams. These coupons shall be tested on site for peel and shear seam strength and thickness in accordance with D6392.

- Heat-welded seams shall be allowed to cool or warm to about 70°F prior to testing. Solvent seams, when used, shall be allowed to cure according to the manufacturer's recommendations. Additionally, at the QC Engineer's option, approximately 10 percent of the coupons size 1 by 6 inches (25 by 150 mm) shall be sent to an independent laboratory for confirmation testing. Should the lab and field tests conflict, installation shall halt until the conflict is resolved to the satisfaction of the Engineer and/or Owner.

The QC Engineer will continuously inspect the installation of the Geomembrane liner to ensure that the procedures specified in this section are adhered to fully.

In the event of a failing test result, the following procedures shall be used:

- The Installer shall follow one of two options:
 - Reconstruct the seam between any two passed test locations, or
 - Trace the weld to an intermediate location at least 10 feet (3 meters) or to where the seam ends in both directions from the location of the failed test. Once the failing limits of the seam are isolated, that portion of the seam shall be reconstructed or capped.

Seams welded prior to and after the failed seam using the same welding device and/or operator shall be tested.

The QC Engineer shall not accept any seam until the destructive test results are deemed passing. In the event that Installer wished to proceed prior to receiving the test results, the Owner shall obtain in writing from the Installer that all liability and cost incurred in the event of a failing test is the responsibility of the Installer.

5.2.2 Geomembrane Non-Destructive Seam Testing

The Geomembrane Installer shall perform visual inspections of deployed and welded Geomembrane panels to identify defects, damage, or protrusion of sharp objects that may affect the integrity of the geomembrane. Defective or damaged areas will be marked and repaired according to the Technical Specifications and the guidelines in the Installer's Quality Control Manual.

A quality control technician or field engineer acting for the Installer shall inspect each seam, marking his initials and date inspected at the end of each panel. Any area showing a defect shall be marked and repaired in accordance with the applicable repair procedures.

5.2.2.1. Continuity Testing

A maximum effort shall be made to install a perfect geomembrane liner. This implies that all seams completed in the field, patches, and extrusions shall be tested and recorded. All failures shall be isolated and repaired as directed by the QC Engineer. A general testing procedure is included as follows:

- Test all field seams and patches with interseam pressure, vacuum box, spark tester, or other approved methods. Pressure, vacuum, and spark testing are discussed in following subsections.
- Isolate and repair all areas indicating any leakage. Retest the repair.

5.2.2.2. Interseam Pressure Testing

Test procedure for interseam pressure for seams (for double-wedge welding only):

- Seal both ends of the seam to be tested by applying heat to the end of the seam via a heat gun until flow temperature is achieved. Clamp off the ends and let cool.
- Insert a pressure gauge/needle assembly into the end of the seam and seal.
- Pressurize the air channel between the two seams to between 30 and 35 psi (207 and 241 kPa). Following pressure stabilization, take the initial pressure reading, hold the pressure a minimum of 5 minutes, and take a second reading.
- The allowable leak down for the seam is 3 psi (21 kPa).
- If the pressure does not drop below the maximum allowable 3 psi (21 kPa), open the air channel at the end away from the pressure gauge. Air should rush out and the pressure gauge should register an immediate drop in pressure, indicating that the entire length of seam has been tested. If this does not happen, either the air channel is blocked or the equipment is faulty, and the test is not valid.
- Enter the results of the leak test on the appropriate document, indicating either a passed or a failed seam. If the seam fails, the repair work and subsequent testing should be recorded on the same document.
- Repair the area where the pressure gauge/needle assembly was installed and where the air was released.

5.2.2.3. Vacuum-Box Testing

The proposed test procedures are as follows:

- Mix a solution of liquid detergent and water and apply an ample amount to the area to be tested. If a seam contains excess overlap or loose edges, it must be trimmed before testing.

- Place a translucent vacuum box over the area and apply a slight amount of downward pressure to the box to seat the seal strip to the liner.
- Apply a vacuum of 3 to 5 psi (21 to 34 kPa) to the area. Any leaks will become visible by large bubbles.
- Enter the results of the leak test on the appropriate document, indicating either a passed or a failed seam. If the seam fails, the repair work and subsequent testing should be recorded on the same document.

5.2.2.4. Spark Testing

The proposed test procedures are as follows:

- During the process of installing a liner patch, insert a 24-gauge copper wire or equivalent around the outside edge of the overlying patch.
- Extrusion weld as normal leaving the wire embedded in the seam. The wire may need to be tacked or lightly secured to keep it in place during the welding procedure
- Once the seam has cooled test the weld with an electrical electrode specifically made for this application. If there is a hole or imperfection in the weld, there will be a visible spark as the electrode grounds to the copper wire. In these areas, the weld is to be lightly abraded and re-welded to seal the hole.
- Enter the results of the spark test on the appropriate document, indicating either a passed or a failed seam. If the seam fails, the repair work and subsequent testing should be recorded on the same document.

5.2.3 Geomembrane Final Acceptance

After completion of installation, repairs and all testing, the finished surface of the geomembrane liner shall be accepted in writing by the Owner and Liner Installer prior to covering with another material. This acceptance shall be recorded on a "Final Geosynthetics Acceptance Form." If any damage has occurred since acceptance, the QC Engineer shall obtain re-acceptance of any area that has been damaged and repaired prior to placement of over liner materials.

5.2.4 Sample Retention

All samples and coupons from the destructive tests shall be archived on-site by the Owner for retention for a minimum of one year after the completion of installation.

5.3 *Equipment Calibration, Maintenance and Operation*

Manufacturer's specifications for instrument calibration and maintenance will be followed. A record of calibration and maintenance activities will be maintained in field notebooks.

The calibration, maintenance, and operating procedures for all instruments, equipment, and sampling tools are based on or are the actual manufacturer's instructions, specifications, and criteria for calibration, maintenance, and operation.

Each piece of equipment used in activities affecting data quality will be calibrated at a frequency specified by the manufacturer's specifications and maintained in accordance with the manufacturer's specifications. Following maintenance, instruments will be calibrated according to the manufacturer's specifications to ensure proper completion of the maintenance procedure.

6.0 Reporting

6.1 *Daily Reports*

The QC Engineer will prepare a daily report summarizing work inspected, tests performed, and other relevant items. The daily report will indicate any failed inspections or tests, the actions taken to rectify these reports received or given about unacceptable or substandard procedures or materials.

6.2 *Monthly Progress Reports*

The QC Engineer will prepare a monthly progress report. This report will:

- Summarize all QC activities
- Summarize all inspection and testing results
- Indicate problems encountered
- Indicate potential difficulties

The Engineer may supplement this report with other items, drawings, figures, and tables as are necessary to clearly present the work performed and planned.

6.3 *Record of Construction Report*

Upon completion of the work, the Engineer will prepare a Record of Construction Report. This report will include:

- A summary of construction methods and materials.
- A summary of any problems encountered and the solutions to them.

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- Results of all tests completed by the QC.
- As-built drawings using survey data collected by the project Surveyor.

The Construction Report will be submitted to the Owner upon compilation and completion of reporting requirements. The report will be stamped by a license Professional Engineer.

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A	03/01/2019	TEA	TEA	TEA	9	Draft Submittal

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1.0 INTRODUCTION

This specification defines the requirements for the earthwork construction activities associated with the Tampa Electric Company (TEC) (Owner) North and South Economizer Ash and Pyrites Pond (EAPP) Closure Project. The specifications set forth in this document cover the quality of materials and workmanship for earthworks construction. **The EAPP closure project is anticipated to be divided into three phases. Phase I will involve removal of all CCR and the liner system. The demolition phase will involve removal of various plastic and steel piping and concrete pavements and structures. Phase II will involve removal of the earthen dikes. Some overlap/interaction of the demolition with both Phase I (removal of existing piping and structures above the liner) and Phase II (removal of existing structures and piping below the liner).**

Any alternatives or exceptions to this specification shall be submitted in writing to TEC or its designated representative and shall be approved by the engineer.

1.1 References

The following is a list of standards which may be referenced in this section:

1. ASTM International (ASTM): D698, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort.
2. ASTM International (ASTM): D1557, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort.

