

**Technical Specifications and
Construction Quality Assurance Plan for
Closure of Cell 1 of
Combustion Waste Storage Area**

**Orlando Utilities Commission
Stanton Energy Center
Orange County, Florida**



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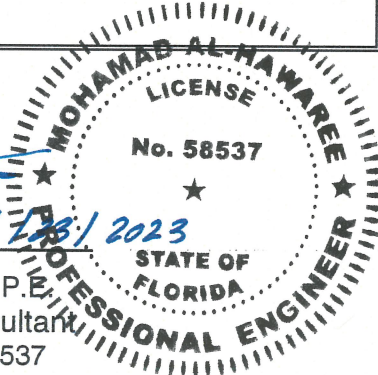


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SPECIFICATIONS

**SECTION 1
LIST OF SPECIFICATION SECTIONS**

CLOSURE OF CELL 1 OF COMBUSTION WASTE STORAGE AREA

**ORLANDO UTILITIES COMMISSION
STANTON ENERGY CENTER
ORANGE COUNTY, FLORIDA**

Section	Title
1	List of Specification Sections
2	Intent
3	List of Drawings
4	Contractor's Understanding, Description of Work, Definitions, and General Conditions
5	Site Preparation and Earthwork Construction
6	HDPE Liner Materials for Final Cover System
7	HDPE Liner Installation for Final Cover System
8	Geocomposites for Final Cover System
9	Protective Soil Cover for Final Cover System
10	Pressure-Rated HDPE Pipe and Fittings
11	Geotextile
12	Aggregates
13	Concrete Uniform Section Mat
14	Sodding
15	Site Limitations
16	General Provisions
17	Final Inspection and Acceptance
18	Scheduling and Coordination
19	Information Required for Bid

SPECIFICATIONS

SECTION 2 INTENT

CLOSURE OF CELL 1 OF COMBUSTION WASTE STORAGE AREA

ORLANDO UTILITIES COMMISSION STANTON ENERGY CENTER ORANGE COUNTY, FLORIDA

These specifications present the minimum standards for providing the required materials and construction quality to ensure proper construction for final closure of approximately 31 acres of the top area, the south slope, and the west slope of Cell 1 located in the approximately 250-acre Combustion Waste Storage Area (CWSA) at the Orlando Utilities Commission (OUC) Stanton Energy Center (SEC) in Orange County, Florida. They also specify the construction, field inspection, sampling, quality control/quality assurance testing, and maintenance procedures associated with site preparation, excavation and grading, placement of soil bedding layer above the waste material, geomembrane liner installation, geosynthetic drainage system installation, placement of liner protective/drainage layer, and all other works associated with the proposed closure construction.

Responsibilities of the parties involved and the minimum qualifications of each party to fulfill their responsibilities are included in these specifications. During the construction work, the following documents should be referred to: (i) technical specifications (Specifications), (ii) construction drawings (Drawings), (iii) applicable manufacturer's quality control/assurance manuals, (iv) Contractor's quality control plan, (v) applicable Florida Department of Environmental Protection (FDEP) regulations, (vi) applicable Occupational Safety and Health Administration (OSHA) safety regulations and OUC safety policy; and (vii) applicable ASTM International (ASTM) and Florida Department of Transportation (FDOT) standards.

The work covered by these specifications includes construction of the final closure cover system for the top area, the south slope, and the west slope of Cell 1, with a combined area of approximately 31 acres. Cell 1 was used by OUC for disposal of: (i) fixated flue gas desulfurization (FGD) sludge, often referred to as ProMat; (ii) bottom ash; (iii) brine solids; (iv) plant generated construction and demolition debris; and (v) miscellaneous wastes consisting of FGD recirculation tank sludge, scrubber sludge blowdown, cooling tower sludge, stack cleanout residue, scrubber residuals, waste coal, coal pulverizer rejects, lined pond cleanouts, soils that have contacted process water, and various power plant sump cleanouts.

The proposed construction will involve installation of a closure cover system over approximately 31 acres of Cell 1. The closure cover system will be placed over the top area, the south slope, and the west slope of Cell 1, and secured inside the anchor trench of the bottom liner system for Cell 1. It was designed to have the following key components in descending order:

- A sod cover for erosion protection.

- A minimum 2-foot thick drainage and protective soil layer for stormwater drainage and liner protection.
- A double-sided HDPE geocomposite connected to the gravel drain system for stormwater infiltration drainage and protective soil layer stability on the slope area.
- A 60-mil textured HPDE liner for infiltration control.
- A minimum 6-inch thick soil bedding layer for liner protection and support.

The work consists of furnishing all labor, materials, plant, equipment, tools, supervisory personnel, and Contractor's facilities to undertake the construction for closure of Cell 1 and associated stormwater drainage system to the lines, grades, and dimensions shown on the Drawings and in accordance with the Specifications. The work shall include the following major tasks:

- Clearing, stripping, grubbing, excavating, surface dewatering, borrowing, moisture conditioning, hauling, placing, grading, and compacting soils to achieve the liner design grades within the designated construction area.
- Excavating any incidental waste materials that occur at less than 6 inches below the liner design grades and transporting them to Cell 2 for disposal, at locations designated by the Owner.
- Supplying, placing, and compacting suitable fill materials to the lines, grades, and dimensions shown on the Drawings to provide a compacted soil bedding layer for placement of the closure liner system.
- Fine grading and maintaining the surface of the soil bedding layer for placement of the HDPE liner.
- Supplying all materials and installing approximately 31 acres of a 60-mil thick textured HDPE liner to the lines and grades shown on the Drawings, including all required ancillary work items.
- Supplying all materials and installing approximately 31 acres of a double-sided HDPE geocomposite to the lines and grades shown on the Drawings, including all required ancillary work items.
- Supplying, hauling, placing, conditioning, and compacting a minimum 2-foot thick drainage and protective soil layer on top of the geocomposite.
- Installing a toe drain system along the reverse bench and an anchor trench drain along the containment dike to collect and convey rainfall infiltration into the geocomposite.
- Installing cleanouts for the anchor trench drain as shown on the Drawings.
- Installing inlet structures, culverts, and Fabriform-lined channels to collect and convey stormwater runoff.
- Sodding all exposed soil surfaces within the designated construction area.

- Maintaining and cleaning all roadways used by construction traffic at all times such that there is no buildup of dirt or debris on the road surfaces to cause dust emission.

Other works covered by the Specifications shall also include, but shall not be limited, to: (i) surveying; (ii) site preparation and stripping of designated areas; (iii) access road construction and maintenance; (iv) repair to any facilities, equipment or property damaged by the Contractor; (v) hauling and spraying water to control dusting; (vi) control of surface water runoff; (vii) management of leachate runoff; (viii) maintenance of completed work items until final acceptance of the entire construction by the Owner; and (ix) site clean-up.

The work shall be executed in conformity with the Drawings and these Specifications and the best acceptable standard practices. The Contractor shall use only competent, skilled workers in all phases of construction.

The proposed closure may involve more than one contractor during the construction period. Each contractor shall coordinate his work activities with the Owner and all other contractors involved in the project.

SPECIFICATIONS

SECTION 3 LIST OF DRAWINGS

CLOSURE OF CELL 1 OF COMBUSTION WASTE STORAGE AREA

ORLANDO UTILITIES COMMISSION STANTON ENERGY CENTER ORANGE COUNTY, FLORIDA

The drawings listed below have been developed for construction of final closure of the top area, the south slope, and the west slope of Cell 1 of the Combustion Waste Storage Area (CWSA) at the Stanton Energy Center. Materials shall not be ordered and work shall not start before receiving the set of Drawings and Specifications labeled "Issued for Construction". The drawings may be revised later to change the location or arrangement of the work, provide additional details, or include additional information or changes in some features of the work. Such revisions shall not be deemed cause for a price change unless it can be shown that the Contractor's work has changed materially and substantially.

Drawing No.	Revision	Title
GENERAL DRAWINGS		
G-1	P0	COVER SHEET
G-2	P0	INDEX OF DRAWINGS AND PROJECT LOCATION MAPS
G-3	P0	GENERAL NOTES, ABBREVIATIONS AND SYMBOLS
G-4	P0	AERIAL PHOTOGRAPH OF STANTON ENERGY CENTER
G-5	P0	TOPOGRAPHIC MAP
G-6	P0	AERIAL PHOTOGRAPH OF CWSA - CELL 1
G-7	P0	TOPOGRAPHIC SURVEY OF CWSA - CELL 1
G-8	P0	CROSS SECTIONS A THROUGH C
G-9	P0	CROSS SECTIONS D THROUGH F
G-10	P0	EROSION CONTROL PLAN AND DETAILS
G-11	P0	EXISTING UTILITY LOCATION MAP
G-12	P0	FINAL GRADING PLAN FOR CWSA – CELL 1
G-13	P0	ACCESS ROAD AND STAGING AREAS MAP
CONSTRUCTION DRAWINGS		
CS-1	P0	TOP OF WASTE GRADING PLAN
CS-2	P0	HDPE LINER PLAN
CS-3	P0	GEOCOMPOSITE PLAN
CS-4	P0	FINAL GRADING PLAN
CS-5	P0	CONCRETE FLUMES 1 AND 2 PLAN VIEWS

Drawing No.	Revision	Title
CONSTRUCTION DRAWINGS (CONTINUED)		
CS-6	P0	CONCRETE FLUMES 3 AND 4 PLAN VIEWS
CS-7	P0	CROSS SECTION G
CS-8	P0	CROSS SECTION H
CS-9	P0	CROSS SECTION I
CS-10	P0	CROSS SECTION J
CS-11	P0	CROSS SECTIONS K AND L
CS-12	P0	CROSS SECTIONS M AND N
CS-13	P0	CROSS SECTIONS O AND P
DETAILS		
D-1	P0	STANDARD DETAILS
D-2	P0	ANCHOR TRENCH DRAIN DETAILS
D-3	P0	TYPICAL FLUME CROSS SECTIONS
D-4	P0	HDPE SEEPSHIELD DETAILS
D-5	P0	MODIFIED FDOT INLET STRUCTURE DETAILS WITH 24-INCH DIA. PIPE
D-6	P0	MODIFIED FDOT INLET STRUCTURE DETAILS WITH 36-INCH DIA. PIPE
D-7	P0	CLEANOUT DETAILS FOR DRAIN

SPECIFICATIONS

SECTION 4 CONTRACTOR'S UNDERSTANDING, DESCRIPTION OF WORK, DEFINITIONS, AND GENERAL CONDITIONS

CLOSURE OF CELL 1 OF COMBUSTION WASTE STORAGE AREA

ORLANDO UTILITIES COMMISSION STANTON ENERGY CENTER

ORANGE COUNTY, FLORIDA

4.1 Description of Work

The work for this project involves construction of final closure of Cell 1 of the Combustion Waste Storage Area (CWSA) at the Stanton Energy Center. The Contractor shall furnish all materials, equipment, supplies, tools, labor, and supervision necessary to perform the work covered by these Specifications and as shown on the Drawings. All work is to be performed and construction completed in accordance with the alignments, lines, grades, and dimensions defined in these Specifications and as shown on the Drawings. The Owner and the Engineer reserve the right to modify the design grade as well as any design elements during construction to maintain cut and fill balance and to expedite construction activities.

4.2 Definition of Parties Involved

Specific items and parties or individuals that are involved with construction of the proposed landfill closure are as follows:

- “Owner” refers to Orlando Utilities Commission.
- “Engineer” refers to the Design Engineer and/or the Construction Quality Assurance Engineer who is retained by the “Owner” to design and/or oversee any or all aspects of construction and installation quality, inspection, and testing.
- “Contractor” refers to the organization that is retained by the “Owner” for performance of site preparation, earthwork, final cover system installation, and other tasks associated with construction of the proposed closure.
- “Liner Manufacturer” or “Manufacturer” refers to the organization that will manufacture and supply the geomembrane liners and/or geosynthetic drainage products.
- “Liner Installer” refers to the organization that will be retained by the “Contractor” for installation of the geomembrane liners and geosynthetic drainage products.
- “Regulatory Agency” or “Agency” refers to the Florida Department of Environmental Protection (FDEP), which has the regulatory authority to review this project.

4.3 Responsibility and Authority

The principal organizations involved in the design and construction works associated with the final closure of Cell 1 at the Stanton Energy Center, as defined in Section 4.2, will have the following responsibilities and authorities in construction quality assurance (CQA). Delineation of these responsibilities and authorities will establish the necessary lines of communication that will facilitate decision making during construction.

4.3.1 Owner

The Owner will oversee, manage, and approve execution of all works associated with construction of the proposed closure of Cell 1. To accomplish the above overall task, the Owner will hire/engage, as necessary, the parties defined in Section 4.2. The Owner has the responsibility to ensure that the approved CQA Plan is adhered to during construction. The Owner has the authority to select and dismiss the Engineer, the Contractor, the Liner Installer and/or the Liner Manufacturer, and to demand replacements of incompetent personnel at any time, as determined solely by the Owner. The Owner also has the authority to accept or reject design plans and specifications, recommendations of the Engineer, the supplied materials, and workmanship of the Contractor and its subcontractors.

4.3.2 Engineer

The Engineer is responsible for the design and construction specifications and quality assurance activities as specified in this CQA Plan.

Specific responsibilities of the Engineer shall include:

- Reviewing design criteria, plans, specifications, and CQA Plan.
- Providing and educating the inspection personnel on the CQA requirements and procedures.
- Reviewing Contractor's quality control plan to ensure that it conforms to the CQA Plan.
- Scheduling, directing, and coordinating the CQA activities.
- Providing results of the CQA activities to the Owner on a regular basis and at the end of the project. Additional responsibilities delegated to the Engineer by the Owner may include periodic review of CQA documentation and specifying corrective measures for any non-conformance with the project specifications.

The inspection personnel provided by the Engineer shall have the following specific responsibilities:

- Performing independent inspection of the work in progress to verify compliance with the design and construction criteria, Drawings, and Specifications.
- Verifying that all testing equipment used meet the test requirements and that the tests are conducted in accordance with standard procedures specified in the CQA Plan.

- Reporting to the Engineer the results of all inspections, including work that is not of acceptable quality or fails to meet the specification requirements.

4.3.3 Contractor

The responsibility of the Contractor is to perform all the construction activities in accordance with the design and construction criteria, the Drawings, and Specifications. The Contractor shall submit all the shop drawings and other necessary documents for approval by the Engineer. The Contractor is also responsible for cooperating with the Engineer in conducting all CQA inspection and testing activities. Furthermore, the Contractor is responsible to manage its subcontractors and to make sure they understand and adhere to the Specifications and the contractual requirements between the Owner and the Contractor. All contractual requirements between the Owner and Contractor shall “flow down” to the contracts between the Contractor and its subcontractors. Furthermore, the Contractor shall include the full text of the Specifications and contractual requirements for each subcontract executed for this project.

4.3.4 Liner Installer

The responsibility of the Liner Installer, working as a subcontractor to the Contractor, is to install the geomembrane liners and geosynthetic drainage products in accordance with the Drawings and Specifications. The Liner Installer shall submit all the shop drawings and other necessary documents for approval by the Engineer. The Liner Installer is also responsible for cooperating with the Engineer in conducting all CQA inspection and testing activities.

4.3.5 Regulatory Agency

The Regulatory Agency has the responsibility and authority to review all permit conditions and requirements for the CQA documentation during and after construction to confirm that the CQA Plan is adhered to during construction and that construction procedures and quality conform to the Specifications.

4.4 **Qualifications**

4.4.1 Engineer

The CQA Engineer and testing laboratory shall have the following minimum qualifications:

- The Engineer and the testing laboratory must have at least five continuous years of experience in similar projects immediately prior to the date of this project.
- The Engineer must have inspected and tested a minimum of five liner projects consisting of at least 5,000,000 square feet of geomembrane liner.
- The Engineer shall be familiar with the ASTM International, GRI, and other applicable testing standards. The testing laboratory shall possess testing equipment capable of testing geomembrane liner seams for peel and shear in accordance with ASTM D6392. The laboratory shall have performed at least 5,000 sets of peel and shear tests on geomembrane liner seams.

- The Engineer shall be capable of providing qualified technicians to perform the required tests on geomembrane liner and able to provide test results within 48 hours of receipt of samples requiring laboratory testing. The Engineer shall also be capable of providing technicians to perform full-time inspection and testing during site preparation, earthwork construction, geomembrane liner installation, and drainage system installation.
- The Engineer must be a full-time licensed Professional Engineer in the state of Florida and be able to sign, seal, and certify that the project was constructed in accordance with the requirements stipulated in the Specifications.

4.4.2 Contractor

To be considered qualified for this project, the Contractor and its subcontractors must be well experienced in earthwork construction, placement, and preparation of soil subgrade below the geomembrane liners, and installation of inlet structures and pipes. The Contractor must also be well experienced in project management, dike construction, earthwork excavation and grading, drain and culvert installation, dewatering, earthwork restoration, slope dressing, and fine grading of the liner subgrade.

At a minimum, the Contractor shall demonstrate the successful completion of at least three projects over the past 5 years similar in size and scope to this project. For each project submitted to document the Contractor's experience, the following information on the completed facility must be provided: (i) the name and purpose of the facility; (ii) the location and date of construction; (iii) the name of the facility owner and design engineer; (iv) the name and telephone number of a contact person at the facility who can discuss the project; and (v) description of the project, scope of work, and construction methods used.

The Contractor shall provide adequate and competent superintendence of all demolition and construction activities in connection with the work at all times. The Contractor shall either personally superintend his work or shall hire a competent superintendent that is approved by the Owner, and such representative shall be authorized to receive instructions from the Owner. The Owner shall have the rights to have the Contractor replace any incompetent personnel or subcontractors working on this project as determined solely by the Owner. The superintendent shall have authority to make sure that the work is carried out in accordance with the CQA Plan, Drawings, and Specifications in a first- class, thorough, and competent manner in every respect.

4.4.3 Liner Manufacturer

The liner materials for this project shall be provided by the Owner. The Liner Manufacturer for this project shall be a qualified liner manufacturer approved by the Owner prior to bid submittal. In any event, sufficient documentation shall be provided to the Owner of previously demonstrated ability to produce the specified liner by having successfully manufactured a minimum of 15 million square feet of HDPE liner installed in similar applications. The Manufacturer shall also provide documentation that he has satisfactorily produced textured HDPE liners, and that such production has been on-line for at least 6 months. The Manufacturer shall submit to the Owner, the Manufacturer's Quality Assurance - Quality Control Plan for review by the Owner. **Continuous spark testing of all liners manufactured for this project at the production facility is required prior to delivery of the liner rolls to the project site.**

The Manufacturer must provide to the Owner a written commitment that sufficient commercial quantities of the textured HDPE liners will be available for this project at the time of construction. The Manufacturer shall also submit specification sheets detailing minimum physical and chemical properties of the proposed 60-mil textured HDPE liner (including testing methods), field seaming methods and properties, and a certificate confirming compliance with the Specifications for this project.

4.4.4 Liner Installer

To be considered qualified for this project, the Liner Installer and all subcontractors must be well experienced in the installation of HDPE liners. The Liner Installer shall be the Manufacturer of the HDPE liner or an approved Installer trained and/or licensed to install the HDPE liner supplied by one of the approved liner manufacturers. If the Liner Installer is not the Manufacturer, then the Liner Installer must submit a written certification, or license to install, provided by an approved Liner Manufacturer.

The Liner Installer shall have installed HDPE liner in similar applications, for a period of not less than two years. The Liner Installer shall submit to the Owner a list of at least ten completed facilities, totaling a minimum of 4 million square feet, for which the Liner Installer has installed an HDPE geomembrane liner of the same type as specified in these Specifications. For each installation, the following information shall be provided:

- Name and purpose of facility, location, and date of installation.
- Name of Owner and Engineer, liner Manufacturer, and name and telephone number of contact at the facility who can discuss the project.
- Type and thickness of HDPE liner installed, and surface area covered (textured and smooth).
- Type of field seaming performed, and names of the Installation Supervisor and Master Seamer representing the Liner Installer.
- Crew size and typical daily production per crew.

The Liner Installer shall also submit to the Owner, for approval by the Engineer, a copy of the Manufacturer's standard specifications for liner handling and installation and any Quality Control Plans for review by the Owner. Moreover, the Liner Installer must submit qualification resumes for the HDPE liner Installation Supervisor(s) and Master Seamer(s) to be assigned to, and who will be present on site for this project, including documentation that each has similar experience on completed facilities totaling a minimum of 4 million square feet of HDPE liner installation.

All other seamers and quality control testing technicians representing the Installer who will be involved in the installation shall have a minimum of 1.5 million square feet of related HDPE liner installation experience.

4.5 Reports and Documentation

4.5.1 Contractor

Throughout the construction period, the Contractor shall maintain a careful record of any changes on the Drawings during actual construction. Any changes, in addition to the Contractor's field construction notes, shall be neatly and legibly prepared. In addition, the Contractor shall take construction photographs to document all construction activities and submit them to the Owner on a weekly basis. The Contractor shall submit three copies of the notes and marked Drawings to the Owner, on a monthly basis, or more frequently if requested by the Owner. Upon completion of the work, and prior to acceptance by the Owner, the Contractor shall file with the Owner two sets of complete Drawings with all changes and the Contractor's field construction notes neatly and legibly recorded thereon. Such information will be used by the Engineer to prepare record Drawings for the Owner. Drawings may not be materially changed, except with the written approval of the Engineer, and the work cannot be considered as having been completed until the Engineer and the Owner has approved it in writing. The Contractor shall not seek approval from the CQA technicians for any deviations from the Drawings and Specifications. Any design modifications or deviations from Drawings and Specifications can only be approved in writing by the Engineer with the approval of the Owner.

4.5.2 CQA Engineer and Technician

Documentation of the CQA activities during construction shall consist of the following: (i) daily field reports; (ii) inspection, test data sheets, and photographs; (iii) acceptance reports for completed components; and (iv) final report.

A daily field report shall be prepared by the lead CQA technician to document the CQA activities of the day. At a minimum, the daily field report shall include the following information: (i) date, project name, location and any other project identification; (ii) description of weather condition; (iii) description of work locations for the day; (iv) description of equipment and personnel used during the day; (v) description of work performed and CQA activities; (vi) description of materials received; (vii) any equipment calibrations; (viii) any approval of completed work and/or rejection of work that did not meet the project specifications; (ix) any supporting inspection data sheets; (x) reports of any meetings held and their results; (xi) description of any problems and suggested corrective measures; and (xii) signature of the CQA personnel. The CQA technician shall work under the supervision of the Engineer and consult daily with the Engineer on CQA activities and any associated problems.

Inspection and test data sheets used to document various CQA inspection and testing activities shall include the following information: (i) date, project name, location and any other project identification, (ii) description of inspection activity or test, (iii) location of inspection activity or test sample, (iv) result of inspection/test and comparison with project specifications, (v) personnel involved in the inspection/testing activity, and (vi) signature of the CQA personnel.

Photographs shall be taken as necessary to keep pictorial records of completed work, work in progress, problems and/or corrective measures. These photographs shall be submitted to the Owner on a weekly basis. The photographic data sheets shall contain the following information: (i) date, project name, location and any other project identification, (ii) location and description of work, (iii) purpose of the photograph, and (iv) signature of the CQA personnel.

Upon acceptance of a completed component of work by the CQA inspector, appropriate acceptance forms shall be filled out and signed by the CQA inspector and the Contractor's or Installer's representatives. At a minimum, the acceptance report shall contain the following information: (i) date, project name, location and any other project identification, and (ii) location and description of the accepted component.

At the completion of the project, the Engineer shall submit a final report, which summarizes the results of the CQA inspection and testing activities for the project. This document shall be signed and sealed by the Engineer and will become a part of the CQA Plan documentation. The final CQA report shall be submitted within 60 days of completion of all construction associated with the project, as outlined within the scope of services and approved by the Owner.

4.6 Project Meetings

Weekly project meetings shall be conducted by the Owner who will arrange for the meetings, record minutes, and distribute copies to the participants and those affected by the decisions made at the meetings. The project meetings shall consist of pre-construction CQA meeting, progress meetings, and problems or work deficiency meetings.

The pre-construction CQA meeting shall be attended by the Owner, the Engineer, the Contractor, and the Liner Installer. Each participating organization will be provided with all relevant CQA documents and the following items shall be discussed at the meeting: (i) the role and responsibility of each organization in carrying out the CQA Plan, (ii) the authority and lines of communication for each organization, (iii) procedures for inspection, sampling, and testing, (iv) procedures for handling construction deficiencies, repairs, and re-testing, (v) methods for documenting and reporting inspection data, (vi) methods for distributing documents and reports, (vii) work area safety and security protocol, and (viii) storage and protection of construction materials. Following the pre-construction meeting, a site tour shall be conducted for visual observation of the site conditions by various organizations in relation to the above CQA Plan items.

