EXHIBIT A

To

AGREEMENT FOR CONSTRUCTION OF A NEW JET-FUEL TANK AT THE MID-CONNECTICUT GAS TURBINE FACILITY

GENERAL REQUIREMENTS

GENERAL REQUIREMENTS

SECTION 01010
SUMMARY OF WORK

Part 1. GENERAL

1.1 SECTION INCLUDES

A. Project Description
B. Work covered by Contract Documents
C. Work Site Location
D. Contractor use of site and premises
E. Work Sequence
F. Owner Occupancy

1.2 PROJECT DESCRIPTION

A. CRRA is seeking bids from qualified contractors to furnish all tools, materials, labor, equipment and incidentals thereto to implement the following construction activities:

1. Construct a new 550,000 gallon, 50-foot diameter by 53-foot high welded-steel aboveground storage tank to store kerosene fuel for four jet turbines;
2. Construct a 60-foot diameter by 45-foot high welded-steel aboveground outer containment tank;
3. Clean and decommission the existing 5,500,000-gallon welded-steel aboveground Tank #6;
4. At CRRA's sole and absolute discretion, demolish the existing 5,500,000-gallon welded-steel aboveground Tank #6; and,
5. Implement all other improvements required for the project, at the Mid-Connecticut Gas Turbine Facility.

1.3 WORK COVERED BY CONTRACT DOCUMENTS

A. Furnish all tools, materials, labor, equipment and incidentals thereto for the following:

1. Install erosion and sediment controls prior to commencing with any construction activities;
2. Construct foundation for the new 550,000-gallon tank and the outer containment tank;
3. Install the new 550,000-gallon aboveground tank and the outer containment tank complete with all appurtenances, valves, piping, and fittings as shown on plans;
4. Perform the hydrostatic tank and outer containment testing as required;
5. Transfer kerosene fuel from the existing tank to the new tank using the new piping system;
6. Clean and decommission the existing tank #6 and abandon all piping;

7. At the Owner's sole and absolute discretion, demolish the existing Tank #6;
8. Obtain City of Hartford Building and Fire Department Permits for construction of new tank and demolition of existing Tank #6;
9. Obtain Federal Aviation Permit for cranes to be used on the project, due to proximity of the Brainard Airport facility;
10. The Contractor will be responsible for removing, handling, stockpiling on-site as directed, testing and covering all soil excavated for this project;
11. Maintenance and protection of traffic and facility operation;
12. Cleaning up, disposing of waste and debris and demolition materials, and restoring the work site to original condition; and
13. All other work required to complete the project.

1.4 WORK SITE LOCATION

A. Mid-Connecticut Gas Turbine Facility
Reserve Road, Gate 20
Hartford, Connecticut 06114

1.5 CONTRACTOR USE OF WORK SITE AND PREMISES

A. Limited use of work site and premises to allow construction activities. Confine operations to areas within contract limits indicated. Do not disturb portions of the site beyond the areas in which the Work is indicated.

1. The Contractor shall confine his operations, including storage or materials, supplies, equipment, and incidentals to the areas specified in the Contract Documents;
2. Existing access roads, drives, walks, and parking areas are to be kept free and clear at all times. All deliveries for the project are to enter the property between 7 AM and 3 PM, Monday through Friday. The Contractor check all roadways for accessibility and clearances for deliveries of all large material and equipment. Only designated areas shall be used for parking and storage of materials. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site;
3. The Contractor shall be responsible for keeping the work area clean and shall pick up rubbish and debris generated by the Contractor and promptly remove from the site. CRRA shall not pay for any trash pickup or removal from the site;
4. Contractor's daily access to the site shall be as indicated on the Contract Documents. Parking for the Contractor's employees shall be limited to an area designated by CRRA and the Contractor may be required to provide identification stickers for all vehicles.
5. Special precautions shall be taken to protect all drainage systems near the Work Area. Prevent any and all sediment, debris, or other materials

from getting into these systems. Should any sediment, debris, or other materials get into these systems or if any damage occurs to them, the Contractor shall immediately contact CRRA. The Contractor shall be fully responsible for all costs associated with additional cleaning and repairs caused by neglecting to protect the drainage systems.

6. No signs, other than those approved by CRRA, shall be visible on the premises.

1.6 WORK SEQUENCE

A. The total contract time for the tank construction and commencement of in service full operation will be 245 days, beginning at a date to be specified in the Notice to Proceed. Within 30 days following the date of in-service, full operation, the Owner will remove all remaining usable fuel from Tank #6. The total contract time for cleaning and decommissioning of the existing Tank #6 shall be 30 days following the date that the Owner completes removal of all remaining usable fuel from Tank #6. The total contract time for the demolition of Tank #6, which will be completed at the Owner's sole and absolute discretion, will be 90 days following the completion of cleaning and decommissioning.

1.7 OWNER OCCUPANCY

A. Cooperate with Owner to minimize conflict, and to facilitate Owner's operations. The contractor shall ensure that all of his action(s) do not, in any manner, unnecessarily delay and/or impede the day-to-day operations of the Facility.

B. Schedule the Work to accommodate this requirement.

Part 2. PRODUCTS

Not used

Part 3. EXECUTION

Not used

END OF SECTION

SECTION 01025
MEASUREMENT AND PAYMENT

Part 1. GENERAL

1.1 SECTION INCLUDES

A. Schedule of Values
B. Format
C. Preparation of Applications
D. Submittal Procedures
E. Substantiating Data

1.2 RELATED SECTIONS

A. Agreement
B. Standard General Conditions
C. Supplementary Conditions
D. Section 01700 - Contract Closeout

1.3 SCHEDULE OF VALUES

A. Submit Schedule of Values in duplicate within ten (10) days after Effective Date of Agreement or date established in Notice to Proceed.

B. Submit at least the following:

1. Mobilization
2. Progress Schedule
3. Sedimentation and erosion controls
4. Site regarding and turf establishment
5. Tank foundation
6. Loading, transport and disposal of soil to Hartford Landfill, if required
7. Construction of new tank
8. Tank coating and lining
9. Hydrostatic testing and settlement
10. Piping, valves and appurtenances
11. Tank level gauging, monitoting and alarm system
12. Tank floodlight and stairway area lighting system electrical work
13. Cathodic protection system, if rquired
14. Transfer of kerosene fuel to new tank
15. Removal and disposal of re-useable fuel credit
16. Removal and disposal of non-useable fuel
17. Removal and disposal of sludge and tank bottom material
18. Cleaning and decommissioning of Tank #6
19. Demolition of Tank #6
20. Miscellaneous work
21. Clean-up

22. Contract Closeout

C. Include within each line item, a directly proportional amount of the Contractor's overhead and profit.

D. Revise schedule to list approved Change Orders, with each Application for Payment.

1.4 FORMAT

A. Form AIA G702 and G703 (or approved substitute) Application for Payment (included at the end of this section).

B. Utilize Schedule of Values for listing items in Application for Payment.

C. Provide a column for listing each of the following items. Items Number; Description of Work; Scheduled Value; Previous Applications; Work in Place and Stored Materials under this Application; Authorized Change Orders; Total Completed and Stored to Date of Application; Percentage of Completion; Balance to Finish; and Retainage.