1.2 Definition of Terms

- "Owner" is defined as Tampa Electric Company (TEC) or any of its authorized representative(s)/agent(s).
- "Engineer" is defined as the Consultant or Engineering Company responsible for the detailed design or any of its authorized representative(s)/ agent(s).
- "Contractor" is defined as the party(s) that has executed the contract agreement for the specified Work with the Owner or its authorized representative(s)/agent(s).
- "Specifications" are defined as this document, all supplemental addenda, and any modifications furnished by the Owner, the Engineer, or others that apply to the Work.
- "Drawings" are defined as the Drawings for the EAPPS Closure Project furnished by the Owner, Engineer, or others that apply to the Work.
- "Site" is defined as the EAPPS project area designated by the Owner and where the Work is to be completed as described in these Technical Specifications and detailed on the Drawings.

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- “CCR” is defined as the accumulated material placed in the North and South Economizer Ash Ponds. The material is typically observed as black or gray, low plasticity or non-plastic, sand, gravel, or silt sized material.
- “Contract” is defined as the document executed by the Owner or its authorized representative(s)/agent(s) with the Contractor to complete specified portions of the Work.
- “Work” is defined as the entire completed construction or the various separately identifiable parts thereof required to be furnished as shown on the Drawings and as described in the Specifications and Contract Documents.
- “Modifications” are defined as changes made to the Specifications or the Drawings that are approved by Owner and Engineer in writing, after the Specifications and Drawings have been issued for construction. These also refer to changes to design elements in the field to account for unforeseen conditions.
- “Units” – In general, these Specifications and the Drawings will utilize English units, however metric units will be used when appropriate.
- “NEAP” – North Economizer Ash Pond
- “SEAP” – South Economizer Ash Pond
- “LTFAP” – Long Term Fly Ash Pond
- “EASP” – Economizer Ash Suction Pond

2.0 EARTHWORK

This section presents the technical requirements for the earthworks required as part of the Economizer Ash and Pyrites Pond System Closure project. The project involves removal of CCR in the NEAP and SEAP, removal of the existing dikes, and regrading the area.

2.1 Clearing, Stripping

The ground surface is to be cleared and stripped of all organic and objectionable materials to the limits shown on the Drawings or as required by the Engineer. The limits of clearing and stripping shall generally extend approximately 10 feet outside of the Work activity areas as shown on the Drawings. Any clearing and stripping beyond the limits shown on the Drawings, or as required by the Engineer, shall be subject to the approval of the Owner. All usable topsoil, as determined by the Owner, shall be stockpiled in locations shown on the Drawings or as designated by the Owner.

Clearing shall include removal of remaining surface debris associated with historical land use and removal of large woody vegetation, if any.

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Stripping shall mean the removal of topsoil, which is defined as soil of any gradation or degree of plasticity that contains significant quantities of visually identifiable plant matter, sod, roots, or humus as determined by the Engineer. Over some of the project area and associated construction areas, stripping will consist of removal of the vegetative cover (grass, crop remnants, brush, weeds, etc) with limited removal of surface soil (approximately 3 inches) generally being required. In areas where the topsoil extends to depths greater than 3 inches, the excavations shall extend to a greater depth as directed by the Owner. The stripped material shall be hauled to stockpile areas as instructed by the Owner. Stripped surface soils and vegetation acceptable for use for erosion control purposes shall be stockpiled separately from material viewed as unacceptable for purposes.

After stripping of the required area, the surface shall be treated as specified on the Drawings or in the Technical Specifications. Prior to any surface treatment on a stripped area, the Engineer shall be notified to inspect the stripped area and designate the method of treatment required for continuance of Work. A survey shall be taken of the area if necessary to determine quantities and/or for verification of lift/layer thickness.

2.2 CCR Removal

CCR removal shall mean the removal of CCR within the existing pond embankments. The limits of the CCR are approximately as shown on the Drawings. The CONTRACTOR shall verify with the OWNER or ENGINEER, the limits of the CCR removal within the ponds. The Contractor shall submit a plan for CCR removal, including details of excavation, dewatering, moisture conditioning, dust control, handling, loadout, etc. The plan shall ensure that: CCR shall be controlled at all times, no CCR shall leave the site boundaries in an uncontrolled manner (i.e. as fugitive dust, in sediment transport, on vehicle tires, outside of vehicles, etc.), and that CCR shall not be intermingled with or otherwise contact existing natural and fill soils, pavements, etc. beneath or outside the lined areas of the NEAP and SEAP.

Vegetation, including root systems, shall be stripped from the CCR and may require separate handling. Various structures within the ponds and above the liners, including piping and supports, pavements, etc. may also require separate demolition and handling including cleaning to avoid commingling CCR with non-CCR demolition waste.

CCR will require dewatering and moisture conditioning prior to transport. CCR shall not be loaded for transport at moisture contents greater than the Standard Proctor Optimum Moisture Content (SPOMC) minus 3 percent unless approved by the Owner.

CCR removal, clearing, and stripping removal will be carried out using whatever method is deemed necessary, providing it is consistent with producing an acceptable end result as determined by the Owner and the Engineer.

After CCR removal, the liner shall be removed for disposal. Any areas beneath the liner with impacted soils shall be removed and loaded for disposal as directed by the OWNER or ENGINEER.

Liner on the outside south dike of the SEAP/north dike of the LTFAP shall be preserved, temporarily rolled, repaired, and reanchored as shown on the drawings and directed by the Owner.

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2.3 Dike Excavation

Once the CCR and liner as well as any soils impacted by CCR have been removed, dike excavation and removal may begin. Demolition of non-CCR contact materials may proceed concurrently with or before dike excavation.

The exterior of the dikes shall be stripped per the above section at this time, preparatory to dike excavation. In general, existing vegetative cover shall be maintained in place until shortly before excavation.

Positive surface drainage shall be maintained across the site at all times to direct surface water flows to appropriate sediment basins. Disturbed areas shall be rolled smooth prior to rainfall and at the end of each work shift to reduce the potential for infiltration and saturation of subgrade.

2.3.1 Unclassified

1. All excess acceptable material excavated from the site and not used for embankment shall be removed from the site to a disposal area specified by the owner.
2. Where material encountered within the limits of the work is considered unacceptable by the Owner for embankment (fills) on any portion of this work, such material shall be excavated as directed by Engineer and replaced with acceptable fill material.
3. Unacceptable excavated material consisting of any type of debris (surface or buried), excavated rock, or other hard objects larger than six (6) inches in any dimension shall be hauled from the site and disposed of by Contractor at Contractor's expense. Debris is defined as "anything that is not earth which exists at the job site."

2.3.2 Muck

Where excavation to the finished grade section results in a subgrade or slopes of unacceptable material, Engineer may require Contractor to remove the unacceptable materials and backfill to the finished graded section with approved material. Disposal of the unacceptable material and replacement with acceptable material shall be at Contractor's expense.

2.3.3 Rock

Rock shall be defined as material which cannot be excavated with a backhoe having a bucket curling force rated at not less than 25,700 pounds (Caterpillar Model 325 or equivalent) using a rock bucket, and occupying an original volume of at least one-cubic yard.

2.4 Grading / Foundation Preparation

Once the CCR and dikes are removed, and the work area has been stripped and approved by the Engineer or Owner, the surface shall be prepared before any overlying materials are placed. All work

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areas shall be graded according to the limits shown on the Drawings. It is anticipated that there will be areas of both cut (excavation) and fill to bring the grading of the work area to the elevations specified in the Drawings.

Except for earthwork required for the berm reconfiguration, areas that are to be filled shall have the exposed surface scarified to a depth of approximately 8 inches, moisture conditioned, and compacted to 90 percent of the maximum dry density as determined by ASTM D1557 to provide a uniform, dense foundation for the first lift of fill. The Engineer may waive this requirement if the exposed surface soils without manipulating will provide a firm, non-yielding surface for fill placement, in which case the surface shall be moistened, scarified to a depth of at least 3 inches, and the first layer of fill placed.

Except for earthwork required for the berm reconfiguration, areas that require cut to achieve grade, shall be scarified to a depth of approximately 8 inches, moisture conditioned, and compacted to 90 percent of the maximum dry density as determined by ASTM D1557 unless waived by the Engineer.

For the earthwork required within the limits of the berm reconfiguration, the compaction requirement is 95 percent of the maximum dry density as determined by ASTM D1557.

Areas of unacceptable material as determined by the Engineer shall be excavated to the limits designated by the Engineer and replaced with compacted Random Fill.