Progress meetings shall be conducted weekly at a time determined at the pre-construction meeting. The progress meeting shall be attended by the Owner, the Engineer, the Contractor, and/or the Liner Installer. The Contractor's Project Manager and Superintendent, as well as the project manager and superintendent of all subcontractors that have on-site activities, shall attend all weekly progress meetings. The following items shall be discussed in the progress meeting: (i) activities and accomplishments of the previous week; (ii) overall progress of the project in relation to the project schedule; (iii) activities and goals for the remainder of the construction activities; (iv) any construction problems/deficiencies; (v) CQA activities and concerns; (vi) safety activities and concerns; (vii) submittals and submittal responses; (viii) change order requests and claims notifications; and (viii) an updated construction schedule and any anticipated changes to the schedule.

The Owner will arrange special meetings when problems and/or deficiencies occur or are anticipated to occur. These meetings shall be attended by the parties involved, which may include the Owner, the Engineer, the Contractor, and the Liner Installer. In these meetings, the problems or deficiencies shall be defined, discussed, and resolved.

4.7 Scheduling and Coordination

All scheduling and coordination of the work outlined herein shall be undertaken through the Owner's Project Manager assigned to the project. The Contractor shall propose a construction schedule to the Owner during contract negotiation and a construction schedule shall be agreed to by the Owner prior to execution of the construction contract. The schedule shall be in the form of a Gantt chart or equivalent documentation depicting all construction activities, and shall be updated weekly and provided to the Owner as work progresses.

The Contractor, the Liner Installer, and other subcontractors shall closely coordinate all planned and ongoing construction activities on a weekly basis, more frequent if warranted, with the Owner to facilitate timely completion of all work.

4.8 Access, Inspection and Testing

All materials furnished by the Contractor shall be subject to the examination and approval of the Owner, or his representative, at all times during the progress of the work and until the completion of the same. At the discretion of the Owner, additional CQA testing will be conducted at Owner's expense. As soon as the materials are examined and tested, the Contractor shall immediately remove all rejected materials from the work to a point such distance there from as the Owner may require. No material shall be used before being examined and approved by the Owner or his representative, but the failure on the part of the Owner or his representative to condemn or reject inferior materials or work shall not be construed to imply an acceptance of the same should their inferiority become evident at any time prior to final acceptance of the work.

The Contractor shall make necessary arrangement so that the Engineer may secure samples of materials used in construction for testing to ascertain whether any material to be included in the work meets the requirements of these specifications.

The Owner and his representative shall have free access to the work at all times. The Contractor shall furnish them with equipment, as needed, for ascertaining whether the work being performed, or the work which has been completed, is in accordance with the requirements of these specifications, even to the extent of uncovering, testing, or removing portions of finished work, if deemed necessary by the Owner. The costs of uncovering work for inspection and testing, and any ensuing repairs, if necessary, shall be borne by the Contractor.

The Owner may order the Contractor to suspend any work that may be affected, damaged, or endangered by climatic conditions. Furthermore, the Owner may temporarily suspend any work at any time when acceptable results, as defined by these Specifications, cannot be achieved because of inclement weather or other unsatisfactory field conditions. All costs associated with these work suspensions shall be borne by the Contractor.

4.9 Survey Control

The Owner will establish reference points for horizontal and vertical control near the construction area. From these reference points, the Contractor shall provide all horizontal and vertical controls necessary to complete the work to the location, lines, and grades shown on the Drawings or as otherwise revised or approved by the Owner. It is the responsibility of the Contractor to verify all dimensions prior to fabrication, installation, and/or construction of any item of work. The Contractor shall maintain the survey control system, and shall provide all his alignment and grade

control surveying of whatsoever nature. The Contractor shall submit the survey results, signed and sealed by a Florida-licensed surveyor, for Owner's written approval prior to the commencement of any construction activities that are dependent upon these survey results.

4.10 Precedence and Discrepancies

Work indicated on the Drawings and not mentioned in the Specifications, or vice versa, shall be performed as though fully set forth in both. Work not particularly detailed, marked, or specified, shall be performed in the same manner as similar work that is detailed, marked, or specified. In work drawings, the precedence shall be drawings of larger scale over those of smaller scale, figured dimensions over scaled dimensions, and noted material over graphic indications.

In the event of a discrepancy between the Drawings and the Specifications, or within either, the discrepancy shall immediately be brought to the attention of the Engineer and the Owner. The Engineer will specify the correct interpretation upon the Owner's approval.

4.11 Superintendence

The Contractor shall provide and maintain continually on the site of the work during its progress, adequate and competent superintendence of all operations for and in connection with the work under these Specifications. The Contractor shall either personally superintend his work or shall hire a competent person that is approved by the Owner. Such representative shall be able to read, write, and speak English fluently, and shall be authorized to receive instructions from the Owner. The Superintendent shall have the responsibility to make sure that the work is carried out in accordance with the Specifications and Drawings.

4.12 Contractor's Staging Area

The staging area(s) will be designated by the Owner. The Contractor shall submit a staging plan within the designated area(s) for review and approval by the Owner. The Contractor shall be responsible for electrical connections and other utilities, as needed and as approved by the Owner. The Owner will provide the water required for construction. However, it shall be the responsibility of the Contractor to transport or convey the water from the designated sources, and to meter the quantity of water used.

4.13 Contractor Safety

The Contractor, contractor employees, subcontractors, and subcontractor employees shall comply with the regulations of the Owner, the U.S. Department of Labor Occupational Safety and Health Administration (OSHA), and/or other applicable agencies. The Contractor shall show evidence for each employee, including employees of subcontractors, of Owner-required site-specific safety training. The regular on-site safety meetings shall be documented, and the minutes of the meetings need to be submitted to the Owner. The Owner's safety requirements are provided in an attachment to the contract.

4.14 Environmental Protection

The Contractor shall comply with all applicable regulations set forth by the Owner and the following governmental agencies:

1. Florida Department of Environmental Protection (FDEP)
2. U.S. Environmental Protection Agency (EPA)
3. St. Johns River Water Management District (SJRWMD)
4. South Florida Water Management District (SFWMD)
5. Orange County, Florida
6. U.S. Army Corps of Engineers
7. Occupational Safety and Health Administration (OSHA)
8. Florida Fish and Wildlife Conservation Commission (FFWCC)

The Contractor shall provide and maintain, during the life of the contract, environmental protection as defined herein. The Contractor shall provide environmental protective measures as required to control pollution that develops during normal construction practice and provide environmental protective measures required to correct conditions that develop during the construction of permanent or temporary environmental features associated with the project, including dust emission caused by construction traffic. The Contractor shall comply with all federal, state, and local regulations pertaining to water, air, and noise pollution.

4.15 Protection of Natural Resources

Limits of Work: The natural resources outside the limits of permanent work performed under this contract shall be preserved in their existing condition or restored to an equivalent or improved condition upon completion of the work. The Contractor shall confine construction activities to areas defined by the scope of work, Drawings, and Specifications.

Land Resources: Except in those areas indicated on the construction plans to be cleared, the Contractor shall not remove, cut, deface, injure, or destroy trees or shrubs without permission from the Owner.

Temporary Facilities: The Contractor shall eliminate all signs of temporary construction facilities such as work areas, structures, foundations of temporary structures, stockpiles of excess or waste materials, and all other vestiges of construction except for access roads. All other areas shall be restored to their original conditions.

Water Resources: The Contractor shall perform all work in such a manner that any adverse environmental impacts on water resources are reduced to a level acceptable to FDEP, SJRWMD, Orange County, FDEP, and EPA. Work must be performed in accordance with the applicable permit requirements. If water quality is compromised, all construction activities will cease until the problem is remedied and the Contractor receives notification to proceed from the Owner.

Oily Substances: The Contractor shall take whatever measures necessary to prevent oily or other potentially hazardous substances from entering the ground, drainage areas, or local bodies of water. All temporary fuel oil, petroleum, or liquid chemical storage tanks shall be protected with a temporary high density polyethylene (HDPE) lined earthen berm and secondary containment area of sufficient size and strength to contain the contents of the tanks in the event of content leakage or spillage. At the request of the Contractor, other forms of containment with impervious liner will be considered. If any spill occurs, the Contractor shall notify the Owner immediately and shall be responsible for all cleanup expenses.

Fish and Wildlife Resources: The Contractor shall take all necessary steps, as required, to prevent interference or disturbance to fish and wildlife. The Contractor shall not alter water flows

or otherwise significantly disturb native habitat, adjacent to the project area, which are critical to fish and wildlife, except as approved by the Owner. The Contractor shall note that harming or harassing of the indigo snake, gopher tortoise, or other protected species is prohibited.

Fines: Any fines levied against the Contractor, or against the Owner that arise because of the Contractor's work during the life of this contract shall be borne by the Contractor.

Protection of Erodible Soils: All earthwork brought to a final grade shall be immediately finished as indicated or specified. The Contractor shall protect all slope areas upon completion of rough grading.

4.16 Protection of Existing Facilities

The Contractor shall employ a security guard from the firm that currently provides security services to the Owner at the Stanton Energy Center for the designated construction entrance to the job site whenever delivery activities are ongoing. The Contractor is responsible, at no additional cost to the Owner, for timely repair or replacement of structures, equipment, pipelines, power lines, power poles, solar panels, monitor wells, piezometers, pumps, or any facilities damaged by the Contractor's operations and/or personnel during construction. All repairs and/or replacements shall be performed in a manner approved by the Owner.

4.17 Daily and Final Cleanup

The Contractor shall clean up the job site and shall install all barricades, as needed, at the end of each workday to maintain the site in a clean and safe condition, as required by the Owner. The Contractor shall fully comply with the requirements set forth in this section and in Sections 4.15 and 4.16 pertaining to site maintenance. The Contractor shall maintain all roadways used during construction in a condition that is acceptable to the Owner. The Contractor shall keep all roadways used by construction traffic free of dirt, debris, and dusting emission at all times, as directed by the Owner. This may require the use of a dedicated onsite vacuum sweep truck. Maintenance of all roadways used by construction traffic shall be at the Contractor's expense.

Upon completion of the work, the Contractor shall remove and dispose of all trash, debris, unused materials, etc. Remaining unused clean soils shall be stockpiled in areas designated by the Owner. Soil surfaces disturbed because of construction activities shall be regraded to their original condition as directed by the Owner.

Waste oil, antifreeze, fuels, grease, or any other hazardous materials shall be disposed of off-site in accordance with applicable regulations, and shall not be dumped on the ground. The Contractor shall furnish proper records documenting the disposition of any such waste materials to the Owner. The Contractor must report any and all spills to the Owner immediately, and shall be solely responsible for all spill remediation.

4.18 Final Inspection and Acceptance

Upon completing all clean-up operations, the Contractor shall advise the Owner that he is ready for final inspection. The Owner will then set a specific date and time for final inspection. The Owner, Engineer, and Contractor shall jointly inspect the project area to verify that all work has been completed in accordance with the Drawings and Specifications. Any work found lacking in any way shall be corrected and re-inspected. The Contractor shall provide certified as-built

drawings to the Owner. The as-built drawings shall include, but shall not be limited to, earthwork, liners, geocomposite panel layout, piping, inlet structures and other items constructed by the Contractor. Upon final inspection and receipt of the as-built drawings, the Owner will issue a Letter of Acceptance to the Contractor, and the Contractor may then request final payment.

4.19 Applicable Specifications, Codes, and Standards

All work shall be performed in compliance with these Specifications unless otherwise approved in writing by the Engineer. In the event of a conflict between these Specifications and the referenced standards, these Specifications shall govern.

4.20 Engineering Data

The Owner does not guarantee the correctness of the designations of any materials shown on the Drawings, nor any interpretations, deductions, or conclusions shown on any drawings or other documents relative to subsurface conditions. Conditions affecting the Contractor's performance and schedule may differ from those indicated or described. The Contractor shall assume all responsibility for deductions and conclusions as to the nature or condition of soil and other materials to be excavated, the difficulties of performing and maintaining the required excavations, filling, dewatering, and of doing other work affected by the existing conditions, geology, and geometry of the job site.

SPECIFICATIONS

SECTION 5 SITE PREPARATION AND EARTHWORK CONSTRUCTION

CLOSURE OF CELL 1 OF COMBUSTION WASTE STORAGE AREA

ORLANDO UTILITIES COMMISSION STANTON ENERGY CENTER ORANGE COUNTY, FLORIDA

5.1 Description of Work

Site preparation and earthwork activities shall include and cover all work for and in connection with: (i) clearing, grubbing, and stripping and stockpiling of all vegetation, organics, and unsuitable materials from the construction area; (ii) proof-rolling and site grading; (iii) liner subgrade preparation; (iv) construction and maintenance of access roads and ramps; and (v) incidental excavation of waste materials.

5.2 Referenced Standards

The following ASTM International (ASTM) standards are referenced in this Specification.

D698: Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³))

D1140: Standard Test Method for Amount of Material in Soils Finer than the No. 200 Sieve

D2216: Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass

D2487: Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System)

D2937: Standard Test Method for Density of Soil in Place by the Drive Cylinder Method

5.3 Site Preparation and Maintenance

5.3.1 Site Access

The Contractor shall, by his own inspection and by careful examination, fully convince himself as to the accessibility of the site for performing the work. The Contractor shall be responsible for modifying or preparing any access roads. Any modifications to the existing topography of the site (i.e., cut and/or fill) required for access during construction shall be submitted to the Owner for approval prior to actual construction.

Any fill material required for site access shall be obtained from off-site sources approved by the Engineer. Fill for temporary access ramps and roads shall consist of fine sands, slightly silty, silty, and clayey sands free of deleterious materials (organic matter, roots, wood, trash, debris, particles greater than 6 inches in size, etc.), and classifying as SP, SP-SM, SM, and SC-type soils in accordance with ASTM D2487.

All areas disturbed by the Contractor in constructing temporary access roads and ramps shall be re-graded and restored to pre-construction condition, or as otherwise approved by the Owner.

5.3.2 Erosion and Sedimentation Control Features

Erosion and sedimentation control practices shall be implemented by the Contractor to minimize erosion and sedimentation during construction until all work has been accepted by the Owner. Methods that may be used shall include, but shall not be limited to, vegetation, berms, silt fences, and hay bales. An erosion and sedimentation control plan outlining the proposed erosion and sedimentation control measures to be undertaken during construction shall be submitted by the Contractor to the Owner for approval prior to construction.

All erosion and sedimentation control measures shall be in-place prior to commencement of construction. If the Owner determines that erosion or sedimentation is occurring because of the Contractor's construction activities despite implementation and maintenance of protective measures, the Contractor shall take additional protective measures, as directed by the Owner.

Upon completion of the Work or upon instructions by the Owner, the Contractor shall dismantle and remove all erosion and sedimentation control measures implemented during construction.

5.3.3 Surface Water Management and Stormwater Runoff Control

The Contractor shall prepare a Stormwater Pollution Prevention Plan and submit to the Owner for written approval. The Contractor shall fully comply with the Storm Water Pollution Prevention Plan (SWPPP) for this project. The Contractor shall be responsible for all runoff control efforts, including providing protection for areas receiving runoff in accordance with applicable regulations, codes, plans, and permits. The Contractor shall furnish, install, and maintain all necessary measures such as temporary retention basins, silt screens, filter fabric, sod, sandbags, etc., to manage surface runoff and to prevent erosion.

5.3.4 Site Dewatering

The Contractor shall be responsible for transferring any standing water within the designated construction area to permit construction in the dry. Clean stormwater that has not been in contact with waste materials shall be discharged to on-site locations designated by the Owner. Any stormwater that has been in contact with waste materials is considered leachate, and shall be pumped to the CWSA Runoff Pond or as otherwise directed by the Owner. No water shall be released off-site or into adjacent ditches or streams without the Owner's written permission and appropriate discharge permits.

5.3.5 Clearing, Grubbing, and Stripping

The work shall consist of furnishing all tools, labor, materials, and equipment required for all clearing, grubbing, and stripping operations within the limits of construction. The work shall

generally be performed in all areas designated for borrow, dike, and general earthen construction.

The Contractor shall remove any debris from within the designated construction area. If required for disposal, these items shall be disposed of on-site at locations designated by the Owner.

Clearing shall consist of cutting, removing, and disposing of all grass, brush, debris, and other objectionable organic material resting on or protruding above ground within the limits of grading as indicated on the Drawings.

Grubbing shall consist of the removal and disposal of roots and other objectionable organic material within the limits of grading, as indicated on the Drawings. Roots and matted roots shall be grubbed to at least 6 inches below the existing grade or the proposed final subgrade surface, whichever is greater.

Stripping shall consist of the removal of organic top-soils from within the limits of grading. Excessive stripping shall be avoided.

The Contractor shall dispose of all organic or otherwise objectionable materials removed by clearing, grubbing, and stripping in on-site areas designated by the Owner.

5.3.6 Unsuitable Soils/Waste Removal

All organics, highly compressible, and other deleterious soils within the designated construction area, as determined by the Engineer, shall be excavated, removed from the construction area, and disposed of on-site at locations designated by the Owner. Any incidental waste materials that have to be excavated to achieve the design waste grade shall be disposed of onsite at locations designated by the Owner.

5.4 **Earthwork for Site Grading**

Unless otherwise approved by the Engineer, the soil bedding layer beneath the closure liner in the Cell 1 shall have a minimum compacted thickness of 6 inches above the waste materials. Any waste materials that protrude within 6 inches below the liner design grade shall be excavated and disposed of onsite at locations designated by the Owner.

5.4.1 Existing and Excavated Surfaces

Existing earthen surfaces and those exposed as a result of excavation shall be scarified, wetted, or dried, as may be required, and compacted to a dry density of not less than 95 percent of the Standard Proctor maximum dry density (ASTM D698) before placement of any fill materials.

5.4.2 Fill Placement for Site Grading

Earthen fill materials meeting the requirements of Section 5.4.4 and subject to approval by the Engineer shall be wetted or dried, as may be required, homogenized and placed in successive relatively horizontal layers not exceeding 12 inches in loose thickness. After a lift is placed and compacted per these Specifications, its surface shall be scarified just before placement and compaction of the next lift to permit proper bonding between lifts. The top of the soil bedding

layer, which will be the subgrade for the proposed final cover system, shall be smoothly graded to the lines and grades shown on the Construction Drawings.

The operation of site grading shall be suspended at any time when satisfactory results cannot be obtained because of rain, inclement weather, or other unsatisfactory conditions in the field.

5.4.3 Source of Fill Materials

Fill materials for site grading and backfilling of areas excavated to remove unsuitable materials or waste materials that protrude within 6 inches of the liner design grade shall be obtained from uncontaminated off-site borrow sources approved in writing by the Owner. The Contractor shall identify the borrow sources and shall have the materials approved by the Engineer prior to delivery of the materials to the Site. The Contractor shall provide all soil test data requested by the Engineer for each proposed borrow source.

5.4.4 Fill Material Requirements

Fill materials used for construction shall consist of fine sands and slightly silty to silty and slightly clayey to clayey fine sands classifying as SP, SP-SM, SP-SC, SM, or SC-type soils in accordance with ASTM D2487 and free from rocks, stones, and gravel in excess of 6 inches in diameter, and other deleterious materials (organic matter, roots, wood, trash, debris, sharp objects, etc.). Fill materials for the soil bedding layer or within 6 inches of the liner shall not contain particles larger than ¼-inch in diameter. Materials used for site grading shall have an organic content less than 3 percent.

5.4.5 Compaction Criteria

Existing earthen surface and surfaces exposed by excavation shall be inspected by the Engineer and compacted to a dry density of not less than 95 percent of the Standard Proctor maximum dry density (ASTM D698) prior to the placement of any fill materials. Standard Proctor compaction tests (ASTM D698) will be performed on samples of the in situ and borrow soils, as needed, to determine the optimum moisture content, allowable range of placement moisture content, and the relationship between dry density and molding moisture content to be used for compaction control.

5.4.6 Dewatering

The project site may have ponded leachate. Although the surface of Promat is anticipated to be mostly dry, removal of surface water shall still be necessary during construction of the closure system. The Contractor shall submit a dewatering plan to the Owner for review and written approval at least four weeks prior to commencement of the dewatering operation. The water from the dewatering operation shall be discharged to on-site locations designated by the Owner. The dewatering operation shall not be terminated until the remaining construction can be conducted in-the-dry.

5.4.7 CQA Inspection and Testing

The Engineer, retained by the Owner, will test and inspect the prepared base for compliance with the material and compaction criteria specified herein. The Engineer will perform in situ moisture content and density determinations at a minimum frequency of twice per acre for compacted existing and excavated base surfaces and a minimum of once per 850 cubic yards of compacted fill using the drive cylinder method (ASTM D2937), or another method approved by the Engineer and deemed equivalent by him at his sole discretion.

5.4.8 Liner Grade Maintenance

It shall be the Contractor's responsibility to maintain, re-grade, and restore, as needed, the condition of the prepared liner grade to the lines, grades, and degree of compaction noted above, and to maintain the surface to be lined, smooth and free from deleterious materials until the entire construction has been accepted by the Owner.

5.5 **Earthen Dike Construction**

The earthen dike along the perimeter on top of Cell 1 shall be constructed at the locations and to the lines and grades shown on the Drawings.

5.5.1 Source of Fill Materials

Fill materials for dike construction shall be obtained from off-site sources approved by the Engineer.

5.5.2 Dike Fill Material Requirements

Fill materials used in dike construction shall be classified as clean granular fill, subject to approval by the Engineer. The fill materials shall be free from wood, roots, trash, rocks, debris, or other deleterious material. The clean granular fill materials shall consist of clean, granular soils that classify as SW, SP, SW-SM, SW-SC, SP-SM, and SP-SC in accordance with ASTM D2487. The soil shall have not more than 12 percent by dry weight passing the U.S. Standard No. 200 sieve in accordance with ASTM D1140. With prior approval by the Engineer, SC-type soils with not more than 25 percent by dry weight passing the U.S. Standard No. 200 sieve size may also be utilized in dike construction.

5.5.3 Dike Construction

The earthen dike shall be constructed upon completion of construction of the 2-foot thick protective and drainage layer. Portions of the prepared subgrade and the protective soil cover that no longer meet the specified compaction criteria shall be scarified, wetted or dried, as needed, and re-compacted prior to placement of dike fill materials. Just prior to placement of the initial lift of dike fill material; the prepared surface shall be scarified to permit proper bonding between the two surfaces.

After a lift is placed and compacted per these Specifications, its surface shall be scarified just before placement and compaction of the next lift to permit proper bonding between the two lifts. At no time shall a new lift of fill be placed over a non-scarified or dried surface. If a dried surface develops, it shall be rewetted and re-compacted or thoroughly and uniformly mixed with moist underlying soils prior to placement of a new lift of fill.

The dike shall be constructed by placement and compaction of the selected fill materials in successive horizontal layers of not more than 12 inches in loose, vertical thickness. The fill materials shall be wetted or dried, and homogenized prior to compaction to obtain uniform moisture content in each lift. Each lift shall be compacted by rolling with a tamping roller, heavy

rubber tire roller, steel wheel (sheep-foot) power roller, or other suitable compaction equipment. The Contractor shall plan the traffic flow of equipment to provide a thorough and uniform compaction effort on each successive lift of fill.

5.5.4 Compaction Criteria

Earthen dike fill materials shall be compacted to a dry density of not less than 95 percent of the Standard Proctor maximum dry density (ASTM D698). The Engineer will perform Standard Proctor compaction tests (ASTM D698) on samples of the borrow soils, as needed, to determine the optimum moisture content and maximum dry density to be used for compaction control.

5.5.5 CQA Inspection and Testing

The Engineer, retained by the Owner, will undertake observations and perform CQA tests to determine compliance of the earthwork construction with these Specifications. Prior to placement, the Engineer shall observe that the surface of the previously compacted lift is satisfactorily prepared in accordance with Sections 5.5.3 and 5.5.4. The Engineer shall also verify that the borrow soils used for construction are free of deleterious materials and meet the requirements specified in the Owner's Specifications and Section 5.5.2 for the appropriate material classification required for earthwork construction. Fines content determinations (ASTM D1140) shall be performed, as needed, to verify conformance of the clean granular fill with the requirements specified in Section 5.5.2.

During placement, the fill materials will be inspected to verify that they have been thoroughly homogenized, uniformly placed, and adequately compacted. The Engineer shall make the necessary penetration tests to quantify the uniformity of compaction and probe measurements to verify compliance with the maximum lift thickness specified herein.

After compaction of each lift is complete, the Engineer, retained by the Owner, will perform moisture content determinations (ASTM D2216) and in situ density determinations at a minimum rate of once per 850 cubic yards of compacted fill using the drive cylinder method (ASTM D2937), or another method approved by the Engineer and deemed equivalent by him at his sole discretion. The Engineer shall compare results of these tests to the results of Standard Proctor tests to determine compliance with the specified compaction criteria.

5.5.6 Maintenance

The Contractor shall maintain and restore, as needed, the condition of the completed earthwork such that it conforms to the lines and grades shown on the Drawings and to the compaction criteria specified herein.