1.5 PREPARATION OF APPLICATIONS

A. Present required information in typewritten form.

B. Execute certification by signature of authorized officer.

C. Use data from approved Schedule of Values. Provide dollar value in each column for each line item for portion of work performed.

D. List each authorized Change Order as an extension on continuation sheet, listing Change Order number and dollar amount as for an original item of Work.

E. Application for Final Payment: as specified in Section 01700.

1.6 SUBMITTAL PROCEDURES

A. Submit three (3) copies of each Application for Payment.

B. Submit an updated construction schedule with each Application for Payment.

C. Payment Period: at intervals stipulated in the Agreement.

D. Submit under transmittal letter specified in Section 01300.

1.7 SUBSTANTIATING DATA

A. When Owner's Representative requires substantiating information, submit data justifying dollar amounts in question.

B. Provide one (1) copy of data with cover letter for each copy of submittal. Show Application number and date, and line item by number and description.

Part 2. PRODUCTS

Not used

Part 3. EXECUTION

Not used

END OF SECTION

01035
MODIFICATION PROCEDURES

Part 1. GENERAL

1.1 SUMMARY

A. This Section specifies administrative and procedural requirements for handling and processing contract modifications.

1.2 MINOR CHANGES IN THE WORK

A. The Owner's Representative, will issue supplemental instructions authorizing Minor Changes in the Work, not involving adjustment to the Contract Sum or Contract Time, on the "Supplemental Instructions" form as required by the Owner.

1.3 PROPOSAL REQUEST

A. Owner-Initiated Requests For Proposals: The Owner will issue a detailed description of proposed changes in the Work via the Owner's Representative that will require adjustment to the Contract Sum or Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications. Such requests shall be on a "Proposal Request" form as required by the owner.

B. "Proposal Request" is issued for information only. Do not consider them as an instruction either to stop work in progress or to execute the proposed change.

C. Within Fourteen (14) Calendar Days of receipt of a "Proposal Request", submit a "Change Order Proposal" with the required information necessary to execute the change to the Owner's Representative for the Owner's review.

D. Include a list of quantities of products required and unit costs, with the total amount of purchases to be made. Where requested, furnish survey data to substantiate quantities.

E. Indicate applicable delivery charges, equipment rental, and amounts of trade discounts.

F. Include a statement indicating the effect the proposed change in the Work will have on the Contract Time.

G. The Owner is tax exempt. All Contractor and Subcontractor services provided under your contract with the State of Connecticut may not be exempt from taxes. The Department of Revenue Services can guide you as to which services are exempt and which are not. Please contact the State of

Connecticut, Department of Revenue Services at 1-800-382-9463 or 566-7033.

H. Dollar values shown on the Schedule of Values shall not be the governing (or deciding) final amounts for change orders involving either additional charges or deletions.

1.4 REQUESTS FOR INFORMATION

A. In the event that the contractor or subcontractor, at any tier, determines that some portion of the drawings, specifications, or other contract documents requires clarification or interpretation by the Owner's Representative, the contractor shall submit a "Request for Information" in writing to the Owner's Representative. "Requests for Information" may only be submitted by the contractor and shall only be submitted on the "Request for Information" forms as required by the owner. In the "Request for Information", the contractor shall clearly and concisely set forth the issue for which clarification or interpretation is sought and why a response is needed from the Owner's Representative.

B. In the "Request for Information", the contractor shall set forth an interpretation or understanding of the requirement along with reasons why such an understanding was reached.

C. The owner acknowledges that this is a complex project. Based upon the owner's past experience with projects of similar complexity, the owner anticipates that there will probably be some "Requests for Information" on this project.

D. The Owner's Representative will review all "Requests for Information" to determine whether they are "Requests for Information" within the meaning of this term. If it is determined that the document is not a "Request for Information", it will be returned to the contractor, unreviewed as to content, for resubmittal on the proper form and in the proper manner.

E. A "Requests for Information Response" shall be issued within seven (7) Calendar Days of receipt of the request from the contractor unless the owner determines that a longer time is necessary to provide an adequate response. If a longer time is determined necessary by the Owner, the Owner will, within seven (7) Calendar Days of receipt of the request, notify the contractor of the anticipated response time. If the contractor submits a "Request for Information" on an activity with seven (7) Calendar Days or less of float on the current project schedule, the contractor shall not be entitled to any time extension due to the time it takes the Owner's Representative to respond to the request provided that the Owner's Representative responds within the seven (7) Calendar Days set forth above.

F. A "Requests for Information Response" from the Owner's Representative will not change any requirement of the contract documents. In the event the contractor believes that the "Requests for Information Response" will cause a change to the requirements of the contract document, the contractor shall immediately give written notice to the Owner's Representative stating that the contractor believes the "Requests for Information Response" will result in "Change Order" and the Contractor intends to submit a "Change Order Proposal" request. Failure to give such written notice immediately shall waive the contractor's right to seek additional time or cost under the requirement these Requirements.

1.5 CHANGE ORDER PROPOSAL

A. When either a "Request for Information" from the Contractor or a "Proposal Request" from the Owner's Representative or Owner results in conditions that may require modifications to the Contract, the Contractor may propose changes by submitting a request for a "Change Order Proposal" to the Owner's Representative on forms as required by the Owner. These forms shall also include "Change Order Proposal Worksheets" as required by the Owner.

B. Include statements outlining the reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and Contract Time.

C. Include a list of quantities of products required and unit costs, with the total amount of purchases to be made. Where requested, furnish survey data to substantiate quantities as directed by Article 13 of the General Conditions of the Contract for Construction.

D. Indicate applicable delivery charges, equipment rental, and amounts of trade discounts.

E. Comply with requirements in Section 01631 Equals and Substitutions if the proposed change requires an equal or substitution of one product or system for a product or system specified.

F. The State of Connecticut construction contract has the following tax exemptions:

G. Purchasing of materials which will be physically incorporated and become a permanent part of the project.

H. Tools, supplies and equipment used in fulfilling the construction contract are not exempt.

I. Services that are resold by the contractor are exempt, i.e. if a General Contractor hires a plumber, carpenter or electrician, a resale certificate may be issued to the subcontractor because these services are considered to be integral and inseparable component parts of the building contract

J. "Change Order Request" Forms: Use "Change Order Proposal" and "Change Order Proposal Worksheets" forms as required by Owner.

K. "Change Order Proposal" cannot be submitted without the Contractor either prior submission of a "Request for Information" from the Contractor or as a response to a "Proposal Request" submitted by the Owner's Representative or Owner.