2.5 Dewatering

Dewatering shall consist of removal of water from within the limits of construction and from excavations, trenches and pits made during construction. The method(s) of dewatering shall be the responsibility of the Contractor, subject to approval by the Owner and the Engineer. Construction activities, including the placement and compaction of fill materials, shall be performed “in the dry” (without the presence of standing water).

CCR shall be dewatered to allow equipment access on the ash surface as well as to facilitate excavation and handling. Dewatering will also be required to desaturate the CCR prior to removing from the site.

Water produced from dewatering activities can be discharged at rates and volumes approved by the owner to the existing LTFAP. No water shall be released off-site or into any ditch without the Owner’s and FDEP’s written permission. The Contractor shall submit a proposed dewatering plan, including proposed discharge locations, for approval by the Owner at least one week prior to implementation.

2.6 Fill Materials

Earthfill shall not be placed until the required foundation preparations have been completed and the foundation has been inspected and approved by the Engineer and any required surveys completed.

All material used for fill shall be loaded and hauled to the placement site, dumped, spread, and leveled to the specified layer thickness. Fill shall be moisture conditioned if required and compacted to form a dense integral fill per the Technical Specifications and the approval of the Engineer. Care shall be taken at all times to avoid segregation of the material being placed and, if required by the Engineer, all pockets

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of segregated or undesirable material shall be removed and replaced with material which matches the surrounding material. All oversize material shall be removed from the fill material either prior to it being placed or after it is dumped and spread but prior to compaction. No additional payment will be made to remove oversized materials unless the work is specifically identified as a payment item on the Schedule of Quantities.

For most construction conditions, the fill is to be constructed in near horizontal layers with each layer being completed over the full length and breadth of the zone before placement of subsequent layers. Each zone shall be constructed with materials meeting the specified requirements and shall be free from lenses, pockets, and layers of materials that are substantially different in gradation from the surrounding material in the same zone, as determined by the Engineer.

After a lift is placed and compacted, its surface shall be scarified or roughened by a sheepsfoot roller to a minimum depth of 3 inches prior to placement and compaction of the next lift in order to bond the interface between lifts. At no time shall a new lift of fill be placed over a dried or smooth surface. If a dried surface develops, it shall be rewetted and thoroughly and uniformly mixed with the moist underlying soils and recompacted prior to placement of a new lift of fill.

Moisture conditioning is the operation required to increase or decrease the moisture content of material to within the specified limits. If moisture conditioning is necessary, it may be carried out by whatever method the Contractor deems is acceptable, provided it produces the moisture content specified in these Technical Specifications or designated by the Engineer. The moisture shall be distributed uniformly throughout each layer of material being placed immediately prior to compaction. Measures shall be adopted as are necessary to ensure that the designated moisture content is preserved after compaction until the overlying layer is placed.

2.6.1 General Fill

General fill material shall be placed in loose lifts not to exceed 12 inches in thickness with thinner lifts placed where small rollers, plate compactors, hand equipment, or similar compaction equipment is used. This material shall be compacted to 90 percent of the modified Proctor maximum dry density (ASTM D1557) unless otherwise indicated on the Drawings. The moisture content of the compacted material will be maintained at +/- 3 percent of the optimum moisture content. The organic content shall be less than 3% (ASTM D2974). Slight variations from the specified moisture range may be acceptable subject to the acceptance of the Engineer and provided the required compacted densities are achieved. The General fill material shall be compacted with appropriate compactive equipment capable of achieving compaction through the full thickness of the lift layer.

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2.7 Erosion Protection

All bare and disturbed soil areas and other areas designated by the Owner, shall be grassed, unless otherwise indicated on the Drawings or directed by the Owner. Grassing shall consist of preparing the ground surfaces (Topsoil placement), sodding, irrigating, and furnishing and spreading fertilizer. The sod shall consist of local native grasses and legumes approved for use in the area by FDOT. The Contractor shall provide the Engineer with sod type and source prior to ordering the sod.

As soon as is practical after finish grade has been established, all operations in connection with grassing shall be performed. Prior to grading and tillage operations, the ground surface shall be cleared of all heavy vegetation, roots, rubbish, grade stakes, and other material that might hinder proper grading, tillage, or subsequent maintenance operations. Grades on areas to be sodded shall be maintained in a true and even condition, preventing the formation of depressions where water could pond.

The Contractor shall water sodded areas immediately after sodding and as necessary to maintain growth of the grass. Each watering shall be in sufficient quantity to prevent rapid drying, and at a rate that will not cause erosion. The Owner may direct the Contractor to substitute other non-erosive materials for the grassing ditches.

2.8 Quality Control

The Engineer will take samples of fill materials and perform field density tests on the compacted fill and any other tests that the Engineer considers necessary to ensure that the fill being placed meets the specified requirements. The Engineer's representative (an experienced soils technician) will observe fill operations and perform at least one density test per every 2 feet of placement for every 10,000 square feet. Cooperation shall be given by the Contractor, to the Owner and the Engineer, for taking samples or making tests, and such assistance shall be rendered as is necessary to enable sampling and testing to be carried out expeditiously.

3.0 QUALITY CONTROL CONSTRUCTION TOLERANCES

The Contractor shall construct the various aspects of the Pond Project to the lines and grades shown on the Drawings, or as required by the Engineer, within the following tolerances:

Finish grades and slopes shall be in general conformance with the Drawings. Deviations from finished grades/slopes are subject to approval by the Engineer and shall not, at any point, vary by more than 0.5' from the drawings nor result in low spots or poor drainage.

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1.0 INTRODUCTION

This specification defines the requirements for the earthwork construction activities associated with the Tampa Electric Company (TEC) (Owner) Economizer Ash and Pyrites Pond System (EAPPS) Closure Project. The specifications set forth in this document cover demolition required for the project. **The EAPP closure project is anticipated to be divided into three phases. Phase I will involve removal of all CCR and the liner system. The demolition phase will involve removal of various plastic and steel piping and concrete pavements and structures. Phase II will involve removal of the earthen dikes. Some overlap/interaction of the demolition with both Phase I (removal of existing piping and structures above the liner) and Phase II (removal of existing structures and piping below the liner).** The Contractor shall include the removal of existing construction to limits indicated on drawings where earthwork or other construction operations are to be performed as specified herein.

Any alternatives or exceptions to this specification shall be submitted in writing to TEC or its designated representative and shall be approved by the engineer.

1.1 Definition of Terms

- “Owner” is defined as Tampa Electric Company (TEC) or any of its authorized representative(s)/agent(s).
- “Engineer” is defined as the Consultant or Engineering Company responsible for the detailed design or any of its authorized representative(s)/ agent(s).
- “Contractor” is defined as the party(s) that has executed the contract agreement for the specified Work with the Owner or its authorized representative(s)/agent(s).
- “Specifications” are defined as this document, all supplemental addenda, and any modifications furnished by the Owner, the Engineer, or others that apply to the Work.
- “Drawings” are defined as the Drawings for the EAPPS Closure Project furnished by the Owner, Engineer, or others that apply to the Work.
- “Site” is defined as the EAPPS project area designated by the Owner and where the Work is to be completed as described in these Technical Specifications and detailed on the Drawings.
- “CCR” is defined as the accumulated material placed in the North and South Economizer Ash Ponds. The material is typically observed as black or gray, low plasticity or non-plastic, sand, gravel, or silt sized material.
- “Contract” is defined as the document executed by the Owner or its authorized representative(s)/agent(s) with the Contractor to complete specified portions of the Work.

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- “Work” is defined as the entire completed construction or the various separately identifiable parts thereof required to be furnished as shown on the Drawings and as described in the Specifications and Contract Documents.
- “Modifications” are defined as changes made to the Specifications or the Drawings that are approved by Owner and Engineer in writing, after the Specifications and Drawings have been issued for construction. These also refer to changes to design elements in the field to account for unforeseen conditions.
- “Units” – In general, these Specifications and the Drawings will utilize English units, however metric units will be used when appropriate.
- “NEAP” – North Economizer Ash Pond
- “SEAP” – South Economizer Ash Pond
- “LTFAP” – Long Term Fly Ash Pond
- “EASP” – Economizer Ash Suction Pond

2.0 SUBMITTALS

The Contractor shall submit proposed methods and operations of demolition for review and approval by the Owner and Engineer before WORK begins.

3.0 RESPONSIBILITIES

A. The CONTRACTOR shall not commence demolition of structure(s) before written permission from the Engineer.

B. If the CONTRACTOR identifies hazardous conditions such as gases, fumes, compounds, or chemicals associated with demolition activities during the course of the demolition work, he shall immediately advise the Owner.