SPECIFICATIONS

SECTION 6 HDPE LINER MATERIALS

CLOSURE OF CELL 1 OF COMBUSTION WASTE STORAGE AREA

**ORLANDO UTILITIES COMMISSION
STANTON ENERGY CENTER
ORANGE COUNTY, FLORIDA**

6.1 Description of Work

This Specification covers the following items for High Density Polyethylene [HDPE] geomembrane liner. The HDPE geomembrane liner materials will be supplied by the Owner.

6.2 Referenced Standards

The following ASTM International (ASTM) standards are referenced in this Specification.

- D570: Standard Test Method for Water Absorption of Plastics
- D638: Standard Test Method for Tensile Properties of Plastics
- D698: Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³))
- D746: Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact
- D792: Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement
- D1004: Standard Test Method for Tear Resistance (Graves Tear) of Plastic Film and Sheeting
- D1203: Standard Test Methods for Volatile Loss from Plastics Using Activated Carbon Methods
- D1204: Standard Test Method for Linear Dimensional Changes of Nonrigid Thermoplastic Sheeting or Film at Elevated Temperature
- D1238: Standard Test Method for Melt Flow Rates of Thermoplastics by Extrusion Plastometer
- D1505: Standard Test Method for Density of Plastics by the Density-Gradient Technique

- D1603: Standard Test Method for Carbon Black Content in Olefin Plastics
- D1693: Standard Test Method for Environmental Stress-Cracking of Ethylene Plastics
- D2487: Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)
- D3895: Standard Test Method for Oxidative-Induction Time of Polyolefins by Differential Scanning Calorimetry
- D4218: Standard Test Method for Determination of Carbon Black Content in Polyethylene Compounds by the Muffle-Furnace Technique
- D4833: Standard Test Method for Index Puncture Resistance of Geomembranes and Related Products
- D4976: Standard Specification for Polyethylene Plastics Molding and Extrusion Materials
- D5199: Standard Test Method for Measuring the Nominal Thickness of Geosynthetics
- D5321: Standard Test Method for Determining the Shear Strength of Soil-Geosynthetic and Geosynthetic-Geosynthetic Interfaces by Direct Shear
- D5397: Standard Test Method for Evaluation of Stress Crack Resistance of Polyolefin Geomembranes Using Notched Constant Tensile Load Test
- D5596: Standard Test Method for Microscopic Evaluation of the Dispersion of Carbon Black in Polyolefin Geosynthetics
- D5721: Standard Practice for Air-Oven Aging of Polyolefin Geomembranes
- D5885: Standard Test Method for Oxidative Induction Time of Polyolefin Geosynthetics by High-Pressure Differential Scanning Calorimetry
- D5994: Standard Test Method for Measuring Core Thickness of Textured Geomembranes
- D6693: Standard Test Method for Determining Tensile Properties of Nonreinforced Polyethylene and Nonreinforced Flexible Polypropylene Geomembranes
- D6913: Standard Test Method for Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis
- D7238: Standard Test Method for Effect of Exposure of Unreinforced Polyolefin Geomembrane Using Fluorescent UV Condensation Apparatus
- D7466: Standard Test Method for Measuring Asperity Height of Textured Geomembranes

E96: Standard Test Methods for Water Vapor Transmission of Materials

F1249: Standard Test Method for Water Vapor Transmission Rate Through Plastic Film and Sheeting Using a Modulated Infrared Sensor

6.3 Material Requirements

Smooth and double-sided textured geomembrane liner shall consist of unreinforced high-density polyethylene (HDPE) designed and manufactured specifically for the purpose of liquid containment.

Product data sheets for each type of liner listing the minimum and nominal liner physical properties shall be provided to the Engineer prior to shipment. Product data sheets for the HDPE resin listing density, melt index, low temperature brittleness, environmental stress crack resistance and ASTM D4976 classification shall be provided for each type of resin prior to shipment.

6.3.1 Base Resin

Uncolored base resin shall be polyethylene having a density equal to or greater than 0.932 g/cm³ classifying as Group 2, Class 2, Grade 4 or Grade 5 [PE 224 or PE 225] in accordance with ASTM D4976.

Formulated colored resin shall classify as a Group 2, Class 3, Grade 4 or Grade 5 high density polyethylene [PE 234 or PE 235] with physical properties meeting A46009 in accordance with ASTM D4976 with environmental stress crack resistance (ASTM D1693) F₅₀ > 1,500 hours [Condition B; 50°C/100% Igepal]. The formulated colored resin shall meet the following requirements:

- contain not less than 97 percent of the base resin, and not less than 2.0 percent carbon black and no more than 3.0 percent carbon black, antioxidants and heat stabilizers combined with no other additives, fillers or extenders;
- manufactured from virgin resin with no more than 3 percent regrind material with regrind material comprised of the same formulation as the virgin resin;
- contain no post-consumer resin of any type;
- carbon black dispersion in the liner rated as Category 1 or 2 in ≥9 of 10 views, and as Category 3 in ≤1 of 10 views classified in accordance with ASTM D5596; and
- the variation in carbon black content within each resin batch shall be no greater than ±10 percent from the average carbon black content determined from factory tests performed at a minimum frequency of once per 5 rolls.

Liner sheets shall be manufactured using one of the following base resins unless otherwise approved by the Engineer.

- Chevron Phillips Marlex K306

- Chevron Phillips Marlex K307
- BP Solvay Fortiflex G36-10-150 (G36-24x1767)
- Formosa Plastics Formolene HL3812

Use of an approved base resin shall not relieve the Liner Manufacturer from complying with all other Specification criteria.

6.3.2 Welding Rod

Welding rod used for field joining liner sheets shall be manufactured from the same HDPE base resin used to manufacture the liner. Welding rod shall be smooth, uniform in appearance and diameter and shall not contain contamination by foreign matter including entrapped moisture that could result in air pockets within extrusion welds.

6.3.3 Physical Appearance of Liner Sheets

All HDPE liner sheets shall have good appearance qualities. The surface of smooth HDPE liner sheets shall be smooth with no visible defects. Texturing on the surface of textured HDPE liner sheets shall be uniform and homogeneously distributed and shall be free from agglomerated texturing material.

All HDPE liner sheets shall be free of pinholes, holes, blisters, gels, undispersed ingredients, fish-eye blemishes, any signs of contamination of foreign matter, or any defect that may affect serviceability. The edges of the sheets shall be straight and free from nicks and cuts.

Rolled out liner that requires more than one patch per 5,000 square feet for repair of blemishes, holes, undispersed ingredients, blisters, gels, contamination by foreign matter, or any other factory defect that may affect serviceability shall be considered faulty and shall be rejected and replaced at the Liner Manufacturer's expense.

6.3.4 Smooth Liner Physical Properties

Smooth HDPE liner shall be in accordance with the thicknesses shown on the Drawings and meet the criteria listed below.

Property	Test Method	Criteria			
		40-mil Liner	60-mil Liner	80-mil Liner	100-mil Liner
Minimum Thickness	ASTM D5199 (mils)	≥36	≥54	≥72	≥90
Average Thickness	ASTM D5199 (mils)	≥40	≥60	≥80	≥100
Density	ASTM D792 [Method B] or ASTM D1505	≥0.932 grams/cm ³ [base resin] ≥0.940 grams/cm ³ [blended resin]			
Melt Index	ASTM D1238 [190°C / 2.16 kg]	≤1.0 grams/10 minutes			
Carbon Black Content	ASTM D4218 or ASTM D1603	≥2.0% & <3.0%			
Carbon Black Dispersion	ASTM D5596 [10 views]	Category 1 or 2 [≥9 views] and Category 3 [≤1 view]			
Tensile Strength at Yield	ASTM D6693 (lb/inch)*	≥84	≥126	≥168	≥210

Property	Test Method	Criteria			
		40-mil Liner	60-mil Liner	80-mil Liner	100-mil Liner
Tensile Strength at Break	ASTM D6693 (lb/inch)*	≥152	≥228	≥304	≥380
Elongation at Yield	ASTM D6693*	≥12%			
Elongation at Break	ASTM D6693*	≥700%			
Tear Resistance	ASTM D1004 (lb)*	≥28	≥42	≥56	≥70
Puncture Resistance	ASTM D4833 (lb)	≥80	≥120	≥160	≥200
Modulus of Elasticity	ASTM D638*	≥80,000 lb/in ²			
Water Vapor Transmission	ASTM E96 [Procedure BW] or ASTM F1249	<0.03 g/m ² /24 hours			
Dimensional Stability	ASTM D1204 [100°C / 1 hour]	±2% (maximum)			
Low Temperature Brittleness	ASTM D746 [Procedure B]	<-94°F (<-70°C)			
Volatile Loss	ASTM D1203 [Method A]	<0.1%			
Water Absorption	ASTM D570	<0.1%			
Environmental Stress Crack Resistance	ASTM D1693 [F ₅₀ ; Condition B; 50°C/100% Igepal]	≥1,500 hours			
Constant Tensile Load Stress Crack Resistance (Single Point at 30% of Yield Stress)	ASTM D5397 [SP-NCTL]	≥500 hours			
Oxidative Induction Time	ASTM D3895 [200°C and 5 lb/in ² O ₂]	≥140 minutes			
Oven Aging	ASTM D5721 [85°C] ASTM D3895 for S-OIT ASTM D5885 for HP-OIT	≥55% S-OIT retained at 90 days, or ≥80% HP-OIT retained at 90 days			
Weathering (UV) Resistance	ASTM D7238 [20-hour UV cycle at 75°C with 4-hour condensation at 60°C] ASTM D5885 for HP-OIT	≥50% HP-OIT retained at 1,600 hours			
* Tested in both machine and transverse directions.					

All individual test specimens shall meet the minimum or maximum criteria listed above with the following exceptions:

- The average elongation at break, tensile strength at break and modulus of elasticity in both the machine and transverse directions, determined as the average of five test specimens in each direction, shall comply with specified values.
- All individual test specimen results shall display minimum elongations at break equal to or greater than 520 percent, minimum tensile strengths at break equal to or greater than 92 percent of the specified criteria, and minimum modulus of elasticity equal to or greater than 64,000 lb/in².
- The average water vapor transmission shall meet the specified value and all individual test specimen results shall be equal to or less than 0.05 g/m²/24 hours.

Routine testing for modulus of elasticity, dimensional stability, low temperature brittleness, environmental stress crack resistance, volatile loss, water absorption, water vapor transmission,

oven aging and weathering [UV] resistance will not be required from the Liner Manufacturer. Certification in writing shall be provided by the Liner Manufacturer that the HDPE liner meets the Specification requirements. In support of the certification, the Liner Manufacturer shall submit at least one test result for each property performed within one year prior to the date of the certification in accordance with the following requirements:

- modulus of elasticity, dimensional stability, and water absorption for each liner thickness and each base resin type;
- volatile loss, water vapor transmission, oven aging, and weathering [UV] resistance for the minimum thickness liner (or thinner, but not less than 40-mil) and each base resin type; and
- low temperature brittleness and environmental stress crack resistance for each base resin type. Compliance with low temperature brittleness and environmental stress crack resistance may be satisfied by submittal of the resin manufacturers product data sheet listing nominal values in compliance with the specification requirements.

6.3.5 Textured Liner Physical Properties

Textured HDPE liner shall be in accordance with the thicknesses shown on the Drawings, textured on both sides unless indicated otherwise on the Drawings and meet the criteria listed below.

Property	Test Method	Criteria			
		40-mil Liner	60-mil Liner	80-mil Liner	100-mil Liner
Minimum Thickness	ASTM D5994 (mils)	≥36	≥54	≥72	≥90
Average Thickness	ASTM D5994 (mils)	≥40	≥60	≥80	≥100
Average Asperity Height	ASTM D7466 (mils)*	≥16	≥16	≥16	≥16
Density	ASTM D792 [Method B] or ASTM D1505	≥0.932 grams/cm ³ [base resin] >0.940 grams/cm ³ [blended resin]			
Melt Index	ASTM D1238 [190°C / 2.16 kg]	≤1.0 grams/10 minutes			
Carbon Black Content	ASTM D4218 or ASTM D1603	≥2.0% & <3.0%			
Carbon Black Dispersion	ASTM D5596 [10 views]	Category 1 or 2 [≥9 views] and Category 3 [≤1 view]			
Tensile Strength at Yield	ASTM D6693 (lb/inch)**	≥84	≥126	≥168	≥210
Tensile Strength at Break	ASTM D6693 (lb/inch)**	≥80	≥120	≥160	≥200
Elongation at Yield	ASTM D6693**	≥12%			
Elongation at Break	ASTM D6693**	≥200%			
Tear Resistance	ASTM D1004 (lb)**	≥28	≥42	≥56	≥70
Puncture Resistance	ASTM D4833 (lb)	≥80	≥120	≥160	≥200
* Each side for double-sided textured liner. Asperity height shall also be sufficient to provide specified interface frictional resistance.					
** Tested in machine and transverse directions.					

All individual test specimens shall meet the minimum or maximum criteria listed above with the following exceptions.

- The average tensile strength and elongation at break in the machine and transverse directions, determined as the average of the five specimens in each direction, shall comply with specified values.
- All individual test specimen results shall display minimum tensile strengths at break equal to or greater than 30 percent of the specified criteria and elongations at break equaling or exceeding 60 percent.

Textured liner shall meet the criteria specified for smooth liner for modulus of elasticity, water vapor transmission, dimensional stability, low temperature brittleness, volatile loss, water absorption, environmental stress crack resistance, constant tensile load stress crack resistance, oxidative induction time, oven aging and weathering [UV] resistance. Certification of compliance for properties not requiring routine testing can be satisfied by:

- test results on smooth liner for water vapor transmission, low temperature brittleness, volatile loss, environmental stress crack resistance, oven aging and weathering [UV] resistance in accordance with the requirements in Section 6.3.4; and
- test results for modulus of elasticity, dimensional stability and water absorption for each textured liner thickness and each base resin type.

6.3.6 Frictional Characteristics

The surface roughness of textured liner shall be such that the peak interface friction angle is equal to or greater than 28 degrees between the double-sided geocomposite and the HDPE liner, and between the HDPE liner and the bedding materials.

For determining compliance with the specified interface friction angles, direct shear tests will be performed by the Engineer in accordance with Standard ASTM D5321 using the geosynthetic products and the on-site fine sand with silt fill materials (Group Symbol SP-SM in accordance with ASTM D2487) meeting the following gradation.

U.S. Standard Sieve Size	Percent Passing (Dry Mass Basis)
No. 4	100
No. 10	97-100
No. 20	95-100
No. 40	90-100
No. 60	60-95
No. 100	20-80
No. 140	7-25
No. 200	5-12

The direct shear tests shall be performed at normal stresses of approximately 5 lb/in² to duplicate field conditions. The soil shall be compacted to a dry density equal to 95 percent of the Standard Proctor maximum dry density (ASTM D698) within ± 2 percent of the Standard Proctor optimum

water content. The interface and soil shall be tested submerged with water. The tests shall be performed using a horizontal displacement rate of 0.3 inches per hour.

6.4 Manufacturing and Factory Quality Control Inspection and Testing

Liner Manufacturer shall submit the following for each HDPE liner type:

- product data sheets and test data presenting minimum physical properties for each property listed in Section 6.3.4 for smooth liner and Section 6.3.5 for textured liner;
- product data sheets for each HDPE base resin type; and
- written certification confirming compliance of the resin and HDPE liner sheets with this Specification.

6.4.1 Minimum Sheet Dimensions

HDPE liner shall be supplied in rolled sheets having a minimum width of 22.5 feet and the minimum lengths shown in the following table.

Thickness (mils)	Minimum Roll Length (feet)	
	Smooth Liner	Textured Liner
40	870	700
60	560	520
80	430	400
100	340	330

Variances for shorter roll lengths based on panel layout or other considerations may be allowed as approved by the Engineer.

6.4.2 Marking and Packaging

Liner Manufacturer shall label each roll with the roll number, thickness, length, width and date manufactured. Each roll shall be individually packaged at the factory and protected to prevent damage during shipment. Liner rolls damaged during shipment shall be rejected. If only the outermost surface of the roll is damaged, it shall be peeled back, cut and wasted. Rolled out liner stock that requires more than one repair patch per 5,000 square feet prior to installation shall be considered faulty and shall be rejected and replaced at the Liner Manufacturer's expense.

6.4.3 Factory Inspection and Spark Testing

Liner Manufacturer shall inspect all liner sheets at the factory for compliance with the physical appearance requirements listed in Section 6.3.3. Liner Manufacturer shall continuously spark test all liner sheets during manufacturing. The spark tester shall be capable of detecting defects or pinholes equal to or less than 10 mils [0.25 mm] in diameter. Liner Manufacturer shall:

- submit a complete description of the spark testing device, operating protocols,

factory quality control plan for operating the system and for identifying and removing defective liner to the Engineer prior to production of liner for the project; and

- provide written certification that all HDPE liner rolls were continuously spark tested and do not contain pinhole defects.

6.4.4 Factory Quality Control Testing and Monitoring

Liner Manufacturer shall submit the factory laboratory quality control manual for all HDPE liner and resin tests required in this Specification to the Engineer prior to production of liner for the project.

Liner Manufacturer shall submit the factory manufacturing quality control plan to the Engineer prior to production of liner for the project. The plan shall identify the manufacturing parameters that are continuously monitored and recorded. Monitored parameters shall include at a minimum extrudate temperature, extruder nozzle pressure, speed of liner production and liner thickness. Factory manufacturing quality control data shall be submitted when requested by the Engineer.

6.4.4.1 HDPE Resin

Factory test reports for HDPE resin shall include:

- the proportions of base polymer, carbon black and other additives;
- test results for melt index, density and oxidative induction time in accordance with the following table: and

Resin Property	Test Method	Minimum Frequency
Density	ASTM D792 [Method B] or ASTM D1505	Once per Batch of Resin
Melt Index	ASTM D1238 [190°C / 2.16 kg]	
Oxidative Induction Time	ASTM D3895 [200°C; 5 lb/in ² O ₂]	

- resin manufacturer's certificate of analysis of each batch of resin.

Resin density and melt index shall be reported for both unblended resin and blended resin after adding carbon black and antioxidants. Oxidative induction time shall be reported for blended resin. Factory test reports shall be submitted for approval to the Engineer prior to shipping liner to the project.

6.4.4.2 Liner Rolls

Factory test reports for each liner roll shall, at a minimum, include test results for the following properties.

- minimum and average thickness
- minimum and average asperity height
- density

- carbon black content and carbon black dispersion
- minimum and average tensile strength and elongation at yield and break
- tear resistance
- puncture resistance
- SP-NCTL

Liner Manufacturer shall perform factory quality control tests in accordance with the following table.

Liner Property	Test Method	Minimum Frequency
Thickness [Smooth Liner]	ASTM D5199	Every Roll
Core Thickness [Textured Liner]	ASTM D5994	
Asperity Height [Textured Liner]	ASTM D7466*	
Tensile Strength at Yield	ASTM D6693**	Every Roll
Tensile Strength at Break	ASTM D6693**	
Elongation at Yield	ASTM D6693**	
Elongation at Break	ASTM D6693**	
Tear Resistance	ASTM D1004**	
Puncture Resistance	ASTM D4833	
Density	ASTM D792 [Method B] or ASTM D1505	Every 5 Rolls
Carbon Black Content	ASTM D4218 or D1603	
Carbon Black Dispersion	ASTM D5596	
Notched Constant Tensile Load Stress Crack Resistance (Single Point at 30% of Yield Stress)	ASTM D5397 [SP-NCTL]	Every 25 Rolls and at a Minimum Once per Batch of Resin
* Each side for double-sided textured liner		
** Tested in machine and transverse directions.		

Factory quality control tests shall be performed in accordance with the following criteria.

- Smooth Liner. Tensile properties, tear resistance and puncture resistance tests may be performed on only one test specimen from each roll [in each direction as applicable] with individual specimen values reported for each roll.
- Textured Liner. Five tensile specimens shall be tested in each direction from each of a minimum of 20 liner rolls. The average and individual test specimen elongation at yield, elongation at break, load at yield and load at break shall be reported for each roll. Tear and puncture tests may be performed on only one test specimen from each roll [in each direction as applicable] with individual test specimen values reported for each roll. The 20 liner rolls shall be consecutive with no more than one break in the sequence of roll number unless approved otherwise by the Engineer. The number of test specimens may be reduced as allowed for smooth liner provided the test results comply with specification requirements and approved by the Engineer.

Certification of the modulus of elasticity, dimensional stability, low temperature brittleness, environmental stress crack resistance, volatile loss, water absorption, water vapor transmission, oven aging and weathering [UV] resistance shall be provided in accordance with Section 6.3.4 for smooth liner and Section 6.3.5 for textured liner.

All factory testing shall be at the Liner Contractor's or Liner Manufacturer's expense.

6.5 Quality Assurance Testing

6.5.1 Sampling by Liner Manufacturer

The Owner will arrange with the Liner Manufacturer for sampling liner rolls during manufacturing for independent testing by the Engineer prior to shipment of the rolls. One 2-foot wide sample across the full width of each roll shall be cut during production. The samples shall be labeled, packaged, and shipped by the Liner Manufacturer to the Engineer for testing.

The following sampling procedure shall be used to allow positive visual confirmation by the Engineer that samples supplied by the Liner Manufacturer represent the corresponding liner rolls.

- Apply three or more randomly and uniquely located, permanent paint-stick markings in the machine direction across the path of the knife on the liner sheet prior to cutting the sample. The markings shall be generally located within 2 feet of the end of the roll bearing the Liner Manufacturer's roll label.
- Cut a minimum 24-inch wide sample across the entire roll width ensuring that the knife passes through the paint markings, leaving half of the marking on the liner roll and the other half on the sample.
- Roll the sample such that the end bearing the paint markings is on the outer end of the rolled sample. The outer end of each sample shall also be marked with the roll number.

The Engineer's representative will observe that the markings on each sample provided for testing match the markings on the corresponding liner roll prior to allowing deployment of a liner roll.

6.5.2 Quality Assurance Testing by Engineer

Quality assurance testing by the Engineer will be made for the HDPE liner properties at the minimum frequencies listed below, unless revised otherwise by the Engineer.

Liner Property	Test Method	Minimum Frequency
Thickness	ASTM D5199 [Smooth Liner]	2 per acre
Core Thickness	ASTM D5994 [Textured Liner]	
Asperity Height	ASTM D7466*	
Density	ASTM D792 [Method B] or ASTM D1505	1 per acre
Carbon Black Content	ASTM D4218 or ASTM D1603	
Tensile Strength at Yield	ASTM D6693**	2 per acre

Liner Property	Test Method	Minimum Frequency
Tensile Strength at Break	ASTM D6693**	2 per acre
Elongation at Yield	ASTM D6693**	
Elongation at Break	ASTM D6693**	
Tear Resistance	ASTM D1004**	
Interface Friction	ASTM D5321	1 per 10 acres
Other Properties	As requested by the Engineer	
* Each side for double-sided textured liner.		
** Tested in both machine and transverse directions.		

Failure of any sample to meet or exceed the requirements specified herein shall be considered cause for rejection of the material or installed liner section from which the sample was collected to the extent designated by the Engineer. If the Liner Contractor or Liner Manufacturer can establish to the Engineer, via additional test results, that the failed sample is representative of a smaller section of the liner, then only that portion will be rejected, provided that such additional tests are performed, at the Liner Contractor's or Liner Manufacturer's expense, by the Engineer.

6.5.3 Sampling by Liner Contractor

In the event sampling is not performed by the Liner Manufacturer in accordance with Section 6.5.1, the Liner Contractor shall obtain and secure samples of the liner during construction for testing by the Engineer from rolls designated by the Engineer, and shall properly mark the samples as needed to identify the liner roll (and panel if applicable) from which the sample was obtained. The sample shall be 2 feet wide across the full width of the roll. Testing by the Engineer will be performed in accordance with Section 6.5.2 unless revised otherwise by the Engineer.

6.6 **Material Warranty**

A written material warranty shall be provided to the Owner from the Liner Manufacturer. This document shall warrant the quality of the liner material for a period of not less than 20 years.

6.7 **Submittals**

The following submittals are required as part of the requirements of this Specification.

- Product data sheets and test data for each liner type listing minimum liner physical properties, and product data sheets for each HDPE base resin type listing resin properties (Section 6.4).
- A written certification from the Liner Manufacturer that the HDPE base resin and liner materials comply with this Specification (Section 6.4).