L. Any "Change Order Request" submitted without a prior submittal of a "Request for Information" or as a response to a "Proposal Request" will be immediately rejected and returned to the Contractor.

1.6 CONSTRUCTION CHANGE DIRECTIVE

A. "Construction Change Directive": When the Owner and the Contractor disagree on the terms of a "Change Order Proposal" resulting from either a "Request for Information" or "Proposal Request", then the Owner's Representative may issue a "Construction Change Directive" on a "Construction Change Directive" as authorized by the Owner on the form required by the Owner. The "Construction_Change Directive" instructs the Contractor to proceed with a change in the Work, for subsequent inclusion in a "Change Order".

B. The "Construction Change Directive" contains a complete description of the change in the Work. It also designates the method to be followed to determine change in the Contract Sum or Contract Time.

C. Documentation: The Contractor shall maintain detailed records on a time and material basis of work required by the "Construction Change Directive".

D. After completion of the change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

E. The final value shall be negotiated based on the supporting data to determine the value of the work.

1.7 CHANGE ORDER PROCEDURES

A. Upon the Owner's approval of a Contractor's "Change Order Proposal", the Owner will issue a "Change Order" for signatures of the Owner and the Contractor on "Change Order" form as required by the Owner.

Part 2. PRODUCTS

Not used

Part 3. EXECUTION

Not used

END OF SECTION

SECTION 01039
COORDINATION AND MEETING

Part 1. GENERAL

1.1 SECTION INCLUDES

A. Coordination.
B. Field engineering.
C. Pre-construction meeting.
D. Progress meetings.
E. Pre-installation meeting.

1.2 RELATED SECTIONS

A. Section 01300 - Submittals.

1.3 COORDINATION

A. Coordinate scheduling, submittals, and Work of the various sections of the Project Manual and Plans to assure efficient and orderly sequence of installation of interdependent construction elements.

B. Coordinate completion and clean up of Work of separate sections in preparation for Substantial Completion.

C. Coordinate access to site for correction of defective Work and Work not in accordance with Contract Documents to minimize disruption of Owner's activities.

1.4 FIELD ENGINEERING

A. Confirm drawing dimensions and elevations.

B. Submit a copy of as-built drawings in conformance with the Contract Documents.

1.5 PRE-CONSTRUCTION MEETING

A. Owner will schedule a meeting after Notice of Award.

B. Attendance Required: Owner, Owner's Representative, and Contractor.

C. Agenda:

1. Submission of executed bonds and insurance certificates.
2. Distribution of Contract Documents.
3. Submission of list of Subcontractors, list of Products, Schedule of Values, and Progress Schedule.

4. Designation of personnel representing parties in Contract.
5. Procedures and processing of field decisions, submittals, and substitutions, Applications for Payments, proposal request, Change orders and Contract Closeout procedures.
6. Scheduling.

D. Record minutes and distribute copies within three (3) days after meeting to participants and those affected by decisions made.

1.6 PROGRESS MEETINGS

A. Owner will schedule and administer meetings throughout progress of the Work.

B. Make arrangements for meetings, prepare agenda with copies for participants, and preside at meetings.

C. Attendance Required: Contractor, major Subcontractors and Suppliers, Owner, and Owner's Representative, as appropriate to agenda topics for each meeting.

D. Agenda:

1. Review minutes of previous meetings.
2. Review of Work progress.
3. Field observations, problems, and decisions.
4. Identification of problems, which impede planned progress.
5. Review of submittals schedule and status of submittals.
6. Review of off-site fabrication and delivery schedules.
7. Maintenance of progress schedule.
8. Corrective measures to regain projected schedules.
9. Planned progress during succeeding work period.
10. Coordination of projected progress.
11. Maintenance of quality and work standards.
12. Effect of proposed changes on progress schedule and coordination.
13. Other business relating to the Work.

E. Record minutes and distribute copies within two (2) days after meeting to participants and those affected by decisions made.

1.7 PRE-INSTALLATION MEETING

A. When required in individual specification sections, convene a pre-installation meeting at work site prior to commencing work of the section.

B. Require attendance of parties directly affecting, or affected by, work of the specific section.

C. Notify Owner five (5) days in advance of meeting date.

D. Prepare agenda and preside at meeting:

1. Review conditions of installation, preparation and installation procedures.
2. Review coordination with related work.

E. Record minutes and distribute copies within two days after meeting to participants and those affected by decisions made.

Part 2. PRODUCTS

Not used

Part 3. EXECUTION

Not used

END OF SECTION

SECTION 01300
SUBMITTALS

Part 1. GENERAL

1.1 SECTION INCLUDES

A. Submittal procedures.
B. Construction progress schedules.
C. Manufacturer's certificates

1.2 RELATED SECTIONS

A. Section 01340 - Shop Drawings
B. Section 01400 - Quality Control
C. Section 01410 - Testing Laboratory Services
D. Section 01700 - Contract Closeout
E. Section 01740 - Warranties and Bonds

1.3 SUBMITTAL PROCEDURES

A. Transmit each submittal with a transmittal letter, except Shop Drawings which will be submitted as specified in Section 01340.

B. Identify Project, Contractor, Subcontractor or supplier; pertinent drawing and detail number, and specification section number, as appropriate.

C. Apply Contractor's stamp, signed or initialed certifying that review, verification of Products required, field dimensions, adjacent construction Work, and coordination of information, is in accordance with the requirements of the Work and Contract Documents.

D. Schedule submittals to expedite the Project, and deliver to Owner's Representative with a copy to Owner. Coordinate submission of related items.

E. Identify variations from Contract Documents and Product or system limitations that may be detrimental to successful performance of the completed Work.

F. Provide space for Contractor and Owner's Representative review stamps.

G. Revise and resubmit, identify all changes made since previous submission.

H. Distribute copies of reviewed submittals as appropriate. Instruct parties to promptly report any inability to comply with provisions.

I. Submittals not requested will not be recognized or processed.

1.4 CONSTRUCTION PROGRESS SCHEDULES

A. Submit initial schedule in duplicate within 10 days after date established in Notice to Proceed.

B. Show complete sequence of construction by activity, with dates for beginning and completion of each element of construction.

C. Submit revised schedules with each Application for Payment, identifying changes since previous version. Progress Reports shall include the following:

1. Listing of target delivery dates for material.
2. A narrative of any problem experienced by the Contractor that could impact progress.

D. Submit a horizontal bar chart with separate line for each section of Work, identifying first work day of each week.

1.5 MANUFACTURER CERTIFICATES

A. Submit certifications by manufacturer to Owner's Representative for all materials required on the project, in quantities specified for Product Data.

B. Indicate material of Product conforms to or exceeds specified requirements. Submit supporting reference data, affidavits, and certification as appropriate.

C. Certificates may be recent or previous test results on material or Product, but must be acceptable to Owner's Representative.