C. Condition of structures to be demolished:

- The Engineer and Owner assume no responsibility for actual condition of structures to be demolished.
- The Owner shall maintain conditions existing at the time of inspection for bidding purposes insofar as practicable.

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D. The CONTRACTOR shall remove foundations, piping, and structures to at least five (5) feet below the proposed and final subgrades (Phase II).

E. The use of explosives shall not be permitted. The CONTRACTOR may use non-explosive methods such as hydraulic or pneumatic hammers, or non-explosive, expanding agent, etc..

F. The Contractor shall provide supervision/management to plan, organize, and coordinate the performance of the work in a safe, efficient, and effective manner The Contractor shall conduct operations to avoid damage to adjacent structures and other facilities, and injury to persons.

G. The Contractor shall protect existing finish work that is to remain in place from damage due to demolition operations.

H. Traffic:

- The Contractor shall conduct operations and debris removal for minimal interference with existing access roads and other adjacent, occupied, or used facilities.
- The Contractor shall not close, block, or otherwise obstruct access roads or other occupied or used facilities without the Owner'S permission.

I. If the Contractor damages adjacent facilities, he shall immediately inform the Owner and shall be responsible for the cost of repairs as directed by the Owner.

J. Utilities disconnection:

- The Contractor shall coordinate location, disconnection, relocation, and/or protection as needed for existing underground, aboveground, and overhead utilities within the demolition limits before demolition operations. Expenses incurred for the coordination with utility companies and agencies shall be at no cost to the Engineer and/or Owner.

K. If the Contractor damages adjacent utilities, he shall immediately inform the Owner and shall be responsible for the cost of any related disruption and incidental costs as well as repairs.

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L. INSPECTION COORDINATION: The Contractor shall provide full-time access to the WORK for the Engineer as requested for inspection. The Contractor shall provide seventy-two (72) hours advance notice of its intention to begin new WORK activities.

4.0 EXECUTION

4.1 Demolition

- A. The Contractor shall provide services for effective air and water pollution controls as required by local jurisdictional authorities.
- B. The Contractor shall backfill below-grade areas and voids resulting from demolition work. The Contractor shall provide fill consisting of approved soil, gravel, or sand (with no trash and debris) and compact to 90 percent of the maximum dry density as determined by ASTM D1557.
- C. If hazardous substances or otherwise harmful materials are encountered during demolition operations, the Contractor shall notify the Engineer and the Owner immediately and comply with applicable regulations, laws, and ordinances regarding removal, handling, and protection against exposure or environmental pollution.

4.2 Disposal of Demolished Materials

- A. The Contractor shall transport materials removed from demolished structures to a loading area and load into trucks that are supplied and transported by others.
- B. Contractor shall reduce size of waste material to fit into trucks.
- C. Demolished materials shall include but not be limited to:
 - Plastic Pipes
 - Steel Pipes
 - Concrete structures
 - Rebar

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- Pavement
- HDPE pipes
- HDPE liner

4.3 Cleanup and Repair

- A. Upon completion of demolition WORK, the Contractor shall remove tools, equipment, and demolished materials from the demolition site location.
- B. The Contractor shall be responsible for costs of repair of demolition performed in excess of that required and costs for returning structures and surfaces to conditions existing before commencement of demolition WORK to the satisfaction of the Owner.
 - Contractor shall be responsible for costs associated with repair of adjacent construction or surfaces soiled or damaged by demolition WORK by a qualified contract to the satisfaction of the Owner.
 - The Contractor shall remove or modify, as indicated, existing construction within the construction limits to the extent required to permit WORK construction. The Contractor shall properly dispose of the material in accordance with this specification.

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1.0 GENERAL REQUIREMENTS

1.1 Scope

This specification defines the requirements for geomembrane materials, installation, and quality control associated with the Tampa Electric Company (TEC) (Owner) North and South Economizer Ash Pond Closure Project. The specifications set forth in this document cover the quality of materials and workmanship for geomembrane repair and construction. Specifically, the geomembrane on the south side of the South Economizer Ash Pond shall be cut, repaired, and reanchored as part of the project. The existing liner shall be preserved. New liner material shall be added only to the extent necessary to patch/replaced damaged areas. At such locations, the liner shall be repaired per Section 3.2.6, Repair Procedures.

Any alternatives or exceptions to this specification shall be submitted in writing to TEC and shall be approved by the Engineer.

1.2 Definitions

- “Owner” is defined as Tampa Electric Company (TEC) or any of its authorized representative(s)/agent(s).
- “Engineer” is defined as the Consultant or Engineering Company responsible for the detailed design or any of its authorized representative(s)/ agent(s).
- “Installer” is the party responsible for handling, transporting, storing, deploying, protecting, sampling, patching, and temporary restraining (against wind and thermal/solar expansion) of the geomembrane products at the construction site.
- “Manufacturer” is the party responsible for the production and quality of the geomembrane products.
- Lot is a group of consecutively numbered rolls from the same manufacturing line.
- “MARV” (Minimum Average Roll Value) is the minimum average value of a particular physical property of a material.

2.0 GEOMEMBRANE

Any new geomembrane used for the project shall match the existing geomembrane material or be an approval equal as designated on the Drawings.

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2.1 Manufacturer's Quality Control

The material shall be warranted against manufacturer's defects as well as degradation due to UV light for exposed areas for a minimum of 20 years from the date of installation or as mutually agreed prior to award of the contract for supply between the Owner and the geomembrane manufacturer. This warranty shall cover the cost of material, freight and duties, handling, labor, and equipment to replace the defective or failed material.

3.0 GEOMEMBRANE INSTALLATION

3.1 General

The geomembrane shall be installed on the areas shown on the Drawings or as specified by the Engineer.

Prior to deployment of geomembrane, the Installer shall inspect and accept, with the Engineer and the Owner, the existing liner and all surfaces on which the geomembrane is to be placed. The surface on which the geomembrane is to be installed shall be free of sharp particles, rocks, or other debris to the satisfaction of the Engineer, the Owner, and the Installer. Sharp objects shall be removed by raking, sweeping, or handpicking as necessary.

The Installer shall supply the Engineer with a liner conservation, reconfiguration, and replacement layout, showing areas of liner to be removed, areas to be preserved and replaced, methods of preservation, and areas of new liner materials with seaming, that must be approved by the Engineer prior to commencing the Work. It is the Installer's responsibility to submit timely proposals (allowing a minimum of three days for approval).

Installation of the geomembrane shall be performed under the direction of a field engineer or supervisor who has installed a minimum of 10,000,000 square feet (1,000,000 square meters) of flexible geomembrane material. The geomembrane shall be placed over the prepared surfaces using methods and procedures that ensure a minimum of handling. Temporary and permanent anchoring devices and ballasting shall be provided to prevent uplift and damage due to wind. The Installer is solely responsible for the safety of his operations including decisions regarding deployment in adverse weather conditions and the amount of temporary anchoring and ballasting required.

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To the extent possible, seams shall be oriented parallel to the slope of the ground. The panels shall be secured temporarily with sandbags or other approved ballasting method to hold them in place until the field seams have been completed and the geomembrane has been permanently anchored.

The Installer shall take into account that frequent high winds may result in delays. The Installer shall take all necessary measures to ensure that each panel is sufficiently ballasted to prevent damage or movement by wind. Fusion of panels and repairs will only be permitted under weather conditions allowing such work, and within the warranty limits of the Geomembrane Manufacturer, as approved by the Owner and the Engineer.

Horizontal field seams on slopes shall be kept to a minimum. Horizontal seams on steep slopes shall be avoided where possible by cutting the liner at a 45-degree angle. Generally, horizontal seams are to be no closer than 10-feet (3 meters) from the toe of the slope. Horizontal seams shall be made by lapping the uphill material over the downhill material. Panels shall be shingled in a manner that prevents water from running beneath the liner.

The geomembrane shall be installed in a relaxed condition and shall be free of tension or stress upon completion of the installation. The installed geomembrane shall contain sufficient slack material to allow for thermal expansion and contraction. Individual wrinkles should take the form of undulations in the liner but should not be large enough for the material to fold over itself.

During installation, the Installer shall give each field panel an "identification" code number consistent with the layout plan. The Engineer shall agree upon the numbering system. The Installer shall update the layout plan as each panel is installed to show the location of each panel. A field panel is defined as the area of geomembrane that is to be seamed in the field (roll or portion of a roll cut in the field).