- Test results and written certification from the Liner Manufacturer that the liner modulus of elasticity, dimensional stability, low temperature brittleness, environmental stress crack resistance, volatile loss, water absorption, water vapor transmission, oven aging and weathering [UV] resistance meet the requirements of this Specification (Section 6.3.4 for smooth liner and Section 6.3.5 for textured liner).
- Description of the spark testing device, operating protocols, factory quality control plan for operating the system and for identifying and removing defective liner (Section 6.4.3).
- Written certification from the Liner Manufacturer that all HDPE liner rolls have been continuously factory spark tested and do not contain pinhole defects (Section 6.4.3).
- Factory laboratory quality control manual for all HDPE liner and resin tests required in this Specification (Section 6.4.4).
- Factory manufacturing quality control plan (Section 6.4.4).
- Factory test reports for each batch of HDPE resin including proportions of base polymer and additives, oxidative induction time, melt index and density. The resin manufacturer's certificate of analysis for each batch of resin shall also be provided (Section 6.4.4.1).
- Factory test reports for each liner roll reporting properties in accordance with this Specification (Section 6.4.4.2).
- Written warranty from the Liner Manufacturer to warrant the quality of the liner material for a period of not less than 20 years (Section 6.6).

SPECIFICATIONS

SECTION 7 HDPE LINER INSTALLATION FOR FINAL COVER SYSTEM

CLOSURE OF CELL 1 OF COMBUSTION WASTE STORAGE AREA

ORLANDO UTILITIES COMMISSION STANTON ENERGY CENTER ORANGE COUNTY, FLORIDA

7.1 Description of Work

This Specification covers the installation of High Density Polyethylene (HDPE) geomembrane liner for the final cover. The HDPE liner shall be installed in accordance with this Specification and as shown on the Drawings. Liner installation shall include: (i) surface water control during liner installation; (ii) maintenance of the prepared 6-inch thick compacted bedding materials for HDPE liner ; (iii) placement and seaming of textured HDPE liner; (iv) excavation of liner anchor trenches; (v) placement of temporary ballast loading; (vi) seaming new liner sheets to existing liner; and (vii) installation of liner penetrations and pipe vents.

7.2 Referenced Standards

The following ASTM International (ASTM) standards are referenced in this Specification.

- D698: Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³))
- D1556: Standard Test Method for Density and Unit Weight of Soil in Place by Sand-Cone Method
- D2216: Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
- D2937: Standard Test Method for Density of Soil in Place by the Drive-Cylinder Method
- D4253: Standard Test Methods for Maximum Index Density and Unit Weight of Soils
- D4254: Standard Test Method for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density
- D4437: Standard Practice for Non-Destructive Testing (NDT) for Determining the Integrity of Seams Used in Joining Flexible Polymeric Sheet Geomembranes
- D4944: Standard Test Method for Field Determination of Water (Moisture) Content of Soil by the Calcium Carbide Gas Pressure Tester

- D5641: Standard Practice for Geomembrane Seam Evaluation by Vacuum Chamber
- D5820: Standard Practice for Pressurized Air Channel Evaluation of Dual Seamed Geomembranes
- D6365: Standard Practice for the Nondestructive Testing of Geomembrane Seams Using the Spark Test
- D6392: Standard Test Method for Determining the Integrity of Nonreinforced Geomembrane Seams Produced Using Thermo-Fusion Methods

7.3 Surface Water Control and Subgrade Maintenance

The liner subgrade shall be maintained well-drained prior to and during liner installation. Liner work areas shall be maintained well-drained and dry to prevent uplift of the liner after installation. The Contractor's proposed methods for dewatering (if needed), surface water control and routing of water to the area designated by the Owner shall be submitted to the Engineer for approval at least two weeks prior to implementation.

The Liner Installer shall maintain, as needed, the condition of the prepared subgrade prior to and during liner deployment and installation such that the prepared subgrade is maintained in accordance with Section 5 of these Specifications at the time of liner deployment.

7.4 Placement of Bedding Materials

The HDPE liner shall be underlain by a minimum of 6 inches of bedding materials at the locations and to the lines and grades shown on the Drawings. Before placement of the HDPE liner bedding materials, the sideslope of the CWSA at the final build-out conditions shall be re-worked, cut, or filled to the lines, grades and dimensions shown on the drawings.

7.4.1 Source of Fill Materials

Fill materials shall be obtained from on-site borrow areas designated by the Owner.

7.4.2 Fill Material Requirements

Fill materials used as a 6-inch thick HDPE liner bedding material shall classify as clean granular fill, subject to approval by the Engineer. The fill materials shall be free from wood, roots, trash, rocks, debris, or other deleterious material.

The clean granular fill materials shall consist of clean, granular soils that classify as SW, SP, SW-SM, SW-SC, SP-SM, and SP-SC in accordance with ASTM D2487. The soil shall have not more than 25 percent by dry weight passing the U.S. Standard No. 200 sieve in accordance with ASTM D1140. With prior approval by the Engineer, SC type soils with not more than 25 percent by dry weight passing the U.S. Standard No. 200 sieve size may also be utilized as bedding materials. The fill materials shall not contain particle sizes larger than 1/4-inch in diameter. The materials shall have an organic content of less than 3 percent.

7.4.3 Fill Materials Placement

The 6-inch thick bedding layer shall be wetted or dried, and homogenized prior to compaction to obtain uniform moisture content. Materials shall be compacted by rolling with a tamping roller, heavy rubber tire roller, steel wheel (sheep-foot) power roller, or other suitable compaction equipment. The Contractor shall plan the traffic flow of equipment to provide a thorough and uniform compaction effort on each successive lift of fill.

7.4.4 Compaction Criteria

Fill materials for the bedding layer shall be compacted to a dry density of not less than 95 percent of the Standard Proctor maximum dry density (ASTM D698). The Engineer shall perform Standard Proctor compaction tests (ASTM D698) on samples of the bedding materials, as needed, to determine the optimum moisture content and maximum dry density to be used for compaction control.

7.4.5 CQA Inspection and Testing

The Engineer, retained by the Owner, will undertake observations, and perform CQA tests to determine compliance of the bedding layer construction with these specifications. Prior to placement, the Engineer shall observe that the side-slope and top of the CWSA at the final build-out condition is satisfactorily prepared. The Engineer shall also verify that the borrow soils used for construction are free of deleterious materials and meet the requirements specified in Section 7.4.2 for the appropriate material classification required for bedding materials. Fines content determinations (ASTM D1140) shall be performed, as needed, to verify conformance of the clean granular fill with the requirements specified in Section 7.4.2.

During placement, the fill materials will be inspected to verify that they have been thoroughly homogenized, uniformly placed and adequately compacted. The Engineer shall make the necessary penetration tests to quantify the uniformity of compaction and probe measurements to verify compliance with the maximum lift thickness specified herein.

The Engineer, retained by the Owner, will perform moisture content determinations and *in situ* density determinations at a minimum rate of two tests per acre of compacted bedding materials using the drive cylinder method (ASTM D2937), or another method approved by the Engineer and deemed equivalent by him at his sole discretion. The thickness of the bedding layer shall be measured at a minimum frequency of four per acre. The Engineer shall compare results of these tests to the results of Standard Proctor tests to determine compliance with the specified compaction criteria.

7.4.6 Maintenance

The Contractor shall maintain and, if needed, restore the condition of the completed bedding layer such that it conforms to the lines and grades shown on the Drawings and to the compaction criteria specified herein until the entire construction has been completed and accepted by the Owner.

7.4.7 Erosion Control Features

Erosion and sedimentation control practices shall be employed by the Contractor to minimize erosion and sedimentation during construction until all work has been accepted by the Owner. Methods, which may be used, include, but are not limited to, vegetation, berms, and silt fences. An erosion control plan outlining the proposed erosion and sedimentation control measures to be undertaken during construction shall be submitted by the Contractor to the Owner for approval prior to construction.

All devices for erosion and sedimentation control shall be installed prior to beginning construction in an area. If the Owner determines that erosion or sedimentation is occurring because of the Contractor's construction activity despite implementation and maintenance of protective measures, the Contractor shall take additional protective measures, as directed by the Owner and at the Contractor's expense.

Upon completion of the work or upon instruction by the Owner, the Contractor shall dismantle and remove erosion and sedimentation control measure implemented during construction.

7.5 **Liner Handling and Installation**

Installation of the liner shall be in compliance with the Drawings and Specifications and with the Liner Manufacturer's standard guidelines and specifications for liner installation, subject to approval by the Engineer, including as applicable, but not limited to the following: liner roll handling and on-site storage; unrolling and laying of liner sheets; field seaming; anchor trench excavation; temporary ballast loading; gas vent installation; liner penetrations; and connecting to existing liner. The Contractor shall submit a liner handling and installation plan to the Owner for review and approval at least two weeks prior to installation.

7.5.1 On-Site Storage

On-site storage shall be as needed to protect the liner rolls from excessive accumulations of soil, or water on the liner surfaces, heat, mechanical abrasion, puncture and vehicular traffic. Liner rolls shall be stored on a firm, dry, elevated surface in a protected storage area designated by the Owner. The liner rolls shall not be stacked more than three rolls high or as otherwise recommended by the Liner Manufacturer.

7.5.2 Handling and Panel Placement

Appropriate handling equipment shall be used when loading or moving rolled liner sheets from one place to another. Appropriate equipment includes spreader and roll bars for deployment, and cloth chokers with a spreader bar for off-loading.

Liner deployment shall not be performed when precipitation is occurring, when excessive moisture (i.e., fog, dew) or wet conditions exist, when the ambient air temperature is below 40°F or above 100°F, when high winds (>20 mph) are occurring, or when other adverse climatologic conditions exist that would, in the opinion of the Engineer and/or Owner, adversely affect liner installation.

The liner sheets shall be unrolled and deployed in a manner which minimizes wrinkles and prevents the occurrence of folds and creases. Liner panels shall be installed from high to low elevation to prevent runoff from flowing below installed liner panels, and shingled at seams with

the upslope panel overlaying the downslope panel. All liner shall be ballasted immediately after deployment to prevent uplift by wind.

“Vise-grips” or other tools, if used to grip the liner during handling and deployment, shall have clean, smooth grip faces, and corners on the grip faces shall be rounded. The pressure applied by the grips shall not be so great as to indent or otherwise damage the liner. The Liner Installer shall demonstrate the methods for handling and deploying liner at the start of installation for approval by the Engineer.

The HDPE liner shall be installed at the locations and to the lines, grades and dimensions shown on the Drawings, or as otherwise approved by the Engineer. Panel layout and deployment shall be such that the seams run down the slope of the dikes and are oriented perpendicular to the top of slope of the dikes. This seam orientation shall be maintained for a distance of not less than 20 feet from the inside toe of the dikes or as otherwise shown on the Drawings or approved by the Engineer.

The Liner Installer shall submit a panel layout plan indicating the proposed liner panel configuration and field seams, and identifying (if applicable and shown on the Drawings) anchor trenches, pipe penetrations, and other details needed to complete the work for approval by the Engineer at least two weeks prior to liner installation.

7.5.3 Field Seams

All liner shall be seamed the same day that the liner is deployed. Welding of field seams shall not take place unless suitable surface and weather conditions exist, the ambient air temperature is above 40° F and below 100°F, and satisfactory field seams can be made as confirmed by field trial test welds. The Liner Installer may submit a procedure for welding in ambient air temperatures below 40°F and above 100°F for review and approval by the Engineer.

All liner sheets must be continuously and tightly bonded using continuous double-wedge fusion welds or extrusion fillet welds both made using automated welding equipment approved by the Engineer. The use of extrusion fillet welds shall be limited to patches at liner panel T-seams, patches at liner repairs, pipe penetrations, or other detail work as approved by the Engineer. Field seaming shall be conducted in the dry, on relatively smooth compacted surfaces, and in such a manner to prevent water, moisture, soil, dust, dirt or other foreign material from being included within the weld.

Adjoining liner sheets shall be overlapped a minimum of 4 inches by adequately lapping the edges of the sheets. The overlap shall not exceed 6 inches for double-wedge fusion welds. Seam overlaps on the bottom area shall be made such that the direction of flow over the lined surface is from the top sheet toward the bottom sheet to form a shingle effect.

Edges to be welded shall be wiped and cleaned thoroughly to remove any water, moisture, soil, dust, dirt or other foreign material. All field seams shall be: symmetric, and uniform in appearance and width satisfying the appearance criteria below and as shown on the Drawings, unless approved otherwise by the Engineer based on peel and shear test results; shall not exhibit heat distortion due to overheating from welding; and shall be uniform in physical properties meeting the seam strength, shear elongation, peel separation and failure mode criteria in Section 7.5.3.1 of this Specification.

- (i) Extrusion Fillet Welds: The surface of extrusion fillet welds shall be uniform and smooth in appearance. The interior of the center extrudate bead shall be homogeneous and uniform in appearance. The weld shall be symmetric in width with the crown of the extrudate bead centered along the edge of the top liner sheet. The total width of the weld shall be between $1\frac{1}{4}$ and $1\frac{3}{4}$ inches with the center bead comprising approximately one-third of the total width. The total thickness of the center of the weld shall be 3 to 4 times the thickness of the liner sheets being welded. The squeeze-out lip along both edges of the weld shall be similar in shape and size.
- (ii) Double-Wedge Fusion Welds: The surface of double-wedge fusion welds shall be uniform in appearance and slightly embossed from the nip rollers along the top and bottom surfaces of both fusion weld areas. The fusion weld areas shall be symmetric, and each shall have a width equal to or greater than $\frac{5}{8}$ inches and thickness reduction of 10 to 25 mils. The width of the air channel shall typically be $\frac{1}{2}$ to $\frac{5}{8}$ inches. Squeeze-out along the inside and outside edges of the fusion welded areas shall be similar in size and typically extend no more than about $\frac{1}{8}$ -inch.

The surface of the HDPE liner sheets along extrusion fillet welds shall be ground prior to welding to remove any oxidized surface film in accordance with the following criteria unless approved otherwise by the Engineer: (i) grind with 80 grit sand paper holding the grinding wheel such that the grinding marks are oriented perpendicular to the seam and made from the bottom sheet toward the top sheet to prevent gouging of the lower sheet; (ii) the edge of the upper sheet shall be beveled approximately 45 degrees by the grinding process; (iii) the depth of grinding shall be approximately 5 percent of the liner thickness and in no case more than 10 percent of the liner thickness; and (iv) the width of grinding shall be slightly less than the width of the extrusion weld such that grinding marks are not visible beyond the edges of the weld. Welding shall be completed within one hour of grinding the surface of the liner.

Heat-degraded resin in the barrel of the extrusion welder shall be purged prior to making extrusion welds.

Seams shall not exhibit heat distortion from overheating during welding (e.g., warping, excessive thermal puckering). The underside of field seams shall be inspected for heat distortion from welding at the end of all seams, wherever samples for destructive testing are cut from the field seam, and at locations identified by the Engineer wherever the appearance of the weld is indicative of potential heat distortion.

7.5.3.1 Field Seam Strength

All welded field seams shall meet the following criteria when tested in accordance with ASTM D6392 except where noted otherwise:

- (i) Shear Strength: The specimen shall exhibit: a strength in shear equal to or greater than 120 lb/inch; a film-tear bond failure (FTB) mode; and a shear elongation at break equal to or greater than 50 percent. The test shall be performed at a rate of displacement of 2 inches/minute for the first 2 inches of displacement, and the test then continued at a rate of displacement of 20 inches/minute until rupture.
- (ii) Peel Strength: The specimen shall exhibit: a peel strength equal to or greater than 91 lb/inch for double-wedge fusion welds and equal to or greater than 82 lb/inch for extrusion fillet

welds; a film-tear bond failure (FTB) mode; and a peel separation (incursion area) less than or equal to 25 percent of the initial bonded area and less than 100 percent of the width of the initial bonded area (excluding the area and width of the squeeze-out from the initial bonded area and width). The peel strength criteria shall apply to both the top and bottom welds of double-wedge fusion welds.

Double-wedge fusion welds exhibiting the following locus-of-break behavior shall be considered non-FTB failure modes: (i) AD; (ii) AD-BRK [with >25% peel separation of the bonded area]; or (iii) AD-BRK [with separation across 100% of the bonded width regardless of separation area]

Extrusion fillet welds exhibiting the following locus-of-break behavior shall be considered non-FTB failure modes: (i) AD1; (ii) AD2; (iii) AD-BRK [with >25% peel separation of the bonded area]; (iv) AD-BRK [with separation across 100% of the bonded width regardless of separation area]; or (v) AD-WLD [with shear strength <120 lb/inch or peel strength <82 lb/inch].

7.5.3.2 Pass/Fail Criteria

The following pass/fail criteria shall be used to determine compliance of field seams with the above strength criteria:

- (i) All five specimens from a given sample tested in peel (both top and bottom for double-edge fusion welds) shall exhibit the specified strength, separation and FTB failure modes, and all five specimens tested in shear shall exhibit the specified strength, shear elongation at break ≥ 50 percent and FTB failure modes (i.e., 0 percent strength, shear elongation at break and peel separation failures, and 0 percent non-FTB failures); or
- (ii) All five specimens from a given sample tested in peel and all five specimens tested in shear shall exhibit the specified strengths, all five specimens tested in shear shall exhibit elongation at break ≥ 50 percent, four of five specimens tested in peel shall exhibit acceptable peel separation, and four of five test specimens, for each type of test, shall exhibit FTB failure modes (i.e., 0 percent strength and shear elongation at break failures, and up to 20 percent non-FTB failures); or
- (iii) One specimen from a given sample tested in peel or shear may exhibit a non-FTB failure and a strength no less than 60 percent of the specified strength provided that all five field seam specimens tested from the duplicate (archive) sample exhibit the specified strength, all five specimens tested in shear exhibit an elongation at break ≥ 50 percent, four of five specimens tested in peel exhibit acceptable peel separation, and no more than one test specimen of the five additional specimens exhibits a non-FTB failure (i.e., 0 percent shear elongation at break failures, 10 percent strength failures, and up to 20 percent non-FTB failures).

If a field seam fails the criteria specified herein, and the Liner Installer wishes to establish to the Engineer that the failed sample represents a smaller section of the field seam than designated by the Engineer, additional samples may be obtained at progressively increasing distances from both sides of the failed sample, at locations approved by the Engineer, until two consecutive samples on each side of the original sample pass the field seam criteria. At that point, the extent of the original defect in both directions along the field seam will be considered isolated and the Liner Installer may then: (i) either cap, re-weld and re-test the seam up to and including the closest of

the two passing samples, and patch and weld the hole of the furthest passing sample; or (ii) cap, re-weld and re-test the entire length of sampling.

If approved by the Engineer, double-wedge fusion welds may be repaired by extrusion welding the flap of the top sheet to the bottom sheet if the seam non-compliance is due only to a non-FTB failure of the destructive test sample.

Duplicate coupons of additional samples requested by the Liner Installer for identifying the extent of a defective seam will not be tested, i.e., the seam shall meet either pass/fail criteria (i) or (ii). The Liner Installer shall reimburse the Owner for the cost of any such requested additional tests which fail to meet the requirements of this Specification.

7.5.4 Anchor Trenches

The liner shall be anchored in anchor trenches at the locations shown on the Drawings. Liner field seams shall be welded continuously through the anchor trench.

Liner anchor trenches shall be no less than 18 inches in width and 24 inches in depth unless indicated otherwise on the Drawings. The corners of the trenches shall be slightly rounded to minimize sharp bends in the liner. After placement of the liner along one side, across the bottom of the trench and partially up the other side, the trench shall be backfilled with fill as shown on the Drawings meeting the materials requirements in Section 5 of this Specification. Anchor trench backfill shall be compacted to a dry density not less than 95 percent of the Standard Proctor maximum dry density (ASTM D698). The liner within the anchor trench shall not be damaged during placement and compaction of the backfill.

7.5.5 Temporary Ballast Loading

Adequate temporary ballast loading that will not damage the liner shall be placed by the Liner Installer over the liner during installation as needed to prevent uplift by wind and by rapid changes in barometric pressure. The temporary ballast loading shall be in addition to anchor trenches and permanent wind ballast trenches if shown on the Drawings. Sufficient temporary ballast loading shall be placed along panel edges, in particular, as needed to minimize the risk of wind flow under the panels. Continuous loading shall be provided at all panel edges during days off, at night, and whenever inclement or stormy weather is anticipated.

Temporary ballast loading may consist of sand filled bags unless indicated otherwise on the Drawings or approved by the Engineer. Bags shall be non-abrasive and non-damaging to the liner, resistant to degradation by ultraviolet radiation, shall contain the selected material without leakage and shall be approved by the Engineer. Soil shall not be placed atop the liner for temporary ballast loading without being adequately and completely contained.

Temporary ballast loading shall be maintained as necessary or as otherwise directed by the Engineer. All temporary ballast loading shall be removed by the Liner Installer prior to demobilizing from the site unless otherwise approved by the Engineer.

The Liner Installer shall submit a complete description and details of the proposed temporary wind ballast at least two weeks prior to liner installation. Approval by the Engineer shall not relieve the Liner Installer from responsibility to provide all temporary wind ballast loading as needed to prevent uplift during construction.

7.5.6 Pipe Penetrations

All pipe penetrations shall be made in accordance with the details shown on the Drawings and the Liner Manufacturer's recommendations, subject to approval by the Engineer. Pipe penetrations through the HDPE liner shall typically consist of a pipe boot, constructed with the same material as the liner penetrated by the pipe, continuously extrusion welded to the liner and the HDPE pipe. Other pipe penetrations, if used, are shown on the Drawings.

7.5.7 Repairs

All liner defects (scratches, blisters, rips, punctures, tears, holes, pinholes, creases, folds, strain-yielded areas, etc.) shall be marked and repaired by completely covering the defect or hole with an oval-shaped piece of the corresponding HDPE liner material extending at least 4 inches beyond the edges of the defect/hole, and continuously welding the patch to the liner using an extrusion weld. Scratches shall be considered a defect when the depth is in excess of 5 percent of the liner thickness or as otherwise determined by the Engineer. Holes created by removal of samples for destructive testing shall be marked, patched and repaired as specified above for liner defects. The panel number, repair location, type of defect, description of repair made, and date repaired shall be documented for each liner repair.

7.5.8 Liner Protection

No equipment, tools or personnel that can readily cause damage to the HDPE liner shall be allowed on the liner during and after installation. Personnel working on the HDPE liner shall not smoke, wear potentially damaging shoes, dispose of trash or other debris, or engage in any activity that could damage the liner.

The passage of construction equipment, other than light rubber-tired equipment approved by the Engineer, over any exposed HDPE liner surface shall be prohibited. Light rubber-tired equipment exerting a contact stress less than 6 lb/in² will be allowed provided proper care is taken when operating the vehicle to avoid: pulling, displacing or damaging the liner; trafficking over wrinkles that become folded or creased by the tires; and making sharp turns and/or abrupt starts/stops.

Excavation of existing soil cover to locate existing liner system shall be performed with plastic shovels to avoid damage to existing liner. Any damage to the liner (scratches, rips, punctures, tears, holes, creases, folds, strain-yielded areas, etc.) shall be immediately reported to the Engineer. Repairs shall be made in a manner approved by the Engineer at the expense of the Liner Installer.

7.5.9 Fuel and Oil Spill Clean-Up

All spills or leaks of fuels or oils from equipment and vehicles on the surface of the liner shall be thoroughly cleaned with soap and water or, at the discretion of the Engineer, the affected liner shall be cut, removed and replaced with new liner material. Subgrade materials contaminated with fuel or oil shall be excavated and replaced to the extent designated by the Engineer. Contaminated materials shall be disposed of on site in an area designated by the Owner.

7.6 Inspection and Field Testing by Liner Installer

7.6.1 Initial Qualifying Welds

All welding technicians shall demonstrate their ability to consistently make successful seams prior to installation of any liner. Each welding technician shall prepare test strips for each type of seam between different liner types, and for both extrusion and double-wedge fusion welds. Each test strip shall have a minimum length of 20 feet. Qualifying welds shall be made using the same conditions that will exist during actual liner installation (i.e., same grinder operator(s) for extrusion welds and making the welds on similar ground conditions). Twelve test specimens shall be cut from the test strip at an approximately uniform spacing of 18 inches or at locations selected by the Engineer, and tested by the Liner Installer in shear and peel (6 test specimens each) for compliance with the Specification requirements in Section 7.5.3. The test strip and test specimens shall satisfy the requirements of Section 7.5.3 before either the welding technician or welding apparatus are allowed to operate on production welds.

7.6.2 Daily Qualifying Welds

At the beginning of each work day, after any interruption in power, after any idle period of greater than 5 hours, and at the request of the Engineer at any other time during the day, each welding technician shall prepare a 3-foot long test strip for extrusion welds, and a 10-foot long test strip for double-wedge fusion welds, using their assigned welding apparatus. Ten test specimens shall be cut from the test strip at locations selected by the Engineer and tested by the Liner Installer in shear and peel (5 test specimens each) for compliance with the Specification requirements in Section 7.5.3. The test strip and test specimens shall satisfy the requirements of Section 7.5.3 before either the welding technician or welding apparatus are allowed to operate on production welds.

7.6.3 Non-Destructive Testing of Welds

The Liner Installer shall continuously test every field weld (i.e., 100 percent of the length of all field seams), including field welds around patches, using non-destructive testing techniques. These tests shall be performed in the presence of the Engineer. Extrusion welds shall be tested using a vacuum box (ASTM D5641). The base of the vacuum box must be able to form tight seal with the liner and weld surface. The vacuum gauge shall be capable of indicating the vacuum in increments of no more than 1/2 lb/in² within the test range.