Part 2. PRODUCTS

Not Used

Part 3. EXECUTION

Not Used.

END OF SECTION

SECTION 01340
SHOP DRAWINGS

Part 1. GENERAL

1.1 REQUIREMENTS INCLUDE

A. Shop drawing submittal procedures.
B. Owner's Representative's review.
C. Shop drawing schedule.
D. Number of copies.
E. Project record documents.

1.2 RELATED SECTIONS

A. Standard General Conditions.
B. Supplementary Conditions
C. Section 01300 - Submittals.

1.3 SHOP DRAWING SUBMITTAL PROCEDURES

A. Coordinate and check all Shop Drawings furnished by suppliers and Subcontractors for accuracy and for conformance with requirements of the Contract Documents.

B. Attach a copy of a Shop Drawing Transmittal form to each group of Shop Drawings, manufacturer's literature, equipment data and samples submitted. Use a sufficient number of Shop Drawing Transmittal forms to provide for the following:

1. Items on a single transmittal form pertain to the same Specification Section.
2. Items on a single transmittal form are either all original submittals or the same number resubmittal.
3. Each material sample is listed on a separate transmittal form.

C. Number each submittal consecutively and insert the number in the space provided on the transmittal form. Assign re-submittals the same transmittal number as the original with a suffix of a sequential letter to indicate the resubmittal. For example, the first resubmittal or submittal 25 would be number 25A.

D. Insert the applicable Specification Section number in the space provided.

E. Enter the number of each item Submitted.

F. Indicate whether the submittal is an original submittal, a first resubmittal or a higher numbered resubmittal by checking the proper box.

G. Indicate the number of resubmittal for second or higher number re-submittals.

H. Complete the information required under the column headings "Manufacturer", "Manufacturer's Number", "Revision Number" and "Subject". Select a brief title under "Subject" which clearly distinguishes the equipment or material covered by the transmittal from other equipment and material furnished under the Contract.

I. Complete the certification at the bottom of the Shop Drawing Transmittal form indicating whether or not the submittal is in strict accordance with the Contract Documents. Specifically note all deviations, if any, from the Contract Documents and reasons therefore in the space provided on the Shop Drawing Transmittal form or in a referenced serial letter.

J. Sign and date the Shop Drawing Submittal form.

K. Submittals which do not have a fully completed Shop Drawings Transmittal form will be returned along with un-reviewed attachments. Such submittals, even though incomplete, will be counted as a submittal. See Supplementary Conditions.

1.4 OWNER'S REPRESENTATIVE'S REVIEW

A. Owner's Representative's review will be completed within a reasonable time after receipt by Owner's Representative of each submittal in proper sequence and will be returned to Contractor with one of the following markings:

1. "No Exception Taken" indicates submittal has been reviewed and appears to be in conformance with requirements of the Contract Documents. Contractor may proceed with construction shown on the submittal.
2. "Make corrections noted" indicates submittal appears to be in conformance with requirements of the Contract Documents. Contractor shall incorporate the corrections noted and may proceed with construction shown on the submittal. No resubmittal is required.
3. "Revise and Resubmit" indicates submittal does not appear to be in conformance with the Contract Documents. Owner's Representative's comments will be noted on the submittal or in a separate letter. Contractor shall recheck, make necessary revisions and resubmit.
4. "Reference" indicates submittal gives general information incidental to but not required for construction.

B. Review of conformance with design concepts and compliance with Contract Documents does not require Owner's Representative to review features solely related to construction or all dimensions, quantities and other data. Contractor shall not rely on Owner's Representative's approval as a verification or check of all such items in the submittal or of satisfactory and safe installation and

construction. Contractor shall verify all fabrication and installation requirements, quantities and dimensions.

1.5 SHOP DRAWING SCHEDULE

A. Include the following:

1. Description of each submittal.
2. Date by which each submittal will be delivered to Owner's Representative.
3. Date by which each submittal must be approved to maintain construction schedule.
4. Relevant Specification Section Reference.

B. Allow reasonable time for Owner's Representative to review Shop Drawings and for possible resubmittal.

1.6 NUMBER OF COPIES

A. Submit the following:

1. Four (4) copies in addition to the number the Contractor wants returned of each Shop Drawing which has been specifically prepared for the Work.
2. Five (5) copies in addition to the number the Contractor wants returned of all pre-printed manufacturer's data, brochures, Suppliers, information and other information submitted as Shop Drawings.
3. Five (5) samples except as otherwise specified.

1.7 PRESENTATION

A. Present in a clear and thorough manner.

B. Identify field dimensions, show relation to adjacent or critical features or Work.

C. Provide space for Contractor and Owner's Representative review stamps.

D. Use sheet size of not less than 8% by 11 inches and not more than 28 by 40 inches.

Part 2. PRODUCTS

Not used

Part 3. EXECUTION

Not used

END OF SECTION

SECTION 01400
QUALITY CONTROL

Part 1. GENERAL

1.1 SECTION INCLUDES

A. Quality assurance - control of installation.
B. Tolerances.
C. References.
D. Inspecting and testing laboratory services.
E. Manufacturers, field services and reports.

1.2 RELATED SECTIONS

A. Section 01300 Submittals: Submission of manufacturers' instructions and certificates.
B. Section 01410 Testing Laboratory Services.

1.3 QUALITY ASSURANCE - CONTROL OF INSTALLATION

A. Monitor quality control over suppliers, manufacturers, Products, services, site conditions and workmanship, to produce Work of specified quality.

B. Comply with manufacturers' instructions, including each step in sequence.

C. Should manufacturers' instructions conflict with Contract Documents, request clarification from Owner's Representative before proceeding.

D. Comply with specified standards as minimum quality for the Work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.

E. Perform Work by persons qualified to produce workmanship of specified quality.

1.4 TOLERANCES

A. Monitor tolerance control of installed Products to produce acceptable Work. Do not permit tolerances to accumulate.

B. Comply with manufacturers' tolerances. Should manufacturers' tolerances conflict with Contract Documents, request clarification from Owner's Representative before proceeding.

C. Adjust Products to appropriate dimensions; position before securing Products in place.

1.5 REFERENCES

A. For Products or workmanship specified by association, trade, or other consensus standards, complies with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.

B. Conform to reference standard by date of issue current on date of Contract Documents, except where a specific date is established by code.

C. Obtain copies of standards where required by product specification sections.

D. The contractual relationship, duties, and responsibilities of the parties to the agreement nor those of the Owner's Representative shall not be altered from the Contract Documents by mention or inference otherwise in any reference document.

1.6 INSPECTION AND TESTING SERVICES

A. Contractor will appoint and employ services of an independent firm to perform inspecting and testing as specified in Section 01410.

B. The independent firm will perform inspections, tests, and other services as required by the Owner's Representative or the Owner.