Individual panels of geomembrane material shall be laid out in a pattern that will produce the least number of seams. The material shall be overlapped prior to welding. Extreme care shall be taken by the Installer in the preparation of the areas to be welded. The joint interface shall be cleaned and prepared according to procedures laid down by the material manufacturer and approved by the Engineer. Seaming shall not take place unless the panel is dry and clean. All sheeting shall be welded together by thermal methods.

Any area showing damage due to excessive scuffing, puncture, or distress from any cause shall be replaced or repaired with an additional piece of geomembrane. The cost of replacing or repairing the geomembrane shall be borne solely by the Installer.

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No “fish mouths” will be allowed within the seam area. Where “fish mouths” occur, the material shall be cut, overlapped, and an overlap extrusion weld applied.

Geomembrane panels must have a finished overlap of four to six-inches (100 to 150-mm) for double-wedge welding seams and minimum six-inches (150mm) for extrusion welding seams. Notwithstanding this provision, sufficient overlap shall be provided to allow peel tests to be performed on any seam.

Handling and storage of the geomembrane material shall be in accordance with the manufacturer’s printed instructions. Persons walking or working on the geomembrane shall not engage in activities or wear shoes that could damage the geomembrane.

An adequate number of handling equipment, welding apparatuses, and test equipment shall be maintained on site to avoid delays due to problems with equipment failures.

3.2 Geomembrane Installation Quality Control

3.2.1 General

The Installer shall submit a copy of his Quality Control Manual to the Engineer through the Owner prior to the start of installation of any geomembrane. If there are discrepancies between this specification and the Installer’s Quality Control Manual, the more stringent requirements will apply unless determined otherwise by the Engineer.

The Installer shall be fully responsible for carrying out all quality control tests on the geomembrane and shall do so to the satisfaction of the Engineer and in accordance with this Specification and the Installer’s Quality Control Manual. On-site physical nondestructive and destructive testing shall be completed on all joints to ensure that watertight uniform seams are achieved on a continuous basis as installation proceeds. At the time of bid submission, details shall be provided by the Installer that set forth the method proposed for both destructive and nondestructive testing of seams. The Engineer shall approve these methods prior to the Installer commencing the Work. Visual inspection alone is unacceptable.

Fusion of panels and repairs will only be permitted under weather conditions allowing work that is in conformance to the Specifications and within the warranty limits imposed by the manufacturer and to the approval of the Engineer.

At a minimum, the Installer’s field installation test program shall consist of periodic visual observations and continuity and strength tests as defined in the following subsections.

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3.2.2 Trial Welds

Trial welds shall be completed to verify the performance of the welding equipment and operator prior to performing production welds. No welding equipment or operator shall perform production welds until equipment and operator have successfully completed a trial weld. The following procedures shall be followed for trial welds:

- Make trial welds under the same surface and environmental conditions as the production welds, i.e., in contact with subgrade and similar ambient temperature.
- Minimum of two trial welds per day per welding apparatus—one made prior to the start of work and one completed at mid-shift or for every five hours of seaming operations.
- Cut seven one-inch-wide-by-six-inch-long (25-mm-wide-by-150-mm-long) test strips from the trial weld. Five of the test strips shall be tested for shear strength and five of the test strips shall be tested for peel (both sides of weld).
 - Label the area where the trial welds were removed and record it by sample number and location on the panel layout.
- Quantitatively test specimens for peel adhesion and then for bonded seam strength (shear).
- Trial weld specimens shall pass when the results shown in Table 3 are achieved in both peel and shear tests and:
 - The break, when peel testing, occurs by Separation in the Plane of the sheet (SIP), not through adhesion failure separation (AD) regardless of whether the peel test results in a passing test value.
 - The break is ductile.
- Repeat the trial weld, in its entirety, when the trial weld samples fail in either peel or shear as defined on Table 3.

3.2.3 Field Seaming

The Contractor shall have at least one master welder who will provide direct supervision over other welders as necessary.

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- The welding equipment shall be capable of continuously monitoring and controlling the temperatures in the zone of contact where the machine is actually fusing the material to ensure changes in environmental conditions will not affect the integrity of the weld.
- The seam area shall be cleaned of dust, mud, moisture, and debris immediately ahead of the welding apparatus.
- The seam overlaps shall be aligned consistent with the requirements of the welding equipment being used. A four to six-inch (100 to 150-mm) overlap shall be used for double wedge welded seams and six-inches (150-mm) for extrusion welded seams unless approved otherwise by the Engineer.
- Seaming shall not proceed when the ambient air temperature or adverse weather conditions jeopardize the integrity of the geomembrane installation.
- Extrusion welding apparatus shall be purged of heat-degraded extrudate before welding.
- The double-wedge fusion welding process shall be used unless alternate methods are approved by the Engineer. Extrusion welding will be permitted to weld short seams, to repair small areas, where double-wedge welding is not feasible, and where test samples have been removed.

3.2.4 Field Seam and Panel Inspection and Testing

3.2.4.1 Nondestructive Testing and Inspection

The Installer shall perform visual inspections of deployed and welded HDPE panels to identify defects, damage, or protrusion of sharp objects that may affect the integrity of the geomembrane. Defective or damaged areas will be marked and repaired according to the Technical Specifications and the guidelines in the Installer's Quality Control Manual.

A quality control technician or field engineer acting for the Installer shall inspect each seam, marking his initials and date inspected at the end of each panel. Any area showing a defect shall be marked and repaired in accordance with the applicable repair procedures.

3.2.4.2 Continuity Testing

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A maximum effort shall be made to install a perfect geomembrane liner. This implies that all seams completed in the field, patches, and extrusions shall be tested and recorded. All failures shall be isolated and repaired as directed by the Engineer. A general testing procedure is included as follows:

- Test all field seams and patches with interseam pressure, vacuum box, spark tester, or other approved methods. Pressure and vacuum testing are discussed in following subsections.
- Isolate and repair all areas indicating any leakage. Retest the repair.

Interseam Pressure Testing. Test procedure for interseam pressure for seams (for double-wedge welding only):

- Seal both ends of the seam to be tested by applying heat to the end of the seam via a heat gun until flow temperature is achieved. Clamp off the ends and let cool.
- Insert a pressure gauge/needle assembly into the end of the seam and seal.
- Pressurize the air channel between the two seams to between 30 and 35-psi (207 and 241 kPa). Following pressure stabilization, take the initial pressure reading, hold the pressure a minimum of five minutes, and take a second reading.
- The allowable leak down for the seam is three-psi (21 kPa).
- If the pressure does not drop below the maximum allowable three-psi (21 kPa), open the air channel at the end away from the pressure gauge. Air should rush out and the pressure gauge should register an immediate drop in pressure, indicating that the entire length of seam has been tested. If this does not happen, either the air channel is blocked or the equipment is faulty, and the test is not valid.
- Enter the results of the leak test on the appropriate document, indicating either a passed or a failed seam. If the seam fails, the repair work and subsequent testing should be recorded on the same document.
- Repair the area where the pressure gauge/needle assembly was installed and where the air was released.

Vacuum-Box Testing. The proposed test procedures are as follows in accordance with ASTM D 5641:

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- Mix a solution of liquid detergent and water and apply an ample amount to the area to be tested. If a seam contains excess overlap or loose edges, it must be trimmed before testing.
- Place a translucent vacuum box over the area and apply a slight amount of downward pressure to the box to seat the seal strip to the liner.
- Apply a vacuum of 3 to 5 psi (21 to 34 kPa) to the area to create a seal and then hold for a duration not less than ten seconds. Any leaks will become visible by large bubbles.
- The adjoining portion of the seam or test area overlapping the previously test area shall be a distance no less than 10% of the minimum chamber length or at least 2 inches
- Enter the results of the leak test on the appropriate document, indicating either a passed or a failed seam. If the seam fails, the repair work and subsequent testing should be recorded on the same document.