Once a generous amount of soap solution is uniformly placed over the weld, a minimum vacuum of 4 to 8 lb/in² should be applied and held for a minimum of 10 seconds. Any bubble formation must be noted and the corresponding defective area identified, marked, and subsequently repaired.

Placement of the vacuum box shall continue at successive locations along the extrusion weld and overlap the prior test location by at least 10 percent of the minimum chamber length or at least 2 inches, whichever is greater.

Double-wedge fusion welds shall be non-destructively tested in general accordance with ASTM D5820 by pressurizing the air channel between the two welds to a pressure between 28 and 36 lb/in² and monitoring the pressure for any decline with time. The pressure gauge shall be marked in increments of no greater than 1 lb/in² within the test range. After allowing 2 minutes for

relaxation, the pressure shall be monitored over a test period of not less than 5 minutes. A weld will be considered satisfactory if either of the following criteria is satisfied:

- (i) the loss in pressure is equal to or less than 2 lb/in² and the pressure stabilizes within the 5-minute test period; or
- (ii) if criteria (i) is not satisfied, the additional pressure drop is equal to or less than 1 lb/in² during an additional test period of 5 minutes (i.e., the total pressure drop is less than or equal to 3 lb/in² over a 10-minute test period), and the pressure stabilizes during the second test period.

The length of welded section tested by air pressure shall not exceed 550 feet, without prior approval by the Engineer. The Liner Installer shall cut the end of the air channel to release the air pressure at the end of the test. The needle and air pressure gauge shall be left in-place until it is observed that the air pressure drops to zero.

If a non-compliant pressure drop is noted, pressure testing may be repeated in a step fashion each time halving the length of weld being tested until the extent of the defective weld is determined. Vacuum box testing may also be used to locate a defect in the top weld or in the top of the air channel.

Once the defect is found, it shall be clearly identified, marked and repaired. Any defective seam shall be repaired so that it meets or exceeds the minimum requirements specified herein.

Welds in inaccessible areas, where the use of vacuum box testing is not possible, shall be spark tested in accordance with ASTM D6365, subject to approval by the Engineer.

7.6.4 Sampling and Destructive Testing

The Liner Installer shall obtain and secure samples of the liner and field seams for destructive testing by the Engineer at locations designated by the Engineer. Samples shall be obtained at the frequency specified in Section 7.6.3. The Liner Installer shall obtain seam samples, in triplicate, from the designated location for laboratory testing. One portion of the sample shall be retained by the Liner Installer for testing. If the results of field tests performed by the Liner Installer, in the presence of the Engineer, indicate compliance with the criteria in Section 7.5.3, then the Liner Installer shall provide the second portion of the sample to the Engineer for independent testing. The third portion will be retained by the Owner for archive storage. If the results of peel and shear tests performed by the Liner Installer in the field do not meet the requirements specified herein, then the provisions of Section 7.5.3 shall apply for temporarily determining the extent of repairs pending performance of independent quality assurance tests by the Engineer.

The portions of seam samples provided to the Engineer for laboratory destructive testing and to the Owner for archive storage shall each be not less than 12 inches wide by 18 inches long in the direction of the seam. The seam shall be centered along the sample length. Each of the triplicate sample portions shall be properly marked and identified by the Liner Installer. The Liner Installer shall repair all holes created by sampling in accordance with Section 7.5.7.

7.6.5 Visual Inspection

The Liner Installer shall visually inspect the entire liner surface for any defects including, but not limited to, seam imperfections, badly scuffed areas, scratches, blisters, rips, punctures, tears, holes, pinholes, creases, folds, strain-yielded areas, etc. The Liner Installer shall identify, mark, and repair all noted defects, as well as defects designated by the Engineer. Repairs shall be made in accordance with Section 7.5.7.

7.6.6 Quality Assurance Forms

The Liner Installer shall adopt and use quality assurance forms prepared by the Engineer, or other forms approved by the Engineer, during all applicable phases of liner installation, inspection and testing. The Liner Installer can request to use their forms. The forms must be submitted to the Engineer at least two weeks prior to liner installation for review and approval.

7.6.7 Certification

The Liner Installer's installation supervisor shall observe and check all phases of liner installation. When the liner is accepted by the Owner, the Liner Installer shall submit written certification to the Owner that the installation conforms to the requirements of the Liner Manufacturer.

7.7 **Quality Assurance Inspection and Testing by Engineer**

7.7.1 Base Maintenance and Repair During Liner Installation

The Engineer will undertake observations and perform tests to determine compliance with these Specifications. Quality assurance by the Engineer will include monitoring soil fill placement to determine the suitability of subgrade materials and adequacy of compaction. The Engineer will perform *in situ* density tests: (i) after compaction of fill as needed to fine grade, maintain and restore the condition of the prepared subgrade; (ii) after dressing the slopes of dikes; (iii) after compaction of fill in excavations as needed to restore the grade; and (iv) after compaction of backfill in anchor trenches. *In situ* density tests will be performed by the drive cylinder method (ASTM D2937), sand cone method (ASTM D1556) or other method(s) approved by the Engineer. Water content tests made in the field using a calcium carbide gas pressure moisture tester (ASTM D4944) may be used to provide water content information for construction control, but final acceptance of all liner subgrade material will be based upon the ASTM D2216 test method unless approved otherwise by the Engineer. Penetration test probes may also be performed at the discretion of the Engineer to verify the uniformity of compaction. The Engineer will perform Standard Proctor compaction tests on fill materials (ASTM D698) to determine compliance with compaction requirements.

Testing of the subgrade will be made by the Engineer following final grading and compaction by the Contractor before the surfaces are turned over to the Liner Installer. Testing of the subgrade will be repeated, as determined by the Engineer, immediately prior to liner placement. Final documentation and results from these tests, however, may not be available prior to liner deployment. Such testing shall not relieve the Liner Installer from his responsibility for restoration or repair of unsuitable areas following liner placement, in the event that such is deemed necessary by the Engineer.

7.7.2 Liner Installation

All aspects of the liner installation will be inspected by the Engineer. The Engineer will conduct his own inspections and tests in addition to those performed by the Liner Installer. The Engineer will undertake observations and perform tests to determine compliance of the liner installation with these Specifications. Quality assurance by the Engineer will include monitoring, as applicable: (i) liner handling and panel deployment; (ii) field welding of liner sheets and non-destructive testing of field welds; (iii) installation of anchor trenches; (iv) placement and maintenance of temporary ballast loading; and (v) liner penetrations. The Engineer will monitor liner repair work and evaluate the adequacy and acceptability of all repair work.

7.7.3 Destructive Testing

The Liner Installer shall obtain and secure samples of the liner and field seams for destructive testing by the Engineer from locations designated by the Engineer and shall properly mark all samples as needed to identify the particular seam or liner panel from which the sample was obtained.

Testing of liner material will be conducted by the Engineer as specified in Section 7.7. Seam samples will be taken for destructive peel and shear strength testing by the Engineer at a minimum frequency of 1 sample per 500 feet of field seam. Samples for destructive seam testing will be obtained by the Liner Installer at locations designated by the Engineer within 48 hours of welding the field seam unless approved otherwise by the Engineer.

Duplicate samples of all HDPE liner material and all field seams tested destructively by the Liner Installer shall also be secured by the Liner Installer and submitted to the Engineer for independent testing. All samples shall be properly marked and identified.

Failure of any sample to meet or exceed the requirements specified herein shall be considered cause for rejection of the material, installed liner section, or field seam from which the sample was collected to the extent designated by the Engineer. If the Liner Installer can establish to the Engineer, via submittal of additional test results, that the failed sample is representative of a smaller section of the liner or field seam, then only that portion will be rejected, provided, however, that the additional tests are performed by the Engineer and approved in writing by the Owner. The Liner Installer shall reimburse the Owner for the cost of any such requested additional tests.

7.8 **Insurance**

The Liner Installer shall provide the Owner insurance coverage against blowout or uplift of the liner during installation. The insurance coverage shall remain in effect until the Owner issues a Letter of Acceptance to the Liner Installer.

The Liner Installer shall agree to provide the Owner with a commitment to re-install or replace any liner that may blowout during the time when the insurance coverage is in effect, at the same rate as required during initial installation, without adversely affecting the rate of progress of work yet to be performed. Additional material, manpower and equipment shall be mobilized to the site within two weeks of a blowout occurrence as needed to comply with this commitment.

7.9 **Warranty**

A written warranty shall be provided to the Owner by the Liner Installer. This document shall warrant the quality of the workmanship for a period of not less than 2 years beginning on the date of the Letter of Acceptance from the Owner.

7.10 **As-Built Drawings**

The Liner Installer shall submit to the Engineer, within 30 days of completion of installation of the liner, an as-built plan in AutoCAD format showing the location and identification of all installed liner panels, anchor trenches, liner penetrations, repairs, and destructive test samples.

7.11 **Submittals**

The following submittals are required from the Liner Installer as part of the requirements of the Specifications.

- The proposed methods for dewatering, surface water control and routing water to Owner designated areas shall be submitted at least two weeks prior to implementation (Section 7.3).
- Shop drawings showing the proposed liner panel configuration and field seams and identifying (if applicable and shown on the Drawings) anchor trenches, pipe penetrations, and other details needed to complete the work shall be submitted for approval at least two weeks prior to liner installation (Section 7.5.2).
- A complete description and details of proposed temporary wind ballast loading shall be submitted at least two weeks prior to liner installation (Section 7.5.5).
- Quality assurance forms proposed for use by the Liner Installer for all phases of liner installation, inspection and testing shall be submitted at least two weeks prior to liner installation (Section 7.6.6).
- Certification by the Liner Installer, when the liner is accepted by the Owner, that the liner installation complies with the requirements of the Liner Manufacturer (Section 7.6.7).
- Workmanship warranty for a period of at least two years beginning on the date of the Letter of Acceptance from the Owner (Section 7.9).
- As-built plan of the installed HDPE liner within 30 days of completion of liner installation (Section 7.10)

SPECIFICATIONS

SECTION 8 GEOCOMPOSITES FOR FINAL COVER SYSTEM

CLOSURE OF CELL 1 OF COMBUSTION WASTE STORAGE AREA

**ORLANDO UTILITIES COMMISSION
STANTON ENERGY CENTER
ORANGE COUNTY, FLORIDA**

8.1 Description of Work

This Specification covers the material requirements and installations of the double-sided geocomposites specified for the final cover system as shown on the Drawings. The double-sided geocomposite materials will be supplied by the Owner.

8.2 Referenced Standards

The following ASTM International (ASTM) standards are referenced in this Specification.

D1238: Standard Test Method for Flow Rates of Thermoplastics by Extrusion Plastometer

D1248: Standard Specification for Polyethylene Plastics Molding and Extrusion Materials

D1505: Standard Test Method for Density of Plastics by the Density-Gradient Technique

D1603: Standard Test Method for Carbon Black in Olefin Plastics

D1683: Standard Test Method for Failure of Sewn Seams in Woven Fabrics

D3786: Standard Test Method for Bursting Strength of Textile Fabrics—Diaphragm Bursting Strength Tester Method

D4491: Standard Test Methods for Water Permeability of Geotextiles by Permittivity

D4533: Standard Test Method for Trapezoid Tearing Strength of Geotextiles

D4632: Standard Test Method for Grab Breaking Load and Elongation of Geotextiles

D4716: Standard Test Method for Determining the (In-plane) Flow Rate per Unit Width and Hydraulic Transmissivity of a Geosynthetic Using a Constant Head

D4751: Standard Test Method for Determining Apparent Opening Size of a Geotextile

D4833: Standard Test Method for Index Puncture Resistance of Geomembranes and Related Products

D5199: Standard Test Method for Measuring the Nominal Thickness of Geosynthetics

D5261: Standard Test Method for Measuring Mass per Unit Area of Geotextiles

D7005: Standard Test Method for Determining the Bond Strength (Ply Adhesion) of Geocomposites

D7179: Standard Test Method for Determining Geonet Breaking Force

8.3 Material Requirements

A double-sided geocomposite shall be installed in the final cover system as a drainage layer to prevent the saturation of the soil cover materials that will be placed on top of the HDPE liner and the geocomposite. The double-sided geocomposite shall consist of an HDPE geonet core with non-woven geotextiles heat bonded to one (single-sided geocomposite) or both (double-sided geocomposite) sides of the geonet core. The geonet cores in the geocomposite shall be manufactured from unreinforced HDPE, and shall be designed and manufactured specifically for use as a drainage product. The geotextile used in the geocomposite shall be manufactured from non-woven geotextile that is suitable for material separation.

A complete description of the geocomposite proposed for use with a minimum 1 square yard sample and the Manufacturer's product data sheets shall be submitted by the Contractor to the Engineer for approval at least two weeks prior to delivery of material to the job site. Certifications from the Manufacturer that the geocomposites comply with this Specification shall also be supplied to the Engineer at least two weeks prior to delivery of material to the job site.

8.3.1 Geonet

8.3.1.1 HDPE Resin

The uncolored base resin for manufacturing of the geonet shall have a density of at least 0.932 g/cm³. The formulated colored resin shall have properties equivalent to ASTM D1248, Type III, Category 4 or 5, and Grade P34. The resin shall contain not less than 97 percent of the base polymer and not less than 2.0 percent carbon black as defined in ASTM D1248 for Class C high-density polyethylene. The geonet shall contain no more than 3 percent carbon black, anti-oxidants and heat stabilizers combined, and no other additives, fillers or extenders. The geonet shall be manufactured from virgin resin, with no more than 3 percent regrind material. No post-consumer resin of any type shall be used.

8.3.1.2 Physical Appearance

The geonet shall be uniform in appearance and composition and shall be free of tears, cuts, gels, undispersed ingredients, any signs of contamination by foreign matter, or any defect that may affect serviceability.

8.3.1.3 Physical Properties

The geonet cores of the geocomposite shall meet the following criteria:

Property	Test Method	Criteria
Melt Index (gm/10 mins)	ASTM D 1238, Condition E	≤1.0
Carbon Black Content (%)	ASTM D1603	2.0-3.0
Density (g/cm ³)	ASTM D1505	≥0.94
Thickness Retention (%)	100 psi for 10,000 hours at 20°C temperature	≥75%
Thickness (inches)	ASTM D5199	≥0.30
Transmissivity* (m ² /sec)	ASTM D4716	≥8.0x10 ⁻³
Tensile Strength** (lb/in)	ASTM D7179	≥75
* The values represent the transmissivities of the geonet core in the primary flow direction under a compressive normal load of 10,000 lbs/ft ² and a gradient of 0.1, with water at 70°F between steel plates for 15 minutes. ** Machine direction.		

A complete description of the geonet proposed for use and the Manufacturer's product data sheets and 2-foot long by roll width sample shall be submitted to the Engineer for approval at least two weeks prior to delivery of material to the job site. Certification from the Manufacturer that the geonet complies with this Specification shall also be supplied to the Engineer at least two weeks prior to delivery of material to the job site.

8.3.2 Geotextiles

Geotextiles for the geocomposite shall be a non-woven, needle-punched fabric manufactured from 100 percent polyester or 100 percent polypropylene. The geotextiles shall be uniform and homogeneous in appearance and composition, and free from tears, cuts, thin spots, or any defects that may affect serviceability. Geotextile with a mass of 8 oz/yd² shall be used in the geocomposite. The properties of the geotextiles are as follows:

Property	Units	Test Method	Criteria
Mass per Unit Area	oz/yd ²	ASTM D5261	≥8
Apparent Opening Size	USSS [†]	ASTM D4751	≥80
Grab Breaking Strength*	lb	ASTM D4632	≥220
Grab Elongation*	%	ASTM D4632	≥50
Trapezoidal Tear Strength*	lb	ASTM D4533	≥50
CBR Puncture	lb	ASTM D6241	≥575
Permittivity	sec ⁻¹	ASTM D4491	≥1.3
UV Resistance [500 Hours]	%	ASTM D4355	≥70
* Tested in both machine and transverse directions. † United States Standard Sieve Size.			

A complete description of the non-woven geotextile proposed for use, the Manufacturer's product data sheets, and a 1 square yard sample shall be submitted to the Engineer for approval at least two weeks prior to installation. Certification from the Manufacturer that the non-woven geotextiles comply with this Specification shall also be supplied to the Engineer two weeks prior to installation.

8.3.3 Geocomposite

The geonet core and geotextile in the geocomposite shall meet the requirements of Sections 8.3.1 and 8.3.2 respectively.

Geocomposites shall have a transmissivity (ASTM D4716) of equal to or greater than 2.0×10^{-3} m²/sec in the machine direction under a compressive normal load of 250 lb/ft², a gradient of 0.33, and a seating time of 100 hours.

The bond between the geotextile and the geonet shall have an average ply adhesion (ASTM D7005) of equal to or greater than 1.0 lb/in and a minimum ply adhesion of equal to or greater than 0.5 lb/in.

A complete description of the geocomposite proposed for use with a minimum 2.5 feet long by full width sample and the Manufacturer's product data sheets shall be submitted to the Engineer for approval at least two weeks prior to installation. Certification from the Manufacturer that the geocomposite is in compliance with this Specification shall also be supplied to the Engineer at least two weeks prior to construction.

8.3.4 Frictional Characteristics

The minimum peak interface friction angle between cover soil and double-sided geocomposite for the final cover liner system shall be 34 degrees.

For determining compliance with the specified interface friction angles, direct shear tests will be performed by the Engineer in accordance with Standard ASTM D5321 using a fine sand with silt fill materials (Group Symbol SP-SM in accordance with ASTM D2487) from the site meeting the following gradation.

U.S. Standard Sieve Size	Percent Passing (Dry Mass Basis)
No. 4	100
No. 10	97-100
No. 20	95-100
No. 40	90-100
No. 60	60-95
No. 100	20-80
No. 140	7-25
No. 200	5-12

The direct shear tests shall be performed at normal stresses of approximately 5 lb/in² to duplicate field conditions. The soil shall be compacted to a dry density equal to 95 percent of the Standard Proctor maximum dry density (ASTM D698) within ± 2 percent of the Standard Proctor optimum water content. The interface and soil shall be tested submerged with water. The tests shall be performed using a horizontal displacement rate of 0.3 inches per hour.

8.4 Factory Testing and Inspection

8.4.1 Factory Testing

8.4.1.1 Geonet

Standard factory testing reports for raw materials including melt index and specific gravity or density for each batch of resin used to manufacture the geonet shall be submitted to the Engineer for approval at least two weeks prior to delivery of material to the job site. The resin Manufacturer's certificate of analysis for each batch of resin shall also be provided to the Engineer at least two weeks prior to delivery of material to the job site.

Factory quality control certificates for the geonet component of the geocomposite shall be provided to the Engineer by the Manufacturer at least two weeks prior to construction. As a minimum, the quality control certificates shall contain the geonet roll identification number, date manufactured, roll width and length, and resin batch number. The following factory quality control tests shall be provided at the indicated frequencies:

Property	Test Method	Frequency
Mass per Unit Area	ASTM D5261	Every 10 Rolls
Thickness	ASTM D5199	Every 10 Rolls
Tensile Strength*	ASTM D7179	Every 10 Rolls
Transmissivity**	ASTM D4716	Every 20 Rolls
Melt Index	ASTM D1238	Once per Batch of Resin or Every 10 Rolls
Carbon Black Content	ASTM D1603	Once per Batch of Resin or Every 10 Rolls
Density	ASTM D1505	Once per Batch of Resin or Every 10 Rolls
* Machine and transverse direction.		
** Machine direction.		

Failure of any of the tests shall result in rejection of the corresponding lot of geonet.

8.4.1.2 Non-Woven Geotextile

Factory quality control certificates for the non-woven geotextile component of the geocomposite, shall be provided to the Engineer by the Manufacturer at least two weeks prior to construction. The quality control certificates shall contain the geotextile roll number, date manufactured, roll length, and width. The following factory quality control tests shall be provided for the geotextile component of the composite at the indicated minimum frequencies:

Property	Test Method	Minimum Testing Frequency
Mass per Unit Area	ASTM D5261	Once per 5,000 yd ² and minimum of once per lot
Thickness	ASTM D5199	
Grab Breaking Load	ASTM D4632	
Grab Elongation	ASTM D4632	
Apparent Opening Size	ASTM D4751	
Permittivity	ASTM D4491	

The Manufacturer shall provide test results to the Engineer at least one sample per lot of geotextile for mass per unit area, thickness, apparent opening size, permeability to water, and grab tensile strength and elongation in accordance with the test procedures in Section 8.3.2. Failure of any of the tests shall result in rejection of the corresponding lot of geotextile.

8.4.1.3 Geocomposite

Factory quality control certificates for the geocomposite shall be provided to the Engineer by the Manufacturer at least two weeks prior to installation. The quality control certificates shall contain the geotextile and geonet roll numbers, date manufactured, roll length and roll width. The following factory quality control tests shall be provided for the geocomposite at the indicated minimum frequencies:

Property	Test Method	Minimum Testing Frequency
Ply Adhesion	ASTM D7005	Every 10 rolls
Transmissivity	ASTM D4716	Every 20 rolls

8.4.2 Factory Inspection

The geotextiles and geocomposite shall be visually inspected at the factory prior to shipment for compliance with the physical appearance requirements in Sections 8.3.1.2 and 8.3.2. Any necessary repair shall be made by the Manufacturer at the factory prior to shipment.

8.4.3 Marking and Packaging

Each geocomposite roll shall be individually packaged at the factory to prevent damage during shipping and handling, and shall be completely wrapped by a protective ultraviolet resistant thin plastic film having a minimum thickness of 2 mils. The Manufacturer shall provide each roll with a label indicating the roll number, product name, length, width, and date manufactured.

8.5 **Handling and Installation**

8.5.1 Storage and Handling

The Liner Installer shall be responsible for unloading and storing the geotextile and geocomposite rolls. During unloading, the Liner Installer shall obtain samples from the ends of rolls for testing by the Engineer at locations selected by the Engineer. These samples shall be a minimum of 3 feet long by roll width or as directed by the Engineer. If, during unloading, the Liner Installer notices any defects or unacceptable conditions on the materials, he shall appropriately and promptly notify the Supplier and the Engineer of such conditions.

The geotextile and geocomposite shall remain wrapped in the protective cover and shall be stored, as recommended by the Manufacturer and approved by the Engineer, in an area of the site that protects the rolls from moisture, water, dirt, ultraviolet light, and mechanical damage until the time of installation. The rolls shall not be unwrapped more than one hour before use. Handling of the rolls shall be in accordance with the Manufacturer's recommendations and shall be as needed to protect the geotextiles from damage.

8.5.2 Laying and Installation

The geocomposite shall be installed at the locations and to the lines and dimensions shown on the Drawings.

The geocomposite shall be deployed with the most transmissive direction. The geocomposites shall be installed in a smooth and unwrinkled condition in uniform contact with the underlying materials, and held in place as needed and approved by the Engineer until covered.

The ends of the geonet shall be overlapped a minimum of 12 inches and tied together with polyethylene or polypropylene ties recommended by the Manufacturer and approved by the Engineer. Metallic ties shall not be used. A minimum of three ties shall be used at each joint, and the ties shall be of a color to allow easy inspection (e.g., white or yellow) against the black geonet. The upper and lower geotextiles of the composite at the joint shall be overlapped a minimum of 4 inches, and both geotextile overlaps shall be sewn in accordance with Section 8.5.3. After installation, the geocomposite shall not be left exposed for more than 48 hours prior to covering.

The exposed edge of the geonet on all cut sides and ends of the geocomposite shall be covered with a piece of the same geotextile as on the composite overlapped 12 inches on the bottom and top of the composite. The edge of the top lap shall be held in-place until covered using spot thermal bonding or black PVC pipe wrapping tape as approved by the Engineer and temporary sand bags.

Field joints in the geotextile shall be made using a nominal overlap of 4 inches and the sheets shall be sewn together as recommended by the Manufacturer and approved by the Engineer, and specified in Section 8.5.3. Care should be taken so that the soil or other debris is not trapped between overlaps.

After installation, the geotextile shall not be left exposed for more than 48 hours after the receipt of conformance test results approved by the Engineer, with a total exposure time not to exceed 7 days. No equipment, tools, or personnel that can cause damage to the geotextile or geocomposite shall be allowed on the installed materials during and after installation. The passage of construction equipment over any exposed materials shall be prohibited.