C. Inspecting, testing, and source quality control may occur on or off the project site. Perform off-site inspecting or testing as required by the Owner's Representative or the Owner.

D. Reports will be submitted by the independent firm to the Owner's Representative in duplicate, indicating observations and results of tests and indicating compliance or non-compliance with Contract Documents.

E. Cooperate with independent firm; furnish samples of materials, design mix, equipment, tools, storage, safe access, and assistance by incidental labor as requested.

1. Notify Owner's Representative and independent firm 24 hours prior to expected time for operations requiring services.
2. Make arrangements with independent firm and pay for additional samples and tests required for Contractor's use.

F. Testing or inspecting does not relieve Contractor to perform Work to contract requirements.

G. If any work is found to be defective in any respect because of a fault of the Contractor, or if any work has been covered over without the approval or consent of the Owner (whether or not it is found to be defective), the

Contractor shall be liable for testing costs and all costs of correction, including labor, material, services or required consultants, additional supervision, and the Owner's administration costs. Said costs will be charged to the Contractor by deducting inspection and testing charges from the contract price.

Part 2. PRODUCTS

Not used

Part 3. EXECUTIONS

Not used

END OF SECTION

SECTION 01410
TESTING LABORATORY SERVICES

Part 1. GENERAL

1.1 SECTION INCLUDES

A. Selection and payment.
B. Contractor submittals.
C. Laboratory responsibilities.
D. Laboratory reports.
E. Limits on testing laboratory authority.
F. Contractor responsibilities.
G. Schedule of inspections and tests.

1.2 RELATED SECTIONS

A. General Conditions: Inspections, testing, and approvals required by public authorities.
B. Section 01300 - Submittals: Manufacturer's certificates.
C. Section 01400 - Quality Control
D. Section 01700 - Contract Closeout: Project record documents.
E. Contract Drawing Specification Requirements: Inspections and tests required, and standards for testing.

1.3 REFERENCES

A. ASTM C1077 - Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation.

B. ASTM D3740 - Practice for Evaluation of Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction.

C. ASTM E329 - Practice for Use in the Evaluation of Inspection and Testing Agencies as Used in Construction.

D. ASTM E543 - Practice for Determining the Qualification of Nondestructive Testing Agencies.

E. ASTM E548 - Practice for Preparation of Criteria for Use in the Evaluation of Testing Laboratories and Inspection Bodies.

F. ASTM E699 - Practice for Criteria for Evaluation of Agencies Involved in Testing, Quality Assurance, and Evaluating Building Components in Accordance with Test Methods Promulgated by ASTM-Committee E6.

1.4 SELECTION AND PAYMENT

A. Employment and payment for services of an independent testing laboratory to perform specified inspecting and testing, by Contractor

B. Employment - of testing laboratory in no way relieves Contractor of obligation to perform Work in accordance with requirements of Contract Documents.

1.5 QUALITY ASSURANCE

A. Comply with requirements of ASTM C1077, ASTM D3740, ASTM D4561, ASTM E329, ASTM E543, ASTM E548, and ASTM E699.

B. Laboratory: Authorized to operate in State in which Project is located.

C. Laboratory Staff: Maintain a full time registered Engineer on staff to review services.

D. Testing Equipment: Calibrated at reasonable intervals with devices of accuracy traceable to either National Bureau of Standards or accepted values of natural physical constants.

1.6 CONTRACTOR SUBMITTALS

A. Prior to start of Work, submit testing laboratory name, address, and telephone number, and names of full time registered Engineer and responsible officer.

B. Submit copy of report of laboratory facilities inspection made by materials Reference Laboratory of National Bureau of Standards during most recent inspection, with memorandum of remedies of any deficiencies reported by the inspection.

1.7 LABORATORY RESPONSIBILITIES

A. Test samples of mixes submitted by Contractor.

B. Provide qualified personnel at site. Cooperate with Owner's Representative and Contractor in performance of services.

C. Perform specified inspecting, sampling, and testing of Products in accordance with specified standards.

D. Ascertain compliance of materials and mixes with requirements of Contract Documents.

E. Promptly notify Owner's Representative and Contractor of observed irregularities or non-conformance of Work or Products.

F. Perform additional inspection and tests required by Owner's Representative.

1.8 LABORATORY REPORTS

A. After each inspection and test, promptly submit three (3) copies of laboratory report to Owner's Representative, and to Contractor.

B. Include:

1. Date issued,
2. Project title and number,
3. Name of inspector,
4. Date and time of sampling or inspection,
5. Identification of product and specifications section,
6. Location on the site,
7. Type of inspection or test,
8. Date of test,
9. Results of tests,
10. Conformance with Contract Documents.

C. When requested by Owner's Representative or owner, provide interpretation of test results.

1.9 LIMITS ON TESTING LABORATORY AUTHORITY

A. Laboratory may not release, revoke, alter, or enlarge on requirements of Contract Documents.

B. Laboratory may not approve or accept any portion of the Work.

C. Laboratory may not assume any duties of Contractor.

D. Laboratory has no authority to stop the Work.

1.10 CONTRACTOR RESPONSIBILITIES

A. Deliver to laboratory at designated location, adequate samples of materials proposed to be used which require testing, along with proposed mix designs.

B. Cooperate with laboratory personnel, and provide access to the Work and to manufacturers, facilities.

C. Provide incidental labor and facilities:

1. to provide access to Work to be tested,
2. to obtain and handle samples at the site or at source of Products to be tested,
3. to facilitate tests and inspections,

4. to provide storage and curing of test samples.

D. Notify Owner's Representative and laboratory 24 hours prior to expected time for operations requiring inspecting and testing services.

1.11 SCHEDULE OF INSPECTIONS AND TESTS

A. Provide supervision, labor, equipment, materials to conduct the tests and inspection.

Part 2. PRODUCTS

Not Used

Part 3. EXECUTION

Not Used

END OF SECTION

SECTION 01600
MATERIAL AND EQUIPMENT

Part 1. GENERAL

1.1 SECTION INCLUDES

A. Products.
B. Transportation and handling.
C. Storage and protection.
D. Product options.
E. Substitutions.

1.2 RELATED SECTIONS

A. Section 01300 - Submittals.
B. Section 01400 – Quality Control: Product quality monitoring.

1.3 PRODUCTS

A. Product: Means new material, -machinery, components, fixtures and systems forming the work. Does not include machinery and equipment used for preparation, fabrication, conveying and erection of the work. Product may also include existing materials or components required for reuse.

B. Do not use materials and equipment removed from existing premises, except as specifically permitted by the Contract Documents.

C. Provide interchangeable components of the same manufacture for components being replaced.

1.4 TRANSPORTATION AND HANDLING

A. Transport and handle Products in accordance with manufacturer's instructions.

B. Promptly inspect shipments to ensure that Products comply with requirements, quantities are correct, and Products are undamaged.