Spark Testing. Extrusion welded patches, pipe penetrations, cap, etc., may be “spark” tested in accordance with ASTM D6365 if vacuum or pressure testing methods are not possible. The basic procedures for spark testing are as follows:

- The seam shall be prepared for extrusion welding in accordance with the installer’s procedures.
- Just prior to applying the extrusion bead, a small-gauge copper wire is placed into the seam. An 18-gauge bare copper wire usually works well. The wire should be grounded at one end and placed at the edge of the top sheet of the overlap seam. Tucking the wire under the edge of the top sheet will help hold the wire in place during welding, but this should be done prior to grinding to avoid the risk of contamination of the weld area.
- Apply the extrudate bead as normal, and allow the weld to cool.
- Energize the spark tester, and move the electrode wand near a grounding source to determine the maximum length of spark that can be generated. Adjust the output voltage setting until the spark length exceeds the greatest potential leak path distance. This is typically the diagonal distance from the embedded wire to the edge of the weld bead at a “T” joint.
- Once the output voltage has been set, testing may be started. Testing is performed by passing the electrode over the seams with the electrode in contact with the membrane and/or the

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extruded weld bead. The audible and visual indication of a spark provides the determination of a potential leak path.

- If a potential leak is detected, the area can be repaired by grinding and re-welding. Applying additional weld beads adjacent to the leaking weld is not an acceptable repair technique. This will only lengthen the leak path to the extent that the spark tester may not be capable of generating a spark of sufficient length to breach the lengthened gap.
- After grinding and re-welding, the seam must be retested. If there is still an indication of a potential leak (spark), it may be required to apply a patch over the entire area.

3.2.4.3 Destructive Testing

Peel and shear seam strength testing shall be carried out on samples of seams removed from the installed panels. For these tests, the following procedures shall be followed:

- Coupon sampling of all field seams, including patches and repair areas, shall be taken by cutting perpendicular to the seams a sample approximately 36 by 12-inches (900 by 300-mm). This sample shall be cut into three-twelve-by-twelve-inch (300-by-300-mm) samples and labeled with the date, sample number, and location, and individually marked "Owner Sample," "QA/QC Sample," and "Lab QA/QC Sample." The frequency and location shall be determined by the Engineer but shall not be less than one sample per 500-feet (150-meters) of field seams. These coupons shall be tested on site for peel and shear seam strength and thickness in accordance with D6392.
- Heat-welded seams shall be allowed to cool or warm to near ambient air temperature prior to testing. Additionally, at the Engineer's option, approximately ten percent of the coupons (size one by six-inches) shall be sent to an independent laboratory for confirmation testing. Should the lab and field tests conflict, installation shall halt until the conflict is resolved to the satisfaction of the Engineer.
- Cut ten one-inch-wide-by-six-inch-long (25-mm-wide-by-150-mm-long) test strips from the destructive test sample. Five of the test strips shall be tested for shear strength and five of the test strips shall be tested for peel (both sides of weld).
- Quantitatively test specimens for peel adhesion and then for bonded seam strength (shear).

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- Destructive test specimens shall pass when the results shown in Table 3 are achieved in both peel and shear tests and:
 - The break, when peel testing, occurs by Separation in the Plane of the sheet (SIP), not through adhesion failure separation (AD) regardless of whether the peel test results in a passing test value.
 - The break is ductile.

The Engineer will continuously inspect the installation of the HDPE liner to ensure that the procedures specified in this section are adhered to fully.

In the event of a failing test result, the following procedures shall be used:

- The Installer shall follow one of two options:
 - Reconstruct the seam between any two passed test locations, or
 - Trace the weld to an intermediate location at least ten-feet or to where the seam ends in both directions from the location of the failed test. Once the failing limits of the seam are isolated, that portion of the seam shall be reconstructed or capped.

Seams welded prior to and after the failed seam using the same welding device and/or operator shall be tested.

3.2.5 Repair Procedures

Damaged or defective geomembrane or seam areas failing a destructive or non-destructive test including bulges in the liner shall be repaired. The Installer shall be responsible for repair of damaged or defective areas. The repair method shall be decided by the Installer but must be agreed upon by the Engineer. Procedures available include the following:

- **Replacement:** Remove damaged geomembrane or unacceptable seam and replace with acceptable geomembrane materials if damage cannot be satisfactorily repaired.
- **Patching:** Used to repair large holes, tears, undispersed raw materials, bulges, and contamination by foreign matter.

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- Abrading and Re-Welding: Used to repair small seam sections.
- Capping: Used to repair large lengths of failed seams.
- Flap welding is not an acceptable repair method for failed seam lengths.

In addition, the following procedures shall be observed:

- The damaged liner area to be removed for bulges shall extend at least 12 inches beyond the bulge perimeter. Liner shall be cut cleanly with the appropriate tool.
- Surfaces of the polyethylene that are to be repaired by extrusion welds shall be lightly abraded to ensure cleanliness.
- All geomembrane shall be clean and dry at the time of repair.
- Extend patches or caps at least six-inches (150-mm) for extrusion weld and four- inches (100-mm) for wedge weld beyond the edge of the defect, and round corner of patch material. The edges of all patches are to be beveled.

Furthermore, repair verification shall be performed as follows:

- Number and log each patch repair.
- Non-destructively test each repair using methods specified in this Specification.

3.3 Certification

At the completion of the geomembrane installation, the Installer shall provide the Owner with a certification stating that the geomembrane was installed and tested in accordance with the Specifications together with a report of the test results. The certification shall be provided to the Owner prior to the demobilization of the installation personnel from the site unless agreed otherwise by the Owner. The report of the test results shall be provided in hard copy and digital format to the Owner and the Engineer not later than 30-days after the installation work has been completed.

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3.4 Completion

At the completion of the installation, the Installer shall provide a set of as-built drawings showing the actual geomembrane panel layout, seams, location of destructive test samples, and the location of major repairs including repaired seams and capped areas. The as-built panel layout must be submitted in hard copy and digital format to the Owner and the Engineer not later than 30-days after the installation work has been completed.

3.5 Verification

On the completion of the installation of the Gyp Liner cover over the geomembrane or substantial completed portions thereof, the Contractor shall conduct an Electrical Leak Location (ELL) survey over entire are of the installed geomembrane in accordance with Dipole Method (ASTM D7007) or an approved alternative. Any holes or damage identified by the ELL shall be uncovered, investigated and repaired in accordance with procedures described above. A survey report shall be provided by the ELL contractor along with a list of subsequent repairs and QA/QC approvals to the Engineer.

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TABLE 1 – HIGH DENSITY POLYETHYLENE (HDPE) GEOMEMBRANE -SMOOTH (ENGLISH UNITS)

Properties	Test Method	Test							Testing Frequency (minimum)
		30 mils	40 mils	50 mils	60 mils	80 mils	100 mils	120 mils	
Thickness (min. ave)	D5199	nom.	nom.	nom.	nom.	nom.	nom.	nom.	Per roll
• lowest individual of 10 values		-10%	-10%	-10%	-10%	-10%	-10%	-10%	
Formulated Density mg/l (min.)	D 1505/D 792	0.940 g/cc	0.940 g/cc	0.940 g/cc	0.940 g/cc	0.940 g/cc	0.940 g/cc	0.940 g/cc	200,000 lb
Tensile Properties (1) (min. ave)	D 6693 Type IV	63 lb/in. 114 lb/in.	84 lb/in. 152 lb/in.	105 lb/in. 190 lb/in.	126 lb/in. 228 lb/in.	168 lb/in. 304 lb/in.	210 lb/in. 380 lb/in.	252 lb/in. 456 lb/in.	20,000 lb
• yield strength		12%	12%	12%	12%	12%	12%	12%	
• yield elongation		700%	700%	700%	700%	700%	700%	700%	
• break strength									
• break elongation									
Tear Resistance (min. ave)	D 1004	21 lb	28 lb	35 lb	42 lb	56 lb	70 lb	84 lb	45,000 lb
Puncture Resistance (min. ave)	D 4833	54 lb	72 lb	90 lb	108 lb	144 lb	180 lb	216 lb	45,000 lb
Stress Crack Resistance (2)	D5397 (App.)	500 hr.	500 hr.	500 hr.	500 hr.	500 hr.	500 hr.	500 hr.	per GRI-GM10
Carbon Black Content (range)	D 4218 (3)	2.0-3.0%	2.0-3.0%	2.0-3.0%	2.0-3.0%	2.0-3.0%	2.0-3.0%	2.0-3.0%	20,000 lb
Carbon Black Dispersion	D 5596	note (4)	note (4)	note (4)	note (4)	note (4)	note (4)	note (4)	45,000 lb
Oxidative Induction Time (OIT) (min. ave) (5)									200,000 lb
(a) Standard OIT	D 3895	100 min.	100 min.	100 min.	100 min.	100 min.	100 min.	100 min.	
— or —									
(b) High Pressure OIT	D 5885	400 min.	400 min.	400 min.	400 min.	400 min.	400 min.	400 min.	
Oven Aging at 85°C (5), (6)									
(a) Standard OIT (min. ave) - % retained after 90 days	D 5721 D 3895	55%	55%	55%	55%	55%	55%	55%	per each formulation
— or —									
(b) High Pressure OIT (min. ave) - % retained after 90 days	D 5885	80%	80%	80%	80%	80%	80%	80%	
UV Resistance (7)									
(a) Standard OIT (min. ave)	D 7238 D 3895	N.R. (8)	N.R. (8)	N.R. (8)	N.R. (8)	N.R. (8)	N.R. (8)	N.R. (8)	per each formulation
— or —									
(b) High Pressure OIT (min. ave) - % retained after 1600 hrs (9)	D 5885	50%	50%	50%	50%	50%	50%	50%	