8.5.3 Geotextile Field Seams

Field seams in geotextiles shall be made using a nominal overlap of 4 inches. The geotextile shall be sewn together with a sewing machine using a flat sewn seam with one row of stitches with a minimum of 4 stitches per inch, or a seam and stitching pattern recommended by the Manufacturer and approved by the Engineer. The thread used to sew the seams shall be 2000 denier minimum, or as recommended by the Manufacturer and approved by the Engineer and shall have the same composition as the geotextile. The strength of field seams shall not be less than 50 percent of that of the unaged geotextile in any principal direction when tested in accordance with ASTM D4884 at a strain rate of 12 inches/minute. The Liner Installer shall submit details of the proposed sewing method (type of stitch, number of stitches per inch, number of stitching rows, distance from the edge of the geotextile to the stitches, weight and type of thread, etc.) and a minimum 5-foot long sample of the sewn seam for approval by the Engineer at least one week prior to installation.

8.5.4 Geotextile Repairs

All tears, punctures, thinly stretched sections, or any other defect that may, as determined by the Engineer, render the geotextile unsuitable, shall be repaired by the Liner Installer. Repairs shall be made by overlaying a patch of geotextile over the damaged area with a 12-inch minimum lap all around. The patch shall be sewn to the geotextile, as specified in Section 8.5.3, all around the patch perimeter. Patches on geotextiles of the geocomposite shall be held in place by thermal bonding or 2-inch wide black PVC pipe wrapping tape and sewn in accordance with Section 8.5.3 of this Specification where directed by the Engineer.

Geotextile and geocomposite rolls that require more than one repair to the geotextile from manufacturing defects or shipping/handling damage per roll shall be rejected and replaced.

8.6 **Sampling and Inspection by Contractor**

8.6.1 Sampling

The Contractor shall obtain and secure samples of the geocomposite for destructive testing by the Engineer when the rolls are delivered to the site or subsequently during installation as requested by the Engineer. The samples shall be obtained from locations designated by the Engineer. All samples shall be properly marked and identified by the Contractor. The Contractor shall repair all openings created by sampling in accordance with Section 8.5.4 or completely remove the full width of the roll at the sampling location.

8.6.2 Visual Inspection

The Contractor shall visually inspect the surfaces of the installed geocomposites for any defects including, but not limited to, rips, tears, punctures and defective seams. The Contractor shall identify, mark, and repair all noted defects, as well as defects designated by the Engineer. Repairs to geotextiles shall be made in accordance with Section 8.5.4. Geocomposite with damage to both geotextile surfaces at any location shall be removed and replaced.

The Contractor shall visually inspect the surfaces for soil, ash, dust or debris that could result in clogging of the geonet or geotextiles. If soil, ash, dust or debris is entrapped in the geonet, it shall be removed and replaced or the surfaces cleaned as approved by the Engineer.

8.7 **Quality Assurance Inspection and Testing**

The Engineer will undertake observations and perform quality assurance tests to determine compliance of the materials and work with this Specification. Quality assurance by the Engineer will include monitoring and/or inspecting: (i) geocomposite handling, installation, overlapping and field joining; (ii) the geotextile and geonet for damage; and (iii) geotextile and geonet for excessive entrapped soil, ash, dust or debris that could reduce the transmissivity of the composite.

Laboratory quality assurance tests shall be performed by the Engineer on the geocomposites at the following minimum frequencies.

Material	Property	Test Method	Minimum Testing Frequency
Geonet	Thickness Mass Per Unit Area Density Carbon Black Content	ASTM D5199 ASTM D5261 ASTM D1505 ASTM D1603	Once per 10 rolls
	Tensile Strength Transmissivity*	ASTM D7179 ASTM D4716	Once per 20 rolls
Nonwoven Geotextile	Thickness Mass Per Unit Area Grab Strength & Elongation	ASTM D5199 ASTM D5261 ASTM D4632	Once per 10 rolls
	Apparent Opening Size Permittivity	ASTM D4751 ASTM D4491	Once per 20 rolls
	Field Seam Strength	ASTM D4884	Once per 1,000 feet of field seam and minimum 1 per day
Geonet-Geotextile Composite	Transmissivity Ply Adhesion	ASTM D4716 ASTM D7005	Once per 20 rolls Once per 10 rolls
* Transmissivities of the geonet cores of the geocomposites shall be measured along the primary flow direction under a compressive normal load of 250lb/ft ² and a gradient of 0.33 with water at 70°F between steel plates for 15 minutes. Test cross section for the geocomposite in the final cover liner system shall consist of, from top to bottom, cover soil, geocomposite, and textured HDPE liner under a compressive normal load of 250 lb/ft ² , a gradient of 0.33, and a seating time of 100 hours.			

Samples for quality assurance testing shall be provided by the Manufacturer to the Engineer in accordance with the testing frequencies listed in the table. Samples shall be 2.5 feet long by the full width of the roll, unless a smaller sample is requested by the Engineer. Geonet-geotextile composite rolls for testing shall be selected by the Engineer based on the roll inventory provided by the Manufacturer. The Manufacturer shall also provide unbonded samples 2.5 feet long by the full width of the roll of nonwoven geotextile and HDPE geonet from each geotextile and geonet lot used to manufacture the composite material.

Failure of any sample to meet or exceed the requirements specified herein shall be considered cause for rejection of the material, installed liner section, or field seam from which the sample was collected to the extent designated by the Engineer. If the Liner Installer can establish to the Engineer, via submittal of additional test results, that the failed sample is representative of a smaller section of the liner or field seam, then only that portion will be rejected, provided, however, that the additional tests are performed by the Engineer representing the Owner. The Contractor shall reimburse the Owner for the cost of these additional tests, including tests that fail to meet the requirements of the Specifications.

8.8 Submittals

The following submittals are required from the Contractor as part of the requirements of this Specification.

- A complete description of the non-woven geotextile and HDPE geonet, the Manufacturer's product data sheets for each, and the Manufacturer's certifications that the HDPE geonet and geotextile meet the requirements of this Specification (Sections 8.3.1 and 8.3.2).
- A complete description of the HDPE geocomposite, a minimum 1-square yard sample of the

geocomposite and 1-square yard sample of the non-woven geotextile used on the composite, the Manufacturer's product data sheets, and the Manufacturer's certification that the geocomposite meets the requirements of this Specification (Section 8.3.3).

- Resin certificates for each batch of HDPE resin, and factory quality control certificates for each roll of non-woven geotextile, HDPE geonet, and geocomposite (Section 8.4).
- Proposed sewing method for field seaming the non-woven geotextiles and a minimum 5-foot long sample of sewn seam (Section 8.5.3).

SPECIFICATIONS

SECTION 9 PROTECTIVE SOIL COVER FOR FINAL COVER SYSTEM

CLOSURE OF CELL 1 OF COMBUSTION WASTE STORAGE AREA

**ORLANDO UTILITIES COMMISSION
STANTON ENERGY CENTER
ORANGE COUNTY, FLORIDA**

9.1 General

This Specification covers the material requirements and installations of the soil cover that will be placed as part of the final cover system. The work shall include, placing a 24-inch thick layer of soil protective/drainage layer above the geocomposite drainage layer to the lines and elevations shown on the Drawings.

9.2 Referenced Standards

The following ASTM International (ASTM) standards are referenced in this Specification.

- D698: Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³))
- D1140: Standard Test Method for Amount of Material in Soils Finer than the No. 200 Sieve
- D2487: Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System)
- D2937: Standard Test Method for Density of Soil in Place by the Drive-Cylinder Method
- D2974: Standard Test Methods for Moisture, Ash, and Organic Matter of Peat and Other Organic Soils
- D4318: Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
- D5084: Test Method for Measurement of Hydraulic Conductivity of Saturated Porous Materials using a Flexible Wall Permeameter

9.3 Layout of Work

The Owner will establish reference points for horizontal and vertical controls near the designated construction area of the CWSA. From these reference points, the Contractor shall provide all horizontal and vertical controls necessary to construct the final cover to the lines and grades shown on the Drawings. It is the responsibility of the Contractor to verify all locations and dimensions prior to performance of any work.

9.4 Material Requirements

The soil used for construction of the protective cover layer shall meet the following requirements:

- The material shall have no particle retained on a U.S. ¼-inch standard sieve.
- The material shall have a plasticity index of 0 percent (ASTM D4318).
- The material shall have an organic content no greater than 8 percent (ASTM D2974) except for the upper 6 inches of the protective soil cover where an organic content up to 15 percent may be used to support vegetative growth.
- The material shall classify as a fine sand, sand with silt or silty fine sand with an SP, SP-SM, SM designation in accordance with ASTM D2487.
- The material shall have a fines content equal to or less than 25 percent, as determined by ASTM D1130.
- The material shall be relatively uniform in character and, after compaction, shall have an in-place saturated hydraulic conductivity no greater than 1.0×10^{-4} cm/sec.

9.5 Pre-Construction Testing of Protective Cover Soil

Fill materials for construction of the protective cover shall meet the requirements listed in Section 9.4 and shall be obtained from off-site sources approved in writing by the Owner and Engineer.

For the purpose of determining the hydraulic conductivity for compliance with the specification requirement, laboratory hydraulic conductivity tests shall be performed on three representative samples of the proposed borrow source using specimens compacted to 95 percent of the Standard Proctor maximum dry density (ASTM D698).

9.6 Placement and Compaction Criteria for Protective Cover

Placement of the protective layer for the final cover system shall begin after the installation of the double-sided geocomposite. The protective soil cover shall be wetted or dried, as may be required, homogenized and placed in one single 24-inch thick lift above the geocomposite. Placement of the protective soil cover on the side slopes shall begin at the toe of the sideslope of Cell 1 and progress upslope to the crest of the sideslope. Placement of the protective soil cover directly over the geocomposite shall be performed by light track-mounted equipment (e.g., low ground pressure Caterpillar D-4 or D-5 dozers or equivalent equipment) and traveling on a minimum of 18 inches of sand. Care shall be exercised during placement so as not to damage the liner with the blade or tracks of the placement equipment. The protective soil cover shall be placed in such a manner to avoid pushing, pulling or otherwise stretching the geocomposite and the underlying HDPE liners.

The protective soil cover shall be compacted to a dry density of at least 95 percent of the Standard Proctor maximum dry density. Standard Proctor compaction tests (ASTM D698) shall be

performed on samples of the selected protective soil cover materials, as needed, to determine the maximum dry density for compaction control.

9.7 Construction Quality Assurance Inspection and Testing

A field representative of the Engineer will be present at the site during installation of the top cover to:

- Ascertain that the materials are free of deleterious materials and that construction materials and procedures are in conformance with these specifications, particularly placement of the protective cover layer without damage to the cover liner system.
- Perform *in situ* density tests in the protective cover after compaction and compare the results to the Standard Proctor compaction test (ASTM D698). Testing shall be performed by the dry density method (ASTM D2937) or any other methods approved by the Engineer. Field *in situ* density measurements shall be made at a minimum frequency of two tests per acre.
- A minimum of four thickness measurements shall be conducted per acre.
- Recover samples for laboratory fines content determinations (ASTM D1140) and hydraulic conductivity tests (ASTM D5084). These tests shall be conducted at a minimum frequency of one test per 2 acres.

Laboratory hydraulic conductivity tests (ASTM D5084) shall be conducted on specimens remolded to 95 percent of the Standard Proctor maximum dry density (ASTM D698). If the hydraulic conductivity documented from a sample within a drainage sand layer section does not meet the requirement of the specifications, that drainage layer section shall be re-worked or the materials replaced, as determined by the Engineer. If re-worked, extreme care shall be exercised to prevent damage to the underlying geosynthetic drainage layers and HDPE liners.

9.8 Submittals

The following submittals are required from the Contractor as part of the requirements of the Specifications.

- A complete description of the Contractor's proposed protective soil cover, mineralogical composition and gradation test results, a 50-lb sample of the material, and the Supplier's certification confirming compliance with the Specification requirements.

SPECIFICATIONS

SECTION 10 PRESSURE-RATED HDPE PIPE AND FITTINGS

CLOSURE OF CELL 1 OF COMBUSTION WASTE STORAGE AREA

**ORLANDO UTILITIES COMMISSION
STANTON ENERGY CENTER
ORANGE COUNTY, FLORIDA**

10.1 Description of Work

This Specification covers material requirements, joint requirements, storage and handling, installation, protection and repairs, quality assurance inspection and testing, and required Contractor's submittals for pressure-rated HDPE pipe and fittings shown on the Construction Drawings.

Contractor shall comply with all provisions set forth in this Section 10 and in addition, shall cause its subcontracts with the pipe Supplier to require the pipe Supplier to comply with all provisions of this Section 10.

10.2 Referenced Standards

The following ASTM International (ASTM) standards are referenced in this Specification.

- D638: Standard Test Method for Tensile Properties of Plastics
- D695: Standard Test Method for Compressive Properties of Rigid Plastics
- D696: Standard Test Method for Coefficient of Linear Thermal Expansion of Plastics Between -30°C and 30°C with a Vitreous Silica Dilatometer
- D746: Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact
- D790: Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
- D792: Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement
- D1238: Standard Test Method for Melt Flow Rates of Thermoplastics by Extrusion Plastometer
- D1505: Standard Test Method for Density of Plastics by the Density-Gradient Technique
- D1603: Standard Test Method for Carbon Black Content in Olefin Plastics
- D2513: Standard Specification for Polyethylene (PE) Gas Pressure Pipe, Tubing and Fittings

- D2837: Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials or Pressure Design Basis for Thermoplastic Pipe Products
- D3261: Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing
- D3350: Standard Specification for Polyethylene Plastics Pipe and Fittings Materials
- D4218: Standard Test Method for Determination of Carbon Black Content in Polyethylene Compounds by the Muffle Furnace Technique
- E90: Standard Test Method for Guided Bend Test for Ductility of Welds
- F714: Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Outside Diameter
- F1055: Standard Specification for Electrofusion Type Polyethylene Fittings for Outside Diameter Controlled Polyethylene and Crosslinked Polyethylene (PEX) Pipe and Tubing
- F1473: Standard Test Method for Notch Tensile Test to Measure the Resistance to Slow Crack Growth of Polyethylene Pipes and Resins
- F2206: Standard Specification for Fabricated Fittings of Butt-Fused Polyethylene (PE)
- F2620: Standard Practice for Heat Fusion Joining of Polyethylene Pipe and Fittings

10.3 Material Requirements

HDPE pipe and fittings shall satisfy the following base resin, physical appearance and physical property requirements.

10.3.1 Base Resin

The base resin shall be high density, high molecular weight polyethylene (HDPE) with properties meeting or exceeding ASTM D3350 cell classification 345464C (thermoplastic material designation code PE3608 or higher). The resin shall contain not less than 97 percent of the base resin and not less than 2.0 percent carbon black. The pipe material shall contain no more than 3 percent carbon black, anti-oxidants and heat stabilizers combined, and no other additives, fillers or extenders. Rework material from the manufacturer's pipe production may be used when blended with new resin of the same thermoplastic material designation code provided pipe containing rework material meets the requirements of ASTM F714. Rework material shall be limited to a maximum of 30 percent by weight.

10.3.2 Physical Appearance

All pipes and fittings shall have good appearance qualities. The pipe and fittings shall be homogeneous throughout and uniform in color, opacity, density and physical properties. The

inside and outside surfaces shall be smooth and uniform without chalking, sticky or tacky material, excessive bloom or visible defects. The pipe walls shall be free of holes, cracks, voids, nicks, cuts, gouges, scratches, blisters, gels, undispersed ingredients, any signs of contamination by foreign inclusions, or any defect that may affect serviceability.

10.3.3 Physical Properties

Pipe and fitting dimensions, workmanship, dimension ratio (DR) and corresponding pressure rating shall be in accordance with the requirements of ASTM F714. Pipes shall be furnished in standard lengths equal to or greater than 40 feet.

The pipe material shall meet the following criteria:

Property	Test Method	Criterion
Density [Natural Resin]	ASTM D1505 or D792	>0.947 g/cm ³
Density [Black]	ASTM D1505 or D792	>0.955 g/cm ³
Melt Index	ASTM D1238 [Cond.190/2.16]	<0.15 g/10 min.
Flow Rate	ASTM D1238 [Cond.190/21.6]	>4.0 and <20 g/10 min
Carbon Black Content	ASTM D1603 or D4218	≥2.0% and <3.0%
Flexural Modulus	ASTM D790 [Method 1/Proc. B]	>110,000 lb/in ²
Tensile Strength at Yield	ASTM D638 [Type IV, 2 ipm]	>3,500 lb/in ²
Elongation at Break	ASTM D638 [Type IV, 2 ipm]	>400%
Compressive Strength at Yield	ASTM D695	>1,600 lb/in ²
Hydrostatic Design Basis	ASTM D2837	>1,600 lb/in ²
Slow Growth Stress Crack Resistance [PENT]	ASTM F1473	>500 hours
Low Temperature Brittleness	ASTM D746	<-60°C
Thermal Expansion Coefficient	ASTM D696	<0.022 %/°C

The Contractor or Supplier shall submit a complete description of the HDPE pipe and fittings proposed for use including the Manufacturer's name or trademark, pipe series designation and dimensions to the Engineer for approval at least two weeks prior to pipe installation. Packaging, handling and shipment of the pipe shall also be in accordance with the pipe Manufacturer's standards, instructions and recommendations, subject to the approval of the Engineer. The Manufacturer's product data sheets and certification from the Manufacturer that the pipe and fittings are in compliance with this Specification shall also be supplied to the Engineer at least two weeks prior to installation.

10.3.4 Pipe Sizes

Pipe shall have the nominal diameters and Dimension Ratios (DR) shown on the Drawings. Dimensions, workmanship, DR and corresponding pressure rating shall be in accordance with ASTM F714.

10.3.5 Slotted Pipe

The slots in all slotted HDPE pipe shall be cleanly cut (inside and out), identical in geometry and evenly spaced. There shall be no burrs, tabs, or other remnant HDPE or debris within or protruding from the slots. The slot length shall be located perpendicular to the longitudinal axis of the pipe. Slots shall be located in two straight rows along the length of the pipe. The rows of slots shall be spaced 180 degrees on centers (o/c) around the circumference of the pipe and shall not be staggered.

The slots in the 6-inch diameter HDPE pipe shall meet the following criteria:

Dimension or Area		Criteria
Slot Width (inches)		>0.10 and <0.15
Slot Length Measured Along Outer Pipe Circumference		>1.50 and <2.70
Slotted Area (inches ² /foot of pipe)	Outer Wall	>2.0
	Inner Wall	>1.0
Spacing Between Slots Along Pipe Length (o/c, inches)		>1.0 and <3.0
Distance from End of Pipe Section to First Slot (inches)		7.0 ± 0.50

The Contractor or Supplier shall submit a 3-foot long sample of slotted pipe for each DR rating shown on the Drawings at least two weeks prior to construction. Slotted pipe shall not be delivered to the site without first receiving approval for delivery from the Owner.

10.3.6 Fabricated Fittings

Fabricated fittings made by butt fusing or sidewall fusing cut segments of pipe shall be used where shown on the Drawings. Fabricated fittings shall not be used elsewhere unless molded fittings are not available from the Manufacturer, and if approved by the Engineer. Fabricated fittings shall be made using pipe segments meeting the base resin, physical appearance and physical property requirements specified in Sections 10.3.1 through 10.3.3 of this Specification. All pipe segments in a fabricated fitting shall be pressure rated to exceed by 20 percent the highest pipe pressure rating to which it is connected or have an Equivalent Dimension Ratio [EDR] matching the pipe to which it is joined.

Fabricated fittings shall be in compliance with ASTM F2206 and butt-fusion welded in accordance with ASTM D3261. Shop drawings for fabricated fittings shall be submitted to the Engineer for approval at least two weeks prior to fabrication.

10.3.7 Molded Fittings

Molded fittings, where shown on the Drawings, shall meet the base resin, physical appearance and physical property requirements specified herein. All fittings shall be pressure rated to match the highest pipe pressure rating to which it is connected. Molded butt fittings shall be in compliance with ASTM D2513 and butt-fusion welded in accordance with ASTM D3261. Molded socket fittings shall not be used.

10.3.8 Electrofusion Fitting

Electrofusion fittings, if approved by the Engineer for use in repairs, shall meet the requirements of ASTM F1055.

10.3.9 Cold Bends

Cold bends in HDPE pipe shall be made using the minimum bedding radii listed in table below unless shown otherwise on the Drawings.

Pipe DR	Minimum Cold Bend Radius
7, 7.3	20 times pipe OD
9, 11, 13.5	25 times pipe OD
15.5, 17, 19, 21	27 times pipe OD
26	34 times pipe OD
32.5	42 times pipe OD
with fitting or flange	100 times pipe OD

10.3.10 HDPE Plate for Liner Penetrations

HDPE plate for the liner penetrations shall have the thicknesses and dimensions shown on the Drawings. The HDPE plate shall meet the material property requirements in Sections 10.3.1 through 10.3.3 of this Specification.

10.3.11 Approved Manufacturers

The following manufacturers and corresponding pipe series designations are approved for use:

- Performance Pipe DriscoPlex PE3608/PE4710 Pipe
- PolyPipe EHMW PE3608/PE4710 Pipe

Other manufacturers producing equivalent pipes may be approved provided product data sheets and resin certificates are submitted to the Engineer to confirm compliance with this Specification. The Manufacturer's product data sheets, resin certificates, and certification from the Manufacturer that the pipe and fittings comply with this Specification shall be submitted to the Engineer for approval at least two weeks prior to installation.

10.3.12 Marking and Packaging

The pipe Manufacturer shall mark each pipe length and each fitting with the Manufacturer's name or trademark, thermoplastic material designation code, diameter, dimension ratio and production code.

Packaging, handling and shipment shall be in accordance with the pipe Manufacturer's standards, instructions and recommendations.

10.4 Joint Requirements and Pressure Testing

The HDPE pipe, and pipe and fittings, shall be joined using butt, heat fusion welds in accordance with ASTM D3261 and F2620. All joints shall be made in compliance with the Manufacturer's recommended practice for heater surface temperature, heating time, applied pressure and cooling time, subject to the Engineer's approval. All joints shall be made by trained technicians qualified by the Manufacturer and using equipment and controlled procedures approved by the Manufacturer.

All pipe joints shall be stronger than the pipe itself under both tension and hydrostatic loading conditions. The joints shall be leak-tight, homogeneous and uniform throughout. Butt fusion beads shall be rounded and uniformly sized all around the pipe circumference and shall comply with the dimensional guidelines in ASTM F2620. The Contractor shall submit written documentation certifying compliance with the Manufacturer's standard specifications and Quality Assurance/Quality Control plan for the butt, heat fusion technique. Bent strap tests (ASTM F2620 Appendix X4) shall be performed at least once per day, or as requested by the Engineer, for each pipe diameter and DR to demonstrate the integrity of the fusion welds.

All pipe joints shall be hydrostatically pressure tested prior to burial in accordance with the Manufacturer's recommendations. At a minimum, the pipes shall be filled with water, trapped air bled from the pipe, and the pipe then pressurized to 90 psi. The initial pressure shall be applied and allowed to stand for 3 hours. During this time water should be added at hourly increments to maintain the pressure. After the initial testing period, the pipe shall be filled with water, the pressure returned to 90 psi, and the pressure held for at least 2 hours. The pipeline and joints will be considered to have passed the pressure test if there are no visual leaks, and not more than the following allowance for expansion under test pressure is met.

Diameter (Inches)	Maximum Allowance for Expansion (U.S. Gallons/100 Feet of Pipe)	
	2-Hour Test	3-Hour Test
12	2.3	3.4
16	3.3	5.0
18	4.3	6.5
24	8.9	13.3
30	12.7	19.2
36	18.0	27.0
42	23.3	35.5

These testing criteria will not be waived unless the hydraulic pressure tests of the welded pipe are performed in accordance with Section 10.4 of the Specifications.

Bolted flange connections, where specified on the Drawings, shall be made in accordance with the Manufacturer's recommendations and the details shown on the Drawings. The flange outside diameter and drilling configuration shall conform to ANSI standards. Bolts, nuts and flat washers shall be new materials and AISI type 316 stainless steel. The HDPE flanges shall have AISI type 316 stainless steel back-up rings. Bolts shall be lubricated with non-fluid lubricant grease and torqued in accordance with the guidelines listed in table below unless recommended otherwise by the HDPE flange and back-up ring Manufacturer.

Pipe Diameter (inch)	Flange Outside Diameter (inch)	Bolt Circle Diameter (inch)	Bolt Hole Diameter (inch)	No. of Bolts	Bolt Diameter and TPI	Bolt Torque No Gasket PE to PE (ft-lbs)
2	6.00	4.75	0.75	4	5/8" - 11	60
4	9.00	7.50	0.75	8	5/8" - 11	60
6	11.00	9.50	0.88	8	3/4" - 10	100
8	13.50	11.75	0.88	8	3/4" - 10	100
10	13.00	14.25	1.00	12	7/8" - 9	150
12	19.00	17.00	1.00	12	7/8" - 9	150
16	23.50	21.25	1.12	16	1" - 8	150

The flange components shall be assembled and aligned, the bolts hand tightened, and the alignment rechecked after hand tightening is complete. The crisscross tightening pattern and percentage of bolt torque applied for each round of tightening shall be in accordance with The Plastic Pipe Institute, Inc. Technical Note TN-38 Bolt Torque for Polyethylene Flanged Joints. Re-torquing of the bolts shall be performed after 4 hours and 24 hours when the bolts are cool. Checking of the torque for each bolt shall be performed by the Contractor in the presence of the Engineer.