C. Provide equipment and personnel to handle Products by methods to prevent soiling, disfigurement, or damage.

1.5 STORAGE AND PROTECTION

A. Store and protect Products in accordance with manufacturers' instructions.

B. Store with seals and labels intact and legible.

C. Store sensitive Products in weather tight, climate controlled, enclosures in an environment favorable to Product.

D. For exterior storage of fabricated Products, place on sloped supports above ground.

E. Provide off -site storage and protection when site does not permit on-site storage or protection.

F. Cover Products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of-Products.

G. Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.

H. Provide equipment and personnel to store Products by methods to prevent soiling, disfigurement, or damage.

I. Arrange storage of Products to permit access for inspection. Periodically inspect to verify Products are undamaged and are maintained in acceptable condition.

J. After receipt of products, the Contractor assumes responsibility for loss and damage including but not limited to breakage, corrosion, weather damage and distortion.

K. Notify Owner and Owner's Representative in writing upon acceptance of a shipment.

1.6 PRODUCT OPTIONS

A. Products Specified by Reference Standards or by Description Only: Any Product meeting those standards or description.

B. Products Specified by Naming One or More Manufacturers: Products of manufacturers named and meeting specifications, no options or substitutions allowed.

C. Products Specified by Naming One or More Manufacturers with a Provision for Substitutions: Submit a request for substitution for any manufacturer not named in accordance with the following article.

1.7 SUBSTITUTIONS

A. Owner's Representative will consider requests for Substitutions only within 15 days after date established in Notice to Proceed.

B. Substitutions may be considered when a Product becomes unavailable through no fault of the Contractor.

C. Document each request with complete data substantiating Compliance of proposed Substitution with Contract Documents.

D. A request constitutes a representation that the Contractor:

1. Has investigated proposed Product and determined that it meets or exceeds the quality level of the specified Product.
2. Will provide the same warranty for the Substitution as for the specified Product.
3. Will coordinate installation and make changes to other Work that may be required for the Work to be complete with no additional cost to Owner.
4. Waives claims for additional costs or time extension that may subsequently become apparent.
5. Will reimburse owner and Owner's Representative for review or redesign services associated with re-approval by authorities.

E. Substitutions will not be considered when they are indicated or implied on shop drawing or product data submittals, without separate written request, or when acceptance will require revision to the Contract Documents.

F. Substitution Submittal Procedure:

1. Submit three copies of request for Substitution for consideration. Limit each request to one proposed Substitution.
2. Submit shop drawings, product data, and certified test results attesting to the proposed Product equivalence. Burden of proof is on proposer.
3. The Owner's Representative will notify Contractor in writing of decision to accept or reject request.

Part 2. PRODUCTS

Not used.

Part 3. EXECUTION

Not Used.

END OF SECTION

SECTION 01700
CONTRACT CLOSEOUT

Part 1. GENERAL

1.1 SECTION INCLUDES

A. Closeout procedures.
B. Final cleaning.
C. Project record documents.
D. As-built and conformed to Construction Record Drawings.
E. Operation and Maintenance Data
F. Warranties and Bonds.

1.2 RELATED SECTIONS

A. Standard General Conditions
B. Supplementary Conditions
C. Section 01025 - Measurement and Payment
D. Section 01300 - Submittals
E. Section 01340 - Shop Drawings
F. Section 01740 - Warranties and Bonds

1.3 CLOSEOUT PROCEDURES

A. Submit written certification that Contract Documents have been reviewed, Work has been inspected, and that Work is complete in accordance with Contract Documents and ready for Owner's Representative's inspection.

B. Provide submittals to Owner's Representative and Owner that are required by governing or other authorities.

C. Submit final Application for Payment identifying total adjusted Contract Sum, previous payments, and balance due.

1.4 FINAL CLEANING

A. Execute final cleaning prior to final project assessment.

B. Clean equipment and fixtures to a sanitary condition with cleaning materials appropriate to the surface and material being cleaned.

C. Clean site; sweep paved areas.

D. Remove waste and surplus materials, rubbish, and construction facilities from the site.

1.5 PROJECT RECORD DOCUMENTS

A. Maintain on site, one set of the following record documents; record actual revisions to the Work:

1. Drawings.
2. Specifications.
3. Addenda.
4. Change Orders and other modifications to the Contract.
5. Reviewed Shop Drawings, Product Data, and Samples.
6. Manufacturer's instruction for assembly, installation, and adjusting.

B. Ensure entries are complete and accurate, enabling future reference by owner.

C. Store record documents separate from documents, used for construction.

D. Record information concurrent with construction progress.

E. Specifications: Legibly mark and record at each Product section description of actual Products installed, including the following:

1. Manufacturer's name and product model and number.
2. Product substitutions or alternates utilized.
3. Changes made by Addenda and modifications.

F. Record Documents and Shop Drawings: Legibly mark each item to record actual construction including:

1. Measured elevations of buried piping.
2. Measured locations of existing buried utilities and appurtenances encountered during the progress of the work.
3. Field changes of dimension and detail.
4. Details not on original Contract drawings.

1.6 AS-BUILT AND CONFORMED TO CONSTRUCTION RECORD DRAWINGS

A. As-built for products: In accordance with Section 01340.

B. Conformed to construction Record Drawings: One complete set of full size prints marked to show changes and revisions to date of the project completion.

1.7 OPERATION AND MAINTENANCE DATA

A. The Contractor shall instruct the Owner's designated personnel in the operation of new equipment and shall provide manuals and if required, provide video tapes of this basic maintenance of the equipment for training

purposes. Provide qualified personnel for as long as necessary to instruct the Owner's personnel.

B. Submit four (4) copies of the manuals in 3-ring, loose-leaf notebooks to the Owner's Representative for approval. Manuals may consist of plain paper copies of approved shop drawings and catalog cuts. Upon completion and approval, 3 copies will be forwarded to the State and one copy retained by the Owner's Representative.

C. Manuals shall include:

1. Operating Procedures:
   (a) Typewritten procedures for each mode of operation of each piece of equipment. Procedures shall indicate the status of each component of a system in each operating mode.
   (b) Procedures shall include names, symbols, valve tags, circuit numbers, schematic wiring diagrams, locations of thermostats, manual starters, control cabinets and other controls of each system.
   (c) Emergency shut-down procedures for each piece of equipment or system, both automatic and manual, as appropriate.
2. Maintenance Schedule:
   (a) Typewritten schedule describing manufacturers schedule of maintenance and maintenance procedures.
3. Catalog Cuts:
   (a) To illustrate each piece of installed equipment, including options.
   (b) Include equipment descriptions including physical, electrical and mechanical; performance characteristics; installation or erection diagrams.
   (c) Include spare parts numbers and names, address and phone number of manufacturer; name, address and phone number of local representative or service department.
   (d) Typewritten list of all subcontractors on the project, including name, address and phone number of local representative or service department.
4. Manuals shall be indexed with dividers indicating each system or piece of equipment.