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Water Vapor Transmission	E96 BW	<0.24 g/m ² /day	200,000 lb
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- (1) Machine direction (MD) and cross machine direction (XMD) average values should be on the basis of 5 test specimens each direction.
 Yield elongation is calculated using a gage length of 1.3 inches
 Break elongation is calculated using a gage length of 2.0 in.
- (2) The yield stress used to calculate the applied load for the SP-NCTL test should be the manufacturer's mean value via MQC testing.
- (3) Other methods such as D 1603 (tube furnace) or D 6370 (TGA) are acceptable if an appropriate correlation to D 4218 (muffle furnace) can be established.
- (4) Carbon black dispersion (only near spherical agglomerates) for 10 different views:
 9 in Categories 1 or 2 and 1 in Category 3
- (5) The manufacturer has the option to select either one of the OIT methods listed to evaluate the antioxidant content in the geomembrane.
- (6) It is also recommended to evaluate samples at 30 and 60 days to compare with the 90-day response.
- (7) The condition of the test should be 20 hr. UV cycle at 75°C followed by 4 hr. condensation at 60°C.
- (8) Not recommended since the high temperature of the Std-OIT test produces an unrealistic result for some of the antioxidants in the UV exposed samples.
- (9) UV resistance is based on percent retained value regardless of the original HP-OIT value.

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TABLE 2 – HIGH DENSITY POLYETHYLENE (HDPE) GEOMEMBRANE - TEXTURED (ENGLISH UNITS)

Properties	Test Method	Test Value							Testing Frequency (minimum)
		30 mils	40 mils	50 mils	60 mils	80 mils	100 mils	120 mils	
Thickness mils (min. ave) • lowest individual for 8 out of 10 values • lowest individual for any of the 10	D 5994	nom. (-5%) -10% -15%	nom. (-5%) -10% -15%	nom. (-5%) -10% -15%	nom. (-5%) -10% -15%	nom. (-5%) -10% -15%	nom. (-5%) -10% -15%	nom. (-5%) -10% -15%	per roll
Asperity Height mils (min. ave)	D 7466	16 mil	16 mil	16 mil	16 mil	16 mil	16 mil	16 mil	every 2 nd roll (1)
Formulated Density (min. ave)	D 1505/D 792	0.940 g/cc	0.940 g/cc	0.940 g/cc	0.940 g/cc	0.940 g/cc	0.940 g/cc	0.940 g/cc	200,000 lb
Tensile Properties (min. ave) (2) • yield strength • break strength • yield elongation • break elongation	D 6693 Type IV	63 lb/in. 45 lb/in. 12% 100%	84 lb/in. 60 lb/in. 12% 100%	105 lb/in. 75 lb/in. 12% 100%	126 lb/in. 90 lb/in. 12% 100%	168 lb/in. 120 lb/in. 12% 100%	210 lb/in. 150 lb/in. 12% 100%	252 lb/in. 180 lb/in. 12% 100%	20,000 lb
Tear Resistance (min. ave)	D 1004	21 lb	28 lb	35 lb	42 lb	56 lb	70 lb	84 lb	45,000 lb
Puncture Resistance (min. ave)	D 4833	45 lb	60 lb	75 lb	90 lb	120 lb	150 lb	180 lb	45,000 lb
Stress Crack Resistance (3)	D 5397 (App.)	500 hr.	500 hr.	500 hr.	500 hr.	500 hr.	500 hr.	500 hr.	per GRI GM10
Carbon Black Content (range)	D 4218 (4)	2.0-3.0 %	2.0-3.0 %	2.0-3.0 %	2.0-3.0 %	2.0-3.0 %	2.0-3.0 %	2.0-3.0 %	20,000 lb
Carbon Black Dispersion	D 5596	note (5)	note (5)	note (5)	note (5)	note (5)	note (5)	note (5)	45,000 lb
Oxidative Induction Time (OIT) (min. ave) (6) (a) Standard OIT — or — (b) High Pressure OIT	D 3895 D 5885	100 min. 400 min.	100 min. 400 min.	100 min. 400 min.	100 min. 400 min.	100 min. 400 min.	100 min. 400 min.	100 min. 400 min.	200,000 lb
Oven Aging at 85°C (6), (7) (a) Standard OIT (min. ave) - % retained after 90 days — or — (b) High Pressure OIT (min. ave) - % retained after 90 days	D 5721 D 3895 D 5885	55% 80%	55% 80%	55% 80%	55% 80%	55% 80%	55% 80%	55% 80%	per each formulation
UV Resistance (8) (a) Standard OIT (min. ave) — or — (b) High Pressure OIT (min. ave) - % retained after 1600 hrs (10)	D 7238 D 3895 D 5885	N.R. (9) 50%	N.R. (9) 50%	N.R. (9) 50%	N.R. (9) 50%	N.R. (9) 50%	N.R. (9) 50%	N.R. (9) 50%	per each formulation

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Water Vapor Transmission	E96 BW	<0.24 g/m ² /day	200,000 lb
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- (1) Alternate the measurement side for double sided textured sheet
- (2) Machine direction (MD) and cross machine direction (XMD) average values should be on the basis of 5 test specimens each direction.
Yield elongation is calculated using a gage length of 1.3 inches
Break elongation is calculated using a gage length of 2.0 inches
- (3) SP-NCTL per ASTM D5397 Appendix, is not appropriate for testing geomembranes with textured or irregular rough surfaces. Test should be conducted on smooth edges of textured rolls or on smooth sheets made from the same formulation as being used for the textured sheet materials.
The yield stress used to calculate the applied load for the SP-NCTL test should be the manufacturer's mean value via MQC testing.
- (4) Other methods such as D 1603 (tube furnace) or D 6370 (TGA) are acceptable if an appropriate correlation to D 4218 (muffle furnace) can be established.
- (5) Carbon black dispersion (only near spherical agglomerates) for 10 different views:
9 in Categories 1 or 2 and 1 in Category 3
- (6) The manufacturer has the option to select either one of the OIT methods listed to evaluate the antioxidant content in the geomembrane.
- (7) It is also recommended to evaluate samples at 30 and 0 days to compare with the 90-day response.
- (8) The condition of the test should be 20 hr. UV cycle at 75° C followed by 4 hr. condensation at 60°C.
- (9) Not recommended since the high temperature of the Std-OIT test produces an unrealistic result for some of the antioxidants in the UV exposed samples.
- (10) UV resistance is based on percent retained value regardless of the original HP-OIT value.

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TABLE 3 – SEAM STRENGTH AND RELATED PROPERTIES OF THERMALLY BONDED SMOOTH AND TEXTURED HIGH DENSITY POLYETHYLENE (HDPE) GEOMEMBRANES (ENGLISH UNITS)

Geomembrane Nominal Thickness	30 mils	40 mils	50 mils	60 mils	80 mils	100 mils	120 mils
Hot Wedge Seams ⁽²⁾							
shear strength, lb/in.	57	80	100	120	160	200	240
shear elongation at break ⁽²⁾ , %	50	50	50	50	50	50	50
peel strength, lb/in.	45	60	76	91	121	151	181
peel separation, %	25	25	25	25	25	25	25
Extrusion Fillet Seams							
shear strength, lb/in.	57	80	100	120	160	200	240
shear elongation at break ⁽²⁾ , %	50	50	50	50	50	50	50
peel strength, lb/in.	39	52	65	78	104	130	156
peel separation, %	25	25	25	25	25	25	25

Notes:

1. Also for hot air and ultrasonic seaming methods
2. Elongation measurements should be omitted for field testing

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REV	DATE	APPROVALS			PAGES	REMARKS
		DESIGN MANAGER	PROJECT MANAGER	ORIGINATOR		
A	03/01/2019	TEA	TEA	TEA	8	Draft Submittal

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1.0 GENERAL

This specification defines the requirements for the grassing activities associated with the Tampa Electric Company (TEC) (Owner) Economizer Ash and Pyrites Pond System (EAPPS) Closure Project.