Flanged connections will not be allowed to be buried unless the bolts are cool, and the torque of each bolt checked just prior to burial.

10.5 Storage and Handling

The Contractor shall comply with the pipe Manufacturer's recommendations for handling and storing pipe and fittings. The pipe shall be stored on clean, level ground to prevent undue scratching or gouging and as needed to protect the pipe from: being covered with excessive dirt, from water and moisture, and from mechanical abrasion. Care shall be taken to minimize the amount of soil collected inside the pipe while handling and installing. The handling of the pipe shall be in such a manner that the pipe is not damaged by dragging it over sharp objects, and care shall be exercised during installation not to damage the pipe and fittings.

- Any pipe section, fitting or joint which becomes broken, cracked, crushed, cut, scratched, gouged or otherwise rendered unsuitable, as determined by the Engineer, shall be removed and replaced by the Contractor. Scratches greater than 6 inches in length and gouges exhibiting a depth in excess of 8 percent of the wall thickness of the pipe shall be cause for rejection of pipe or fittings to the extent designated by the Engineer.

10.6 Storage and Handling

10.6.1 HDPE Pipe and Fittings

Pipe laying, handling and installation shall be in accordance with the pipe Manufacturer's recommendations as approved by the Engineer, these Specifications, and the details shown on the Drawings.

Pipe sections shall be joined adjacent to the location where the pipe is to be installed. The joined sections of pipe shall then be placed in position on the prepared bedding. Care shall be taken not to drop the pipe while moving and handling, and to avoid excessively bending, stressing or

straining the pipe during installation. When pulling the pipe, either a pulling head or a suitable wraparound sleeve with rubber protective cover shall be used to prevent the pulling cables from damaging the pipe. The maximum pulling length shall be limited to 500 feet.

Slotted HDPE pipe, where shown on the Drawings, shall be installed with the two rows of slots centered at the pipe spring-line.

Pipe installation and placement of backfill around pipes shall be performed when the pipe is in a contracted state, i.e., during the cool of morning, at night or during periods of over-cast skies.

Immediately after placement, the pipe shall be thoroughly and completely embedded, supported, and covered with backfill placed and compacted in accordance with these Specifications and the details shown on the Drawings.

10.6.2 Pipe Seep Shields

Pipe seep shields shall be field fabricated from HDPE liner to the lines and dimensions shown on the Drawings, and connected to the HDPE pipes with flanged connections in accordance with the details shown on the Drawings. HDPE seep shields shall be extrusion welded to the HDPE liner by the Liner Installer in accordance with these Specifications and the details shown on the Drawings. Shop drawings of the pipe connections to the seep shields shall be submitted to the Engineer prior to fabrication for approval.

10.6.3 Liner Pipe Penetrations

Liner pipe penetrations shall be fabricated from HDPE plate to the lines and dimensions, and in accordance with the details shown on the Drawings. Shop drawings of the liner penetrations shall be submitted to the Engineer prior to fabrication for approval.

10.6.4 HDPE Structures

HDPE structures (manholes, sumps, drainage structures) shall be fabricated to the lines and dimensions, and in accordance with the details shown on the Drawings. Shop drawings for each HDPE structure shall be submitted to the Engineer prior to fabrication for approval. HDPE pipe and HDPE plate used in structures shall meet the material property requirements in Section 10.3.1 through Section 10.3.4.

10.7 **Protection and Repairs**

Care shall be exercised during construction not to damage the pipes and fittings. Construction equipment shall not be allowed to pass over any pipe until a minimum of 2 feet of compacted cover is placed above the crown of the pipe.

Any pipe section, fitting or joint, which becomes broken, cracked, crushed, cut, scratched, gouged or otherwise rendered unsuitable, as determined by the Engineer, shall be removed and replaced by the Contractor. Scratches greater than 6 inches in length and gouges exhibiting a depth in excess of 8 percent of the wall thickness of the pipe or fitting shall be cause for rejection of a pipe section or fitting to the extent designated by the Engineer.

10.8 Quality Assurance Inspection and Testing

The Engineer, representing the Owner, will undertake observations and inspections to determine compliance of the materials and work with this Specification. The Engineer will monitor and/or inspect: (i) the HDPE pipe and fittings; (ii) damage during installation; and (iii) the installation, alignment and joining of pipe and fittings.

The Contractor shall obtain and secure samples of slotted pipe and fusion welds for testing by the Engineer. The Contractor shall obtain the samples from locations designated by the Engineer. All samples shall be properly marked and identified by the Contractor.

Tests will be performed by the Engineer on pipe and fusion weld samples at the following minimum frequencies.

Property	Test Method	Minimum Testing Frequency
Slot Dimensions and Slotted Area	Caliper Measurements	Once per 1,000 feet
Fusion Weld Integrity	Wall Thickness $\leq 1"$ Bent Strap Test ASTM F2620 [App. X4]	Once per day per Pipe Diameter and DR
	Wall Thickness $> 1"$ ASTM E190	
Density Melt Index Carbon Black Content	ASTM D792 or ASTM D1505 ASTM D1238 [Cond 190/2. 16] ASTM D1603 or D4218	Once per 10,000 feet

Failure of any sample to meet the requirements specified herein shall be considered cause for rejection of the material or installed section from which the sample was collected to the extent designated by the Engineer. If the Contractor can establish to the Engineer, via additional tests performed by the Engineer, that the failed sample is representative of a smaller section of the installed material than the entire lot represented by the original test sample, then only that portion will be rejected. The additional tests, however, shall be performed by the Engineer representing the Owner. The Contractor shall reimburse the Owner for any such requested test that fails to meet the requirements specified herein.

10.9 Submittals

The following submittals are required from the Contractor or Owner's pipe supplier as part of the requirements of the Specifications.

- A complete description of the HDPE pipe and fittings with the Manufacturer's product data sheets, description of the HDPE resin, Manufacturer's certificate of analysis for the HDPE resin, and Manufacturer's certification that the pipe and fittings satisfy the requirements of this Specification.
- A complete description of the slot dimensions, spacing and orientation, and 3-foot long section of each type of slotted pipe with different DR ratings.
- Shop drawings for: fabricated pipe vents; pipe connections to the seep shields; liner pipe penetrations; HDPE structures; and non-standard fabricated pipe fittings.

SPECIFICATIONS

SECTION 11 GEOTEXTILE

CLOSURE OF CELL 1 OF COMBUSTION WASTE STORAGE AREA

ORLANDO UTILITIES COMMISSION STANTON ENERGY CENTER ORANGE COUNTY, FLORIDA

11.1 Description of Work

This Specification covers the material requirements and installation of the non-woven geotextile for the gravel drains and concrete erosion control mat shown on the Drawings.

11.2 Referenced Standards

The following ASTM International (ASTM) standards are referenced in the Specification.

- D792: Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement
- D1238: Standard Test Method for Flow Rates of Thermoplastics by Extrusion Plastometer
- D1505: Standard Test Method for Density of Plastics by the Density-Gradient Technique
- D1603: Standard Test Method for Carbon Black in Olefin Plastics
- D1693: Standard Test Method for Environmental Stress-Cracking of Ethylene Plastics
- D3786: Standard Test Method for Hydraulic Bursting Strength of Knitted Goods and Nonwoven Fabrics-Diaphragm Bursting Strength Tester Method
- D3787: Standard Test Method for Bursting Strength of Textiles-Constant-Rate-of-Traverse (CRT) Ball Burst Test
- D4355: Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture and Heat in a Xenon Arc Type Apparatus
- D4491: Standard Test Methods for Water Permeability of Geotextiles by Permittivity
- D4533: Standard Test Method for Trapezoid Tearing Strength of Geotextiles
- D4595: Standard Test Method for Tensile Properties of Geotextiles by the Wide-Width Strip Method

- D4632: Standard Test Method for Grab Breaking Load and Elongation of Geotextiles
- D4716: Standard Test Method for Constant Head Hydraulic Transmissivity (In-Plane Flow) of Geotextiles and Geotextile Related Products
- D4751: Standard Test Method for Determining Apparent Opening Size of a Geotextile
- D4833: Standard Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products
- D4884: Standard Test Method for Strength of Sewn or Bonded Seams of Geotextiles
- D4976: Standard Specification for Polyethylene Plastics Molding and Extrusion Materials
- D5199: Standard Test Method for Measuring Nominal Thickness of Geotextiles and Geomembranes
- D5261: Standard Test Method for Measuring Mass per Unit Area of Geotextiles
- D6241: Standard Test Method for Static Puncture Strength of Geotextiles and Geotextile-Related Products Using a 50-mm Probe
- D7005: Standard Test Method for Determining the Bond Strength (Ply Adhesion) of Geocomposites
- D7179: Standard Test Method for Determining Geonet Breaking Force

11.3 Material Requirements

11.3.1 Geotextile

The geotextile shown on the Drawings shall be a non-woven, needle-punched fabric manufactured from 100 percent polyester or 100 percent polypropylene. The geotextile shall be uniform and homogeneous in appearance and composition, and free from tears, cuts, thin spots, or any defects that may affect serviceability.

The non-woven geotextile shall meet the following criteria.

Property	Unit	Test Method	Criteria
Mass per Unit Area	oz/yd ²	ASTM D5261	12
Apparent Opening Size	USSS [†]	ASTM D4751	≥100
Grab Tensile Strength*	lbs	ASTM D4632	≥320
Grab Elongation*	%	ASTM D4632	≥50
Trapezoidal Tear Strength*	lbs	ASTM D4533	≥120
Permittivity	sec ⁻¹	ASTM D4491	≥0.85
CBR Puncture	lbs	ASTM D6241	≥900
UV Resistance	%	ASTM D4355	≥70
* Tested in both machine and transverse directions.			
† United States Standard Sieve Size.			

A complete description of the geotextiles proposed for use and the Manufacturer's product data sheets shall be submitted to the Engineer for approval at least two weeks prior to installation. Certification from the Manufacturers that the geotextiles are in compliance with this Specification shall also be supplied to the Engineer two weeks prior to installation.

11.4 Factory Testing and Inspection

11.4.1 Factory Testing

Factory quality control certificates for the non-woven geotextile shall be provided to the Engineer by the manufacturer at least two weeks prior to installation. The quality control certificates shall contain the geotextile roll number, date manufactured, roll length and roll width.

The following factory quality control tests shall be provided at the indicated minimum frequencies:

Geotextile Property	Test Method	Minimum Testing Frequency
Mass per Unit Area	ASTM D5261	Once per 5,000 yd ² and minimum of once per lot
Grab Breaking Load	ASTM D4632	
Grab Elongation	ASTM D4632	
Apparent Opening Size	ASTM D4751	
Permittivity	ASTM D4491	

Failure of any of the tests shall result in rejection of the corresponding lot of geotextile.

Factory quality control certificates for geotextile shall be provided to the Engineer by the manufacturer at least two weeks prior to installation. The quality control certificates shall contain the geotextile roll numbers, date manufactured, roll length and roll width.

11.4.2 Factory Inspection

The geotextiles shall be visually inspected at the factory prior to shipment for compliance with the physical appearance requirements in Sections 11.3.1. All necessary repairs shall be made by the Manufacturer at the factory prior to shipment.

11.4.3 Marking and Packaging

Each geotextile roll shall be individually packaged at the factory to prevent damage during shipping and handling and shall be completely wrapped by a protective ultraviolet radiation resistant thin plastic film having a minimum thickness of 2 mils. The Manufacturer shall provide each roll with a label indicating the roll number, product name, roll length, roll width and date manufactured.

11.5 **Handling and Installation**

11.5.1 Storage and Handling

The Liner Installer shall be responsible for unloading and storing the geotextile rolls. During unloading, the Liner Installer shall obtain samples from the ends of rolls for testing by the Engineer at locations selected by the Engineer.

The geotextiles shall remain wrapped in the protective cover and shall be stored, as recommended by the Manufacturer and approved by the Engineer, in an area of the site that protects the rolls from moisture, water, soil, dirt, ultraviolet radiation and mechanical damage until the time of installation. The rolls shall not be unwrapped more than one hour before use. Handling of the rolls shall be in accordance with the Manufacturer's recommendations and shall be as needed to protect the geotextiles from damage.

11.5.2 Laying and Installation

The geotextile shall be installed at the locations and to the lines, grades and dimensions shown on the Drawings. After installation, the geotextile shall not be left exposed for more than 48 hours prior to covering with the overlying material shown on the Drawings. Equipment, tools or personnel that can damage the geotextile shall not be allowed on the installed materials during and after installation. The traffic of construction equipment over any exposed materials shall be prohibited.

Geotextile that requires more than one repair per roll from manufacturing defects or shipping damage that is discovered during deployment shall be rejected and replaced unless approved otherwise by the Engineer.

Geotextile seams shall overlap a minimum of 4 inches. Care should be taken so that soil or other debris is not trapped within the overlap. The geotextile overlap shall be sewn in accordance with Section 11.5.3.

11.5.3 Geotextile Field Seams

Field seams in the non-woven geotextiles shall be made using a minimum overlap of 4 inches. The geotextile shall be sewn together with a sewing machine using a flat sewn seam with one row of stitches with a minimum of 4 stitches per inch, or a seam and stitching pattern recommended by the Manufacturer and approved by the Engineer. The thread used to sew the seams shall be 2000 denier minimum, or as recommended by the Manufacturer and approved by the Engineer, and shall have the same composition as the geotextile. The strength of field seams

shall not be less than 50 percent of that of the unaged geotextile when tested in accordance with ASTM D4884.

The Liner Installer shall submit details of the proposed sewing method (type of stitch, number of stitches per inch, number of stitching rows, distance from the edge of the geotextile to the stitches, weight and type of thread, etc.) and a minimum 5-foot long sample of the sewn seam for approval at least two weeks prior to installation.

11.5.4 Geotextile Repairs

All tears, punctures, thinly stretched sections, or any other defect that may, as determined by the Engineer, render the geotextile unsuitable, shall be repaired by the Liner Installer. Repairs shall be made by overlaying a patch of geotextile over the damaged area with a 12-inch minimum lap all around. The patch shall be sewn to the geotextile, as specified in Section 11.5.3, all around the patch perimeter. Geotextile that require more than one repair to the geotextile per roll shall be rejected and replaced.

11.6 Sampling and Inspection

11.6.1 Sampling by Manufacturer

The Manufacturer shall obtain and secure samples of the geotextile during manufacturing for independent testing by the Engineer prior to shipment of the rolls. One 2.5-foot wide sample across the full width of each roll shall be cut during production. The samples shall be labeled, packaged, and shipped by the Manufacturer to the Engineer for testing.

11.6.2 Visual Inspection

The Liner Installer shall visually inspect the surfaces of the installed geotextiles for any defects including, but not limited to, rips, tears, punctures and defective seams. The Liner Installer shall identify, mark, and repair all noted defects, as well as defects designated by the Engineer. Repairs to geotextiles shall be made in accordance with Section 11.5.4.

The Liner Installer shall visually inspect the surfaces for soil, dust or debris that could result in clogging of the geonet or geotextiles. If soil, dust or debris is entrapped in the geotextile that section of geotextile shall be removed and replaced.

11.7 Quality Control Inspection and Testing

The Engineer will undertake observations and perform quality control tests to determine compliance of the materials and work with this Specification. Quality control by the Engineer will include monitoring and/or inspecting: (i) placement for compliance with the lines, grades and dimensions shown on the Drawings; (ii) geotextile handling, installation, overlaps and field sewn seams; (iii) the geotextile for damage; and (iv) the geotextile for excessive entrapped soil, dust or debris that affect performance of the geotextile.

Laboratory quality control tests may be performed by the Engineer on the geotextile at the following minimum indicated frequencies.

Property	Test Method	Minimum Testing Frequency
Transmissivity	ASTM D4716	Once per 20 rolls
Mass Per Unit Area	ASTM D5261	Once per 20 rolls
Grab Strength & Elongation Apparent Opening Size Permeability	ASTM D4632 ASTM D4751 ASTM D4491	Once per 20 rolls
Field Seam Strength	ASTM D4884	Once per 1,000 feet of field seam (minimum 1 day)

Failure of any sample to meet the requirements specified herein shall be considered cause for rejection of the material or installed section from which the sample was collected to the extent designated by the Engineer. If the Liner Installer can establish to the Engineer, via additional tests performed by the Engineer, that the failed sample is representative of a smaller section of the installed material than the entire lot represented by the original test sample, then only that portion will be rejected. The additional tests however, shall be performed by the Engineer representing the Owner. The Liner Installer shall reimburse the Owner for any such requested test that fails to meet the requirements specified herein.

11.8 Submittals

The following submittals are required from the Liner Installer as part of the requirements of this Specification.

- A complete description of the non-woven geotextile, the Manufacturer's product data sheets, and the Manufacturer's certification that the geotextile meet the requirements of this Specification (Section 11.3.1).
- A minimum 10 square feet sample of the non-woven geotextile.
- Factory quality control certificates for each roll of non-woven geotextile.
- The proposed sewing method for field seaming the woven and non-woven geotextiles and a minimum 5-foot long sample of sewn seam for each (Section 11.5.3)

SPECIFICATIONS

SECTION 12 AGGREGATES

CLOSURE OF CELL 1 OF COMBUSTION WASTE STORAGE AREA

ORLANDO UTILITIES COMMISSION STANTON ENERGY CENTER ORANGE COUNTY, FLORIDA

12.1 Description of Work

This section of the Specifications covers the material requirements and installation of aggregate in the gravel drains as shown on the Construction Drawings.

Contractor shall comply with all provisions set forth in this Section 12 and in addition, shall cause its subcontracts with the Supplier to require the Supplier to comply with all provisions of this Section 12.

12.2 Referenced Standards

The following ASTM International (ASTM) standards and Florida Department of Transportation (FDOT) standards are referenced in this Specification:

- D2487: Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)
- D2488: Standard Practice for Description and Identification of Soils (Visual-Manual Procedure)
- D2974: Standard Test Methods for Moisture, Ash, and Organic Matter of Peat and Other Organic Soils
- D4254: Standard Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density
- D4373: Standard Test Method for Rapid Determination of Carbonate Content of Soils
- D6913: Standard Test Method for Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis
- FDOT: Standard Specifications for Road and Bridge Construction

12.3 Material Requirements

12.3.1 Silica Gravel

The silica gravel shall consist of rounded, sub-rounded to sub-angular processed clean silica gravel mined from an alluvial deposit. The silica gravel shall contain at least 98% silica, and shall classify as a GP-type poorly graded fine gravel, or fine gravel with coarse sand, in accordance with ASTM D2487, Classification of Soils for Engineering Purposes. The silica gravel shall exhibit the following gradation requirements as determined using ASTM D6913:

U.S. Standard Sieve Size	Percent Passing (Dry Weight Basis)
1-inch	100
3/4-inch	80-100
3/8-inch	12-40
No. 4	0-25
No. 8	0-8
No. 40	0-1
No. 200	0-0.3

A complete description of the proposed filter gravel, including its chemical composition and the gradation test results, shall be submitted by the Contractor to the Engineer for approval at least one week prior to delivery of the material to the job site to confirm compliance with these specifications.

12.3.2 Coarse Sand (Not used for this Project)

Coarse sand shall consist of clean silica sand containing at least 35 percent rounded, sub-rounded to sub-angular particles, and no more than 70 percent angular particles. Particle angularity shall be determined in accordance with ASTM D2488 criteria for coarse-grained particles. The material shall classify as poorly-graded coarse sand with fine gravel to poorly-graded coarse to medium sand [Group Symbol SP] in accordance with ASTM D2487.

Coarse sand shall meet the gradation requirements listed below, unless approved otherwise by the Engineer, determined in accordance with ASTM D6913.

U.S. Standard Sieve Size	Percent Passing (Dry Mass Basis)
3/8-inch	100
No. 4	62 - 100
No. 6	35 - 87
No. 8	15 - 64
No. 10	12 - 50
No. 20	0 - 20
No. 40	0 - 10
No. 200	0 - 0.5

Coarse sand shall also meet the following criteria:

- (i) contain at least 98 percent silica;
- (ii) the carbonate content determined in accordance with ASTM D4373 shall be less than 1 percent; and
- (iii) the organic content determined in accordance with ASTM D2974 [Method C] shall be less than 0.1 percent.

A complete description of the coarse sand, mineralogic composition, gradation test results, a 25-pound sample of aggregate, and the Supplier's certification confirming compliance with this Specification shall be submitted to the Engineer for approval at least two weeks prior to construction.

12.3.3 Fine Sand

Fine sand shall classify as poorly-graded medium to fine sand [Group Symbol SP] in accordance with ASTM D2487. Fine sand shall meet the gradation requirements listed below, unless approved otherwise by the Engineer, determined in accordance with ASTM D6913.

U.S. Standard Sieve Size	Percent Passing (Dry Mass Basis)
No. 10	100
No. 20	60 - 100
No. 40	25 - 72
No. 60	10 - 41
No. 100	0 - 20
No. 140	0 -11
No. 200	0 -4
No. 270	0 -1

Fine sand shall also meet the following criteria:

- (i) contain at least 98 percent silica;
- (ii) the carbonate content determined in accordance with ASTM D4373 shall be less than 1 percent; and
- (iii) the organic content determined in accordance with ASTM D2974 [Method C] shall be less than 0.1 percent.

A complete description of the fine sand, mineralogic composition, gradation test results, a 25-pound sample of aggregate, and the Supplier's certification confirming compliance with this Specification shall be submitted to the Engineer for approval at least two weeks prior to construction.

12.4 **Placement**

Placement of the silica gravel for the drain shall be in accordance with the locations, lines, grades,

dimensions and details shown or identified on the Construction Drawings, and in compliance with this section.

Following the installation of the HDPE pipe above the 12-oz non-woven geotextile, silica gravel shall be carefully placed on both sides of the pipe and above the pipe to the minimum thickness and dimensions shown on the Construction Drawings. The gravel pack shall be carefully shaped to grade along the pipe length to be installed. Care shall be exercised during placement so as not to damage the geotextile fabric and to avoid pulling the fabric. Any damage to the fabric shall be repaired by the Contractor at his expense.

Placement of the silica gravel shall be controlled such that the gravel completely surrounds the pipe. Precautions shall be taken to prevent lateral or vertical movement of the pipe and the geotextile fabric during filling. The pipe shall be weighted down as needed. The silica gravel shall completely fill around and be in contact with the pipe circumference, with particular care taken to ensure that voids are not present around the lower one-third of the pipe circumference. Care shall be exercised so as not to damage the pipes and filter fabric. Any damage to the pipes and filter fabric shall be repaired by the Contractor at his expense. Care shall be taken to prevent the silica gravel and sand materials from becoming contaminated with soil or dust, prior to and during placement.

12.5 Quality Assurance Monitoring and Testing

The Engineer will undertake observations and perform tests to determine compliance of the materials and work with this Specification. Quality assurance by the Engineer will include monitoring the suitability and placement of the aggregates. Laboratory tests will be performed by the Engineer on samples of aggregate at the minimum frequencies listed in the following table unless revised otherwise by the Engineer during construction.

Material	Property	Test Method	Minimum Testing Frequency
Gravel	Mineralogic Composition Particle Shape Gradation Classification	Visual Examination ASTM D2488 ASTM D6913 ASTM D2487	Once per 1,000 yd ³
	Total Carbonates Soluble Silica	ASTM D4373 0.3M H ₂ SO ₄ Extraction	Once per 2,000 yd ³
Sand	Particle Shape Gradation Classification Total Carbonates	ASTM D2488 ASTM D6913 ASTM D2487 ASTM D4373	Once per 500 yd ³

Failure of any sample to meet the requirements specified herein shall be considered cause for rejection of the material or installed section from which the sample was collected to the extent designated by the Engineer. If the Contractor can establish to the Engineer, via additional tests performed by the Engineer, that the failed sample is representative of a smaller section of the installed material than the entire lot represented by the original test sample, then only that portion will be rejected. The additional tests, however, shall be performed by the Engineer representing the Owner. The Contractor shall reimburse the Owner for any such requested test that fails to

meet the requirements specified herein.

12.6 Submittals

The following submittals are required from the Contractor as part of the requirements of this Specification.

- A complete description of the Contractor's proposed silica gravel, mineralogical composition and gradation test results, a 50-pound sample of the silica gravel, and the Supplier's certification confirming compliance with the Specification requirements.
- A complete description of the Contractor's proposed sand, mineralogical composition and gradation test results, a 50-pound sample of the sand, and the Supplier's certification confirming compliance with the Specification requirements.
- The Contractor shall submit the manufacturer's specifications and product data sheets for all ancillary materials to the Engineer for approval at least two weeks prior to installation.