1.8 WARRANTIES AND BONDS

A. Submit in accordance with Section 01740.

Part 2. PRODUCTS

Not Used

Part 3. EXECUTION

Not Used

END OF SECTION

SECTION 01740
WARRANTIES AND BONDS

Part 1. GENERAL

1.1 SECTION INCLUDES

A. Preparation and submittal.

B. Time and schedule of submittals.

1.2 RELATED SECTIONS

A. Instruction to Bidders

B. General Conditions: Performance bond and labor and material payment bonds, warranty, and correction of work.

C. Section 01700 - Contract Closeout: Contract closeout procedures.

D. Section 01700 - Contract Closeout.

E. Contract Drawing Specifications: Warranties required for specific Products or Work.

1.3 FORM OF SUBMITTALS

A. Bind in commercial quality 8-1/2 x 11 inch three ring binders with durable plastic covers.

B. Cover: Identify each binder with typed or printed title WARRANTIES AND BONDS, with title of Project; name, address and telephone number of Contractor and supplier; and name of responsible company principal.

C. Table of Contents: Neatly typed, in the sequence of the Table of Contents of the Project Manual, with each item identified with the number and title of the specification section in which specified, and the name of Product or work item.

D. Separate each warranty or bond with index tab sheets keyed to the Table of Contents listing. Provide full information, using separate typed sheets as necessary. List Subcontractor, supplier, and manufacturer, with name, address, and telephone number of responsible principal.

1.4 PREPARATION OF SUBMITTALS

A. Obtain warranties and bonds, executed in duplicate by responsible Subcontractors, suppliers, and manufacturers, within ten days after completion of the applicable item of work. Except for items put into use with

Owner's permission, leave date of beginning of time of warranty until the Date of Substantial completion is determined.

B. Verify that documents are in proper form, contain full information, and are notarized.

C. Co-execute submittals' when required.

D. Retain warranties and bonds until time specified for submittal.

1.5 TIME OF SUBMITTALS

A. Make submittals within ten days after Date of Substantial Completion, prior to final Application for Payment.

B. For items of Work for which acceptance is delayed beyond Date of Substantial Completion, submit within ten days after acceptance, listing the date of acceptance as the beginning of the warranty period.

Part 2. PRODUCTS

Not Used

Part 3. EXECUTION

Not Used

END OF SECTION

EXHIBIT B

To

AGREEMENT FOR CONSTRUCTION OF A NEW JET-FUEL TANK AT THE MID-CONNECTICUT GAS TURBINE FACILITY

TECHNICAL SPECIFICATIONS

CONNECTICUT RESOURCES RECOVERY AUTHORITY
TANK No. 6 REPLACEMENT PROJECT – RFB No. 11-EN-002
TECHNICAL SPECIFICATIONS
TABLE OF CONTENTS

SECTION 01500

CONSTRUCTION FACILITIES

PART 1 GENERAL

1.1 TEMPORARY UTILITIES

Water and Electricity – If the Contractor chooses, they may establish connections to existing utilities. The Contractor shall pay all costs incurred in connecting, converting, and disconnections of the utilities. The Contractor shall make all connections and providing disconnects, fuse protection, overhead and buried power feed wires, transformers, and making disconnections upon project completion. Water, up to 500 gpm, can be obtained from the facility water hydrants in certain areas of the site as permitted for use by the Owner.

1.2 TEMPORARY SANITARY FACILITIES

Provide adequate sanitary conveniences of a type approved for the use of persons employed on the work, properly secluded from public observation, and maintained in such a manner as required or approved by the Owner's Representative. Sanitary conveniences shall be provided at the Contractor's furnished office trailer. Maintain these conveniences at all times without nuisance. Upon completion of the work, remove the conveniences from the premises, leaving the premises clean and free from nuisance.

1.3 ODOR AND PEST CONTROL

Include provisions for pest control and elimination of odors.

1.4 PROJECT SIGN

No signs shall be posted without prior approval of the Owner's Representative.

1.5 IDENTIFICATION OF CONTRACTOR VEHICLES

Each Contractor provided vehicle and towed trailer shall show the Contractor's name so that it is clearly visible on both front doors of the vehicle and both sides of a towed trailer and shall at all times display a valid state license plate and safety inspection sticker. Contractor vehicles operated on CRRA property shall be maintained in good state of repair.

PART 2 PRODUCTS

Contractor shall ensure that all equipment and materials used to provide temporary utility connections conform to the requirements of the owners of the utilities to which the temporary connection is made.

PART 3 EXECUTION

The Contractor is responsible for providing, installing, connecting to the utilities, maintaining, and removing upon completion of the project and all associated costs. The Contractor is also responsible for ensuring that the connections have been inspected and meet the requirements of the utility owner and any applicable regulations of the City of Hartford.

END OF SECTION 01500

SECTION 01560

SOIL EXCAVATION HEALTH, SAFETY, AND EMERGENCY RESPONSE

PART 1 GENERAL

1.1 SUMMARY

A. This specification describes the minimum health, safety, and emergency response requirements for the execution of soil excavation activities at the South Meadows Station site.

1.2 REFERENCES

A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

CODE OF FEDERAL REGULATIONS (CFR)

29 CFR 1910	Occupational Safety and Health Standards
29 CFR 1926	Safety and Health Regulations for Construction
29 CFR 1926-SUBPART P	Excavations
40 CFR 261	Identification and Listing of Hazardous Waste
40 CFR 262	Generators of Hazardous Waste
40 CFR 263	Transporters of Hazardous Waste
40 CFR 264	Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities.
49 CFR 171-179	General Information, Regulations, and Definitions
49 CFR 172	Hazardous Materials, Tables, and Hazardous Materials Communications Regulations
49 CFR 178	Shipping Container Specification

CONNECTICUT COUNCIL ON SOIL AND WATER CONSERVATION (CCSWC)

CCSWC GSESC	Connecticut Guidelines for Soil Erosion and Sediment Control, May 2002, latest edition

REGULATIONS OF CONNECTICUT STATE AGENCIES (RCSA)

RCSA 22a-449(c)	Connecticut Department of Environmental Protection (CTDEP) Hazardous Waste Management
RCSA 22a-209	Connecticut Department of Environmental Protection (CTDEP) Solid Waste Management
RCSA 22a-430	Connecticut Department of Environmental Protection (CTDEP) Water Pollution Control
RCSA 22a-6k	Connecticut Department of Environmental Protection (CTDEP) Water Pollution Control

STATE OF CONNECTICUT

CTDPH 20-441	Refresher Training

STATE OF CONNECTICUT DEPARTMENT OF TRANSPORTATION (CTDOT)

CTDOT OEMCA	On-Site Environmental Mitigation for Construction Activities, CTDOT Office of Environmental Planning, January 1986, latest edition
FORM 815/816	State of Connecticut, Department of Transportation, Standard Specifications for Roads, Bridges and Incidental Construction, and amendments to date.