The work covered by this section consists of furnishing all the necessary equipment, materials and labor associated with the establishment and maintenance of grass in all areas as specified herein and in the drawings. These include, but are not limited to seeding, mulching and fertilizing newly grassed areas and maintenance.

Any alternatives or exceptions to this specification shall be submitted in writing to TEC or its designated representative and shall be approved by the engineer.

1.1 Definition of Terms

- “Owner” is defined as Tampa Electric Company (TEC) or any of its authorized representative(s)/agent(s).
- “Engineer” is defined as the Consultant or Engineering Company responsible for the detailed design or any of its authorized representative(s)/ agent(s).
- “Contractor” is defined as the party(s) that has executed the contract agreement for the specified Work with the Owner or its authorized representative(s)/agent(s).
- “Specifications” are defined as this document, all supplemental addenda, and any modifications furnished by the Owner, the Engineer, or others that apply to the Work.
- “Drawings” are defined as the Drawings for the EAPPS Closure Project furnished by the Owner, Engineer, or others that apply to the Work.
- “Site” is defined as the EAPPS project area designated by the Owner and where the Work is to be completed as described in these Technical Specifications and detailed on the Drawings.
- “CCR” is defined as the accumulated material placed in the North and South Economizer Ash Ponds. The material is typically observed as black or gray, low plasticity or non-plastic, sand, gravel, or silt sized material.
- “Contract” is defined as the document executed by the Owner or its authorized representative(s)/agent(s) with the Contractor to complete specified portions of the Work.
- “Work” is defined as the entire completed construction or the various separately identifiable parts thereof required to be furnished as shown on the Drawings and as described in the Specifications and Contract Documents.
- “Modifications” are defined as changes made to the Specifications or the Drawings that are approved by Owner and Engineer in writing, after the Specifications and Drawings have been issued for construction. These also refer to changes to design elements in the field to account for unforeseen conditions.

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- “Units” – In general, these Specifications and the Drawings will utilize English units, however metric units will be used when appropriate.
- “NEAP” – North Economizer Ash Pond
- “SEAP” – South Economizer Ash Pond
- “LTFAP” – Long Term Fly Ash Pond
- “EASP” – Economizer Ash Suction Pond

2.0 SUBMITTALS

2.1 Certificates

Seed and fertilizer shall be certified that they meet requirements of these specifications, stating botanical name, percentage by weight, percentage of purity, germination, and weed seed for each grass seed species.

3.0 WARRANTY

The CONTRACTOR shall warrant the WORK against defects for one (1) year from the date of Substantial Completion and as described in the contract documents.

4.0 MATERIALS

4.1 Grass Seed

- A. Provide fresh, clean, new crop seed complying with tolerance for purity and germination established by Official Seed Analysts of North America and as required below.
- B. Seed shall be labeled according to the U.S. Department of Agriculture Federal Seed Act and shall be furnished in containers with tags showing seed mixture, purity, germination, weed content, name of seller, and date on which seed was tested.

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1. Seed Mixtures: Meet the following minimum weight of pure live seed per acre:

Seed Name	Pounds Pure Live Seed
Argentine Bahia	41
Bermudagrass	14
Brown Top Millet	21

NOTE: Pure live seed (PLS) is determined by multiplying the % pure seed by the % germination. Therefore, if the pure seed is 80% and the germination is 70% the PLS is .80 X .70 or 56%. At 56% it would take 53.5 pounds to equal 30 pounds of PLS.

- 2.
3. Moldy seed or seed that has been damaged in storage will not be accepted.
4. When seasonal conditions mandate, substitute a winter grass such as rye grass for the brown top millet.

4.2 Fertilizer

- A. Commercial fertilizer shall be Ammonium Sulfate (21-0-0-24S) containing 21 percent nitrogen and 24 percent sulfur. Fertilizer containing phosphorus is not acceptable.
- B. Deliver to site in unopened, labeled bags or containers.

4.3 Mulch

- A. Vegetative Anti-Erosion Mulch: Seed free, salt hay, rye or oats, or of pangola, peanut, coastal Bermuda or Bahia grass hay.
- B. Only undeteriorated mulch that can readily be cut into the soil shall be used.
- C. Green mulch will not be accepted.

5.0 EXECUTION

5.1 Soil Preparation

- A. Any growth, rocks, or other obstructions which might interfere with tilling, seeding, or later maintenance operations shall be removed and disposed of properly. Remove stones over two (2) inches in any dimension and sticks, roots, rubbish and other extraneous matter.

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- B. Areas to be seeded are to be graded to a smooth, even surface with loose, uniformly fine texture. Roll and rake, remove ridges and fill depressions, to meet finish grades. Limit fine grading to areas which can be planted within immediate future.
- C. Moisten prepared areas before planting if soil is dry. Water thoroughly and allow surface to dry before planting.
- D. If prepared areas are eroded or otherwise disturbed after fine grading and prior to planting they shall be restored to specified condition prior to planting.
- E. Immediately upon completion of construction, grass shall be planted in all disturbed areas and as designated in the drawings. Method of planting shall be either hydroseeding or dry seeding.

5.2 Fertilizing

- A. Apply fertilizer in accordance with MANUFACTURER's recommendations.
- B. Incorporate fertilizer into the soil to a depth of at least two (2) inches by discing, harrowing or raking, except on slopes steeper than two (2) horizontal to one (1) vertical.

5.3 Seeding

- A. Do not use wet seed or seed that is moldy or otherwise damaged in transit or storage.
- B. Do not seed when wind velocity exceeds five (5) miles per hour. Distribute seed evenly over entire area by sowing equal quantity in two directions at right angles to each other.
- C. Sow not less than a rate of 76 pounds of pure live seed per acre.
- D. Rake seed lightly into top 1/8-inch of soil, roll lightly, and water with fine spray.
- E. Methods of Application:
- F. Dry Seeding: Spreader or seeding machine.

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5.4 Mulching

- A. Apply a mulch covering to all seeded areas.
- B. Apply vegetative mulch to loose depth of two (2) inches, by means of a mechanical spreader or other approved methods.
- C. Mulch material shall be cut into the soil so as to produce a loose-mulched thickness of three to four inches. The use of harrows will not be permitted.
- D. Immediately following the application of the mulch, water the seeded area in one watering, in sufficient amount to penetrate the seedbed to a minimum depth of two (2) inches. Perform so as not to cause erosion or damage to the seeded surface.
- E. Protect seeded areas against hot, dry weather or drying winds by applying mulch not more than 24 hours after completion of seeding operations.

5.5 Maintenance

- A. Perform maintenance until eight (8) weeks after all areas have been seeded.
- B. Requirements:
 - 1. The CONTRACTOR shall water all newly grassed areas a minimum of once a week until satisfactory grass growth is attained.
 - 2. Repair any portion of the seeded surface which becomes gullied or otherwise damaged, or the seeding becomes damaged or destroyed.
 - 3. Replace mulch when washed or blown away.
- C. If, at the end of the 8-week maintenance period, a satisfactory stand of grass has not been produced, renovate and reseed the grass or unsatisfactory portions thereof immediately.

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5.6 Acceptance of Grassing

- A. When grassing work is substantially completed, including maintenance, the Owner will, upon request, make an inspection to determine acceptability.
 - 1. Seeded areas may be inspected for acceptance in parts agreeable to the Owner, provided WORK offered for inspection is complete, including maintenance.

- B. Replant rejected WORK and continue specified maintenance until reinspected by the Owner and found to be acceptable.
 - 1. A satisfactory stand is defined as a grass or section of grass that has:
 - a. No bare spots larger than three (3) square feet.
 - b. Not more than five (5) percent of total area with bare spots larger than six (6) inches.
 - c. Not more than ten (10) percent of total area with bare spots larger than two (2) inches square.
 - 2. If the grassing is still unsatisfactory upon inspection of replanted area, the CONTRACTOR shall sod those areas that are unacceptable. Acceptance of the sodded areas is dependent upon satisfactory coverage criteria established in these specifications.