SPECIFICATIONS

SECTION 13 CONCRETE UNIFORM SECTION MAT

CLOSURE OF CELL 1 OF COMBUSTION WASTE STORAGE AREA

**ORLANDO UTILITIES COMMISSION
STANTON ENERGY CENTER
ORANGE COUNTY, FLORIDA**

13.1 Description of Work

This Section covers the material requirements and installation of concrete uniform section mat at the locations shown on the Drawings.

13.2 Referenced Standards

The following ASTM International (ASTM) standards are referenced in this Specification.

- C31: Standard Practice for Making and Curing Concrete Test Specimens in the Field
- C33: Standard Specification for Concrete Aggregates
- C39: Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
- C150: Standard Specification for Portland Cement
- C618: Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete

13.3 Material Requirements

The concrete uniform section mats (with thicknesses as shown on the Drawings) shall consist of concrete-filled Fabriform-type facing, with weep holes, underlain by non-woven geotextile filter fabric.

13.3.1 Fabric

The fabric forms shall consist of 100 percent woven polyester or polypropylene with a mass per unit area of no less than 6 oz/yd² and with a double-layer mass per unit area of no less than 12 oz/yd². The fabric forms shall consist of multiple panels of double-layer fabric joined in such a manner as to provide an average thickness as shown on the Drawings. Individual width panels shall be cut to suitable lengths and the two layers of fabric separately joined edge to edge by means of a heavy thread, double-stitched. The tensile strength of stitch joints shall be not less than 100 pounds per inch.

13.3.2 Grout

Grout shall consist of a mixture of Portland cement, fine aggregate and water so proportioned and mixed as to provide a pumpable slurry. Pozzolan and grout fluidizers conforming to the Specifications may be used at the option of the Contractor. The mix shall obtain a minimum compressive strength of 2000 psi at 28 days when tested in accordance with ASTM C31 and ASTM C39. The grout mix design shall be submitted to the Engineer for approval at least two weeks prior to construction of the mats.

Portland cement shall conform to ASTM C150. Pozzolan, if used, shall conform to ASTM C618. Only clean fresh water shall be used. Aggregate shall meet the requirements of ASTM C33, except as to grading. Aggregate grading shall be reasonably consistent and shall be well graded from the maximum size, which can be handled with available pumping equipment.

13.3.3 Weep Holes

The mat shall contain weep holes at the specific locations shown on the Drawings. The weep holes, where specified, shall consist of $\frac{7}{8}$ -inch inside diameter polyethylene tubes through the mat on a 60-inch center-to-center spacing. The weep holes shall not protrude past the bottom surface of the mat to avoid damaging the HDPE liner.

13.3.4 Non-woven Geotextile

The non-woven geotextile underlying the fabric form shall be 100 percent polyester or polypropylene with a mass per unit area equal to or greater than 12 oz/yd² meeting the requirements for non-woven geotextile in Section 11.3.1.

13.4 **Installation Procedures**

Prior to placement of the fabric form panels, a layer of 12 oz/yd² non-woven geotextile, meeting the requirements of Section 11 of the Specifications, shall be placed on the prepared subgrade to the lines and dimensions shown on the Drawings.

Prior to grout injection, the fabric form panels shall be positioned to the locations, lines and grades shown on the Drawings. Panels of fabric may be factory assembled in predetermined sizes and joined side-by side at the site by field sewing or by means of zipper closures attached to the upper and lower layers of fabric. Simple butt joints shall not be permitted.

Expansion joints shall be used at the locations shown on the Drawings.

Only approved grout mixing, pumping and agitating equipment shall be used in preparation and handling of the grout. All oil and other rust inhibitors shall be removed from the pumps and mixers. All materials shall be accurately measured by volume or weight as they are fed into the mixer or delivered to the pump. The quantity of water shall be such as to produce a grout having a pumpable consistency. Time of mixing shall be not less than 1 minute. If agitated continuously, the grout may be held in the mixer or agitator for a period not exceeding 2.5 hours in temperatures below 70° F and for a period not exceeding two hours at higher temperatures. If there is a lapse in a pumping operation, the grout shall be re-circulated through the pump or through the mixer drum (or agitator) and pump.

Grout shall be introduced into the space between the layers of fabric and shall be injected in such a way that excessive pressure on the fabric envelope is avoided. The injection pipe shall be wrapped tightly at the point of injection with a strip of burlap and the burlap pushed into the slit as the injection pipe is withdrawn in order to minimize spillage of grout.

The thickness of the mat shall be measured by survey or other appropriate methods, approved by the Engineer. Measurement of thickness shall not be made by inserting anything through the mat that could damage the HDPE liner. Any mat measuring less than 90 percent of the average of all thickness measurements shall be re-injected with grout until the average thickness has been attained.

Foot traffic shall not be permitted on the freshly pumped mat. Walk boards shall be used where necessary.

13.5 Quality Assurance Inspection and Testing

The Engineer will undertake observations and perform quality assurance tests to determine compliance with this Specification. Quality assurance by the Engineer will include checking layout and measuring dimensions of the fabric forms, placement and spacing of weep holes, placement of expansion joints, measuring the thickness of the mat, and taking field samples of the grout in accordance with ASTM C31 for compressive strength tests in accordance with ASTM C39.

13.6 Submittals

The Contractor shall submit a complete description of the concrete uniform section mat, weep holes and proposed grout mixture to the Engineer for approval at least two weeks prior to installation of the mat.

SPECIFICATIONS

SECTION 14 SODDING

CLOSURE OF CELL 1 OF COMBUSTION WASTE STORAGE AREA

ORLANDO UTILITIES COMMISSION STANTON ENERGY CENTER ORANGE COUNTY, FLORIDA

14.1 Description of Work

Sodding of the protective soil cover over entire Cell 1 closure liner system and any other areas disturbed by the construction activities shall be performed in accordance with these Specifications.

The Contractor shall be responsible for furnishing all labor, material, and equipment required to perform sodding activities, including soil/ground preparation, commercial fertilizer placement, and placement of sod.

14.2 Material Requirements

All sod shall be in accordance with Section 981-3 of the Florida Department of Transportation (FDOT) Standard Specifications for Road and Bridge Construction and shall meet the following requirements:

- Sod shall be common Pensacola Bahia grass.
- Sod shall be at least 18 months old and shall be well matted with roots.
- Sod shall be supplied in commercial size rolls (25 square yards) or in rectangles (preferably 12-inch by 24-inch or larger) as approved by the Owner.
- The sod shall be sufficiently thick to secure a dense stand of live grass. The sod shall be live, fresh and uninjured, at the time of planting. It shall have a soil mat of sufficient thickness adhering firmly to the roots to withstand all necessary handling. It shall be reasonably free of weeds. Prior to harvesting, the area from which the sod is to be taken up shall be closely mowed and raked as necessary to remove excessive top growth and debris.
- Approved devices, such as sod cutters, shall be used for cutting the sod and due care shall be exercised to retain the native root soil intact.
- Sod shall be planted as soon as possible after being cut for use in the work. No sod that has been cut more than 72 hours prior to installation may be used. A letter of certification from

the supplier as to when the sod was cut and what type shall be provided to the Owner, upon delivery of the sod to the job site.

A commercial fertilizer satisfying the requirements of Section 982 of the FDOT Standard Specifications for Road and Bridge Construction, Florida Department of Transportation, latest revision, or as specified by the Owner shall be used. Commercial fertilizers shall comply with the State fertilizer laws. The numerical designation for fertilizer indicates the minimum percentages, respectively, of total nitrogen, available phosphoric acid, and water-soluble potash contained in the fertilizer. The chemical designation of the fertilizer for this work shall be 16-8-8 or as recommended by the Orange County Extension Service based on soil testing.

The Contractor shall provide necessary documents/certifications to the Owner confirming that all materials supplied meet the requirements of these specifications. (e.g., sod quality, sod age, etc.)

14.3 Ground Preparation and Fertilizer Application

The upper 6 inches of the soil surface shall be prepared to be favorable to turf growth in all areas to be sodded. The finished grade of the area to receive sod shall be a smooth and even surface, free of stones, gravel, and all other vegetation. Prior to placement of the prepared soil layer, the Contractor shall inspect and remove from the sites any large clods, stones, rocks, or other materials that may interfere with the sodding operation or the placement of the amended soil. All weeds or other objectionable vegetation shall also be removed by the Contractor. If necessary, the Contractor shall apply a systematic herbicide to all weeds or other objectionable vegetation. All herbicides shall be an EPA-approved product and applied according to the Manufacturer's recommendations, subject to the approval of the Owner.

The ground over which the sod is to be placed shall be prepared by disking to a depth of 6 inches. The prepared surface shall be loose and reasonably smooth.

The prepared soil layer shall meet the requirements of Section 987-1 of the FDOT Standard Specifications for Road and Bridge Construction. If necessary to meet the pH requirements (i.e., pH value of 4.5 or greater and less than or equal to 8.5 as determined in accordance with FM 5-550), dolomitic limestone shall be spread uniformly over the area to be sodded. Once the pH has been properly adjusted, a commercial fertilizer satisfying the requirements of Section 982 of the FDOT Standard Specifications for Road and Bridge Construction shall be applied at a rate of 700 lbs per acre or as recommended by the Orange County Extension Service based on soil testing. The device for spreading fertilizer and dolomitic limestone shall be capable of uniformly distributing the materials at the specified rates. Both fertilizer and dolomitic limestone shall be uniformly mixed into the soil, to a depth of 6 inches.

Grades on areas to be sodded shall be maintained in a true and even condition, preventing the formation of depressions where water will stand.

14.4 Sod Installation

Any sod that is not planted within 24 hours after cutting shall be stacked in an approved manner and maintained properly moistened. Sodding shall not be performed when weather and surface conditions are, in the Owner's opinion, unsuitable for proper results.

Sod shall be installed only when the soil is moist and in proper condition to induce growth. No sodding shall be done when the ground is unduly wet or otherwise not in a suitable condition.

The sod shall be placed on the prepared surface, with no visible open joints and no overlapping joints. The setting of the pieces shall be staggered to prevent a continuous seam along the line of flow. After placement, all sod shall be rolled to provide good contact between soil and sod. End joints shall be staggered 12 inches minimum. The sod shall be placed on prepared surfaces in close contact with one another. The edges of the grass sod shall be staggered to avoid continuous seams. The sod shall be carefully placed by hand, edge-to-edge with no gaps, commencing at the base of the area to be sodded and working upward. If necessary, the sod may be staked with wood lath. The stakes shall not interfere with the mowing operation. A true and even sod surface shall be provided which does not vary more than 1 inch from a 10-foot straight edge.

In order to prevent erosion caused by vertical edges at the outer limits, the outer two rows of sod shall be tamped in-place and the soil graded up to the sod edge and tamped in place to produce a feather edge effect.

In areas where the sod may slide, due to height and slope, the contractor will install the downslope edge of the sod such that it is bermed or buried in soil to reduce the potential for sliding.

Any pieces of sod which, after placement, show an appearance of extreme dryness shall be removed from the work and replaced.

14.5 Watering and Maintenance

The Contractor shall water and otherwise maintain sodded areas as required to prevent the grass from drying out and to maintain the necessary soil moisture until the sod is firmly rooted into the underlying soil and cannot be easily pulled up. The moistened condition shall extend to the full depth of the rooting zone. Overwatering shall be avoided. The irrigation water shall be obtained from locations designated by the Owner.

Areas in which the grass dies, fails to root, or becomes eroded within 3 months of installation, shall be repaired as necessary and re-sodded by the Contractor. At no time shall the height of the grass be allowed to exceed 6 inches.

SPECIFICATIONS

SECTION 15 SITE LIMITATIONS

CLOSURE OF CELL 1 OF COMBUSTION WASTE STORAGE AREA

ORLANDO UTILITIES COMMISSION STANTON ENERGY CENTER ORANGE COUNTY, FLORIDA

15.1 Owner's Activities and Other Construction

Landfilling of waste materials and other operation activities by the Owner are expected to occur around the area of the proposed landfill cell closure throughout the period of construction. The Owner will designate an access road to the construction area. All activities of the Contractor must be coordinated with the Owner to avoid conflicts with the Owner's activities.

Construction activities by other Contractors may be ongoing throughout the period of construction as part of other projects. The activities of the Contractor must be coordinated with the Owner to avoid conflicts with other contractors.

15.2 Contact with Stormwater Runoff and Leachate from Existing Landfill

Rainwater that comes in contact with waste materials in the existing landfill is considered leachate. Appropriate personal protective equipment (PPE) must be used by all personnel in contact with waste materials or leachate during construction activities. Safety Data Sheets (SDS) for the waste materials and leachate may be requested from the Owner.

15.3 Existing Facilities

Any damage to existing facilities by the Contractor shall be repaired by the Contractor at his expense and as directed by the Owner.

SPECIFICATIONS

SECTION 16 GENERAL PROVISIONS

CLOSURE OF CELL 1 OF COMBUSTION WASTE STORAGE AREA

ORLANDO UTILITIES COMMISSION STANTON ENERGY CENTER ORANGE COUNTY, FLORIDA

This Specification presents general provisions covering work performed for construction of final closure of Cell 1 at the Stanton Energy Center.

16.1 General

16.1.1 Scheduling and Coordination

The Contractor shall keep the Owner informed, at least one week in advance, of the times and places at which he intends to do work. All work shall be scheduled and coordinated with the Owner.

16.1.2 Submittal of Worked Man-Hours

The Contractor shall keep records of the worked man-hours weekly. A report summarizing all work hours must be submitted to the Owner at the weekly project meeting.

16.1.3 Inspection and Sampling of Materials

All materials furnished by the Contractor shall be subject to the examination and approval of the Owner or the Engineer at all times during the progress of the work until completion of the project. As soon as the materials are examined and/or tested and approved, the Contractor shall immediately remove all rejected materials from the work to a point such distance there from as the Owner may require. No material shall be used before being examined and/ or tested and approved by the Owner or the Engineer. Failure on the part of the Owner, or the Engineer, to condemn or reject inferior materials or work shall not be construed to imply an acceptance of the same should their inferiority become evident at any time prior to final acceptance of the work.

The Contractor shall make timely necessary arrangements so that the Engineer may secure sample specimens of materials on the job for testing to ascertain whether materials included, or to be included, in the work meet the requirements of the Specifications.

16.1.4 Access to Work

The Owner and Engineer shall have free, unrestricted access to the work at all times. The Contractor shall furnish the owner and the engineer with tools, equipment, labor and samples, as

needed, for ascertaining whether the work being performed, or the work which has been completed, is in accordance with the requirements of the Specifications, even to the extent of uncovering, testing, or removing portions of finished work, if deemed necessary by the Owner or the Engineer. Any repair costs associated with these inspections and any required repairs shall be borne by the Contractor.

16.1.5 Suspension of Work

The Owner may order the Contractor to suspend any or all work that may be affected, damaged, or endangered by climatic conditions. Further, the Owner may suspend any work at any time when acceptable results as defined in the Specifications cannot be obtained due to inclement weather or other unsatisfactory field conditions. During emergency conditions, the Contractor shall shut down all operations and muster all personnel to pre-designated areas.

16.1.6 Utilities and Contractors Facilities

Utilities may not be available at the job site. Utilities, electricity and fuel as may be required for construction and other purposes shall be secured and purchased by the Contractor. The Owner will make space available for Contractor's facilities for storage and for trailers. Fresh water for non-potable use shall be provided at a location selected by the Owner.

16.2 Drawings and Specifications

The Drawings and Specifications are intended to be coordinated. Anything shown on the Drawings but not mentioned in the Specifications, or vice-versa, or anything not expressly set forth in either, but which is reasonably implied, shall be furnished as though specifically shown and mentioned in both without any extra charge. Should anything be omitted from the Drawings, which is the subject of the Contract between the Owner and the Contractor, it shall be the duty of the Contractor so to notify the Owner before signing the Contract. The Contractor shall furnish such detailed plans and drawings as may be required for the execution of the work and which are not included in the Drawings furnished by the Engineer on behalf of the Owner; these shall include shop details.

Shop drawings for the HDPE geomembrane liner, and the geocomposite drainage products shall be prepared and submitted to the Engineer for approval at least two weeks prior to installation. Shop drawings prepared by a subcontractor or supplier shall first be checked by the Contractor for compliance with the Specifications, and shall be initialed by the Contractor, prior to submittal to the Engineer for review and approval.

The Contractor shall submit all drawings and schedules with the supporting information sufficiently in advance of construction activities to allow ample time for engineer's review, recommendations and changes if any; applying the recommendations and changes of the engineer and resubmitting them before final approval. No claim by the Contractor for delays, arising from his failure in this respect, shall be allowed.

All drawings submitted by the Contractor must bear the stamp of approval by the Contractor as evidence that the drawings have been checked by the Contractor. The approval by the Engineer of drawings submitted by the Contractor shall be only for conformance with the design of the

project and shall not relieve the Contractor from the responsibility for adherence to the Contract, nor shall it relieve him of the responsibility for any error, which may exist.

16.3 Engineering Data

The background information provided on the Drawings is for informational purposes only, and the data should be reviewed in conjunction with the notes on the Drawings. The Contractor shall be responsible for locating all underground utilities and infrastructure within the designated construction area.

The Contractor must form his own opinion of the character of the work and of the waste materials, and must satisfy himself with his own investigations, explorations, tests or studies, of the conditions affecting the work to be done. The Contractor must assume all responsibility for deductions and conclusions as to the nature or condition of the in-place waste (Promat), soil, borrow materials, subsurface water conditions, the difficulties of making and maintaining the work area dewatered, and doing any work affected by the job site condition.

16.4 Right to Change Location and Drawings

When additional information regarding the topography, subsurface, or other conditions becomes available from excavation, testing, data, or other work, the Engineer may find it desirable to change alignment, dimensions, or design of a portion of the work to conform to the newly disclosed conditions. Toward this end, the Owner reserves the right to make any such reasonable changes and the Contractor's operations shall be conducted to accommodate reasonable changes without additional expense.

16.5 As-Built Drawings

The Contractor shall maintain one set of prints of drawings issued for construction on the job site at all times for the preparation of As-Built Drawings. This set will be in addition to any sets needed and used in the actual construction operation. The As-Built Drawings shall be kept up-to-date by the Contractor, as approved by the Owner, on a daily basis, and will be reviewed by the Owner at the weekly progress meetings. The plans shall show the actual as-built condition. As-built Drawings shall be submitted to the Owner upon final acceptance of the work.

SPECIFICATIONS

SECTION 17 FINAL INSPECTION AND ACCEPTANCE

CLOSURE OF CELL 1 OF COMBUSTION WASTE STORAGE AREA

**ORLANDO UTILITIES COMMISSION
STANTON ENERGY CENTER
ORANGE COUNTY, FLORIDA**

17.1 Final Inspection

Upon completing all clean-up operations, the Contractor shall advise the Owner he is ready for final inspection. The Owner will then set a specific date and time for the final inspection. The Owner, Engineer and Contractor will jointly inspect the project area to verify that all work has been completed in accordance with the Drawings and Specifications. Any work found lacking in any way should be corrected by the Contractor and re-inspected.

17.2 Letter of Acceptance

The Owner will issue a Letter of Acceptance for the work to the Contractor once all work has been satisfactorily completed and inspected. Final payment can be requested by the Contractor after receipt of the Letter of Acceptance.

17.3 Material and Workmanship Warranties

Warranties for HDPE liner, geosynthetic drainage products, and liner cover material and workmanship shall take effect from the date of the Letter of Acceptance for the liner from the Owner.

SPECIFICATIONS

SECTION 18 SCHEDULING AND COORDINATION

CLOSURE OF CELL 1 OF COMBUSTION WASTE STORAGE AREA

ORLANDO UTILITIES COMMISSION STANTON ENERGY CENTER ORANGE COUNTY, FLORIDA

All scheduling and coordination of the work shall be undertaken through the Owner.

18.1 Pre-Construction Coordination Meeting

There will be at least one coordination meeting with the Contractor and subcontractors, the Engineer, and the Owner before construction begins.

Each contractor shall submit a construction schedule to the Owner at the first coordination meeting. The schedule shall be in the form of a bar chart showing all construction activities and shall be updated weekly and provided to the Owner as the work progresses. Each contractor shall also designate a project manager at the first coordination meeting. Each contractor's designated site supervisor shall also attend the coordination meeting.

18.2 Correspondence with Owner

All correspondence with the Owner shall be directed to the following address:

Mailing Address: Orlando Utilities Commission
Stanton Energy Center
5100 South Alafaya Trail
Orlando, FL 32831-2005

Attention: Mr. Charlie Doud, P.E.
Telephone: 407-719-6055
E-mail: cdoud@ouc.com

18.3 Correspondence with Engineer

All correspondence regarding the Drawings and Specifications shall be directed to the Engineer, Ardaman & Associates, Inc., at the address below:

Mailing: Ardaman & Associates, Inc.
Post Office Box 593003
Orlando, Florida 32859-3003

Delivery: 8008 South Orange Avenue
Orlando, Florida 32809

Attention: Mr. Francis K. Cheung, P.E.
Telephone: 407-855-3860 (Office)
407-468-1492 (Cell)
Facsimile: 407-859-8121
E-mail: fcheung@ardaman.com

Mr. Jeyisanker Mathiyaparanam, P.E.
407-855-3860 (Office)
407-467-7377 (Cell)
407-859-8121
jmathiyaparanam@ardaman.com

18.4 Coordination with Other Contractors and Suppliers

Construction by other contractors may be ongoing through the period of construction. The schedule and activities of each contractor shall be approved by and coordinated with the Owner to avoid conflicts with other contractors. No contractor will be allowed additional payment for any delays in his work not coordinated through and approved by the Owner.

SPECIFICATIONS

SECTION 19 INFORMATION REQUIRED FOR BID

CLOSURE OF CELL 1 OF COMBUSTION WASTE STORAGE AREA

ORLANDO UTILITIES COMMISSION STANTON ENERGY CENTER ORANGE COUNTY, FLORIDA

19.1 Information Required for Bid

All requested information and required submittals shall be described and provided as part of the supporting information for the Bid. In particular, the supporting information for the Bid shall include, as applicable:

- (1) Demonstration of the successful completion by the Contractor of at least three (3) projects over the past five (5) years similar in size and scope to this project. For each project submitted to document the Contractor's experience, the following information on the completed facility must be provided: (i) the name and purpose of the facility, and location and date of construction; (ii) the name of the facility owner and design engineer; (iii) the name and telephone number of a contact person at the facility who can discuss the project; and (iv) description of the project, scope of work, and construction methods used.
- (2) If the Contractor is not the Manufacturer, a written certification or a license to install provided by an approved Liner Manufacturer.
- (3) A copy of the Liner Manufacturer's standard Specifications for liner handling and installation and any Quality Assurance - Quality Control Plans for review by the Owner.
- (4) Resumes of the Contractor's designated Project Manager and Site Supervisor that will actually be assigned the project....
- (5) Resumes for the HDPE liner Installation Supervisor(s) and Master Seamer(s) to be assigned to, and who will be present on Site for this project, including documentation that each has similar experience on completed facilities totaling a minimum of four (4) million square feet of HDPE liner installation.
- (6) The name of any proposed Subcontractors. Resumes of each Subcontractor's designated Project Manager and/or Site Supervisor who will be present on Site for this project must also be provided.
- (7) Certificate of Compliance with the Specifications for this project.
- (8) Construction schedule with offsite soil delivery trucking plan.
- (9) Manufacturer's liner warranty.

- (10) Contractor's workmanship warranty for two (2) years.
- (11) Verification that the proposed Contractor has installed HDPE liner in similar applications, for a period of not less than two (2) years.
- (12) A list of at least ten (10) completed facilities, totaling a minimum of four (4) million square feet, for which the Contractor has installed an HDPE geomembrane liner of the same type as specified in these Specifications. For each installation, the following information shall be provided:
 - Name and purpose of facility, location, and date of installation.
 - Name of Owner, Engineer, Manufacturer, and name and telephone number of contact at the facility who can discuss the project.
 - Type and thickness of HDPE liner installed, and surface area covered (textured and smooth).
 - Type of field seaming performed, and names of the Installation Supervisor and Master Seamer representing the Contractor.
 - Crew size and typical daily production per crew.
- (13) The name of the geocomposite manufacturer/supplier, and the proposed product trade names and/or numbers.
- (14) The Contractor's independent materials quantity take-off.
- (15) The anticipated rate of progress of earthwork (cubic yards per day) and liner installation (square feet per day), and a detailed construction schedule for the project prepared using Microsoft Project 2021 scheduling software or other software approved by the Owner. The schedule shall include the specific period of each work task. In addition, the schedule shall include submittals requiring Owner or Engineer approval before delivery of materials to the Site (e.g., shop Construction Drawings, product specification sheets, product samples, etc.), and shall include order placement and delivery of construction materials.
- (16) Proposed leachate management plan within construction limit.
- (19) Erosion and sedimentation control measures.
- (20) Insurance coverage against blowout or uplift of the liner during installation.
- (21) The Contractor shall submit a payment & cancellation Schedule which, upon OUC approval, shall become a part of this Contract.