1.3 DEFINITIONS

The following terms are defined for use under this contract. Additional definitions of terms used in conduct of hazardous waste and hazardous substances operations are as contained in 29 CFR 1910.120.

Area Monitoring

Monitoring shall be performed by OWNER'S REPRESENTATIVE where there may be a question of employee exposure to hazardous concentrations of hazardous substances in order to assure proper selection of engineering controls, work practices and personal protective equipment so that employees are not exposed to levels which exceed permissible exposure limits, or published exposure levels if there are no permissible exposure limits, for hazardous substances.
Air monitoring shall be used to identify and quantify airborne levels of hazardous substances and safety and health hazards in order to determine the appropriate level of employee protection needed on site.

Contaminated Waste

A material or substance that contains chemicals or has physical properties that may result in human health effects from short-term or prolonged exposure.

CTDEP

The Connecticut Department of Environmental Protection, 79 Elm Street, Hartford, CT 06106

CTDPH

The Connecticut Department of Public Health, 410 Capitol Avenue, Hartford, CT 06106.

Decontamination

The removal of hazardous substances from employees, their equipment, and vehicles to the extent necessary to preclude the spread of the contaminant(s) to undesired locations.

EPA

The U.S. Environmental Protection Agency, 401 M Street SW, Washington, DC 20460.

Hazardous Substance

Any substance that results or may result in adverse effects to the health or safety of employees.

Hazardous Waste

A waste or combination of wastes defined in 40 CFR 261.3, or (2) those substances defined in 49 CFR 171.

Health Hazard

A chemical, biological, or physical agent, or mixture of agents, which may cause acute or chronic health effects in exposed persons.

Immediately Dangerous to Life or Health (IDLH)

An atmospheric condition that would pose an immediate threat to life, would cause irreversible or delayed adverse health effects, or would interfere with an individual's ability to escape from a dangerous atmosphere.

Permissible Exposure Limits (PELs)

PEL means levels published by Occupational Safety and Health Act (OSHA) that establish limits of inhalation exposure. There are three basic PEL classifications: time-weighted average (TWA), short-term exposure limit (STEL), and ceiling limit. The TWA and STEL limits are an "averaged" concentration over two different time periods. The TWA is generally calculated by averaging measured concentrations of a contaminant over an 8-hour time period; whereas, the STEL is calculated by averaging measured concentrations of a contaminant over a 15-minute time period. The third type of PEL is a ceiling limit, which is an absolute threshold. No

averaging occurs with the measured concentration. It is an "instantaneous" limit that is not to be exceeded for any period of time.

Physical Boundary

Area physically roped or partitioned off around an enclosed lead control area to limit unauthorized entry of personnel.

Project Monitor/Inspector

A representative of the Owner who functions as their on-site representative overseeing the activities of the Contractor.

Uncontrolled Waste Site

An area where an accumulation of hazardous waste or contaminated waste creates a threat to the health and safety of individuals and/or the environment.

1.4 REQUIREMENTS

A. The Contractor shall perform work in compliance with all Federal, State, and local regulations and requirements and be responsible for obtaining and payment of fees for all permits and approvals required to perform the work. Applicable regulations and requirements may include, but are not limited to:

1. Federal Regulations

Environmental Protection Agency (EPA) requirements for the management of hazardous waste including 40 CFR 261, 40 CFR 262, and 40 CFR 263, 40 CFR 268, and 40 CFR 761.

Department of Transportation (DOT) requirements for the transportation of waste including 49 *CFR* 171, 49 *CFR* 172, and 49 CFR 173.

OSHA requirements for Safety and Health Protection including 29 CFR 1910 and 29 CFR 1926.

2. State of Connecticut Regulations

Connecticut Department of Environmental Protection (CTDEP)

a. Waste Management Bureau - requirements for Hazardous, Connecticut-regulated and Solid Waste management, transport and disposal including RCSA 22a-449(c) and RCSA 22a-209.

b. Water Management Bureau - requirements for control of wastewater discharges and use of Best Management Practices (BMPs) to protect surface and ground waters including RCSA 22a-430 and 22a-6k.

c. Air Management Bureau - requirements for control of fugitive dust and visible emissions and permitting of sources exceeding state limits.

Connecticut Department of Transportation (CTDOT)

a. Requirements for environmental mitigation for construction activities (CTDOT OEMCA).

Connecticut Council on Soil and Water Conservation (CCSWC)

a. Requirements for soil erosion and sediment control (CCSWC GSESC).

3. City of Hartford Regulations

a. Health Department - requirements to comply with health standards prior to start of work.

b. Fire Department - requirements for fire protection during work.

1.5 SUBMITTALS

Submit the following a minimum of fifteen (15) days prior to the start of work:

A. Statements

1. Site Safety and Health Plan (SSHP)

Submit an SSHP prepared by Certified Industrial Hygenist for review and approval. Conform to the requirements of Federal, State and local laws, rules, and regulations. Work cannot proceed until the Safety Plan has been approved. The SSHP shall include:

a. Identification and evaluation of the hazards and risks associated with the decontamination activities, including excavation hazards and precautionary measures to be followed by workers for all hazards.

b. Identification and evaluation of the hazards and risks associated with trenching activities and construction of the storm drainage, including utility hazards and precautionary measures to be followed by workers for all hazards.

c. Identification of supervisory personnel and alternates responsible for site safety/response operations. Name and title of person responsible for administering plan.

d. Determination of levels of personal protection to be worn for various site operations.

e. List of equipment with adequate nomenclature by item, that will be used at the job site and the date and location where this equipment can be inspected by OWNER'S REPRESENTATIVE.

f. Establishment of work zones (exclusion area, contamination reduction area, and support area).

g. Establishment of decontamination methods and procedures.

h. Establishment of emergency procedures, such as: escape routes, fire protection, signals for withdrawing work parties from site, emergency communications, wind indicators, and procedures for evacuation of injured workers.

i. Identification and arrangements with nearest medical facility for emergency medical care for both routine-type injuries and toxicological problems. Submit name, location, and telephone number of this medical facility.

j. Establishment of air and personnel monitoring procedures.

k. Establishment of procedures for obtaining and handling potentially contaminated materials.

l. Identification of medical monitoring program, including respirator medical qualification examination for each individual at the work site.

m. Certification for each person entering the reduction or exclusion zones that the person is fit for duty at hazardous waste sites, and adequate medical screening tests have been obtained which address the contaminants associated with the specific hazardous waste site.

n. Identification of training plan to be instituted, including contents of 29 CFR 1910.1200 and 29 CFR 1910.134; its training contents; and instructor with appropriate training certification. Training plan shall also include counseling to each employee on exposure hazards.

o. Establishment of a hazard communication program (29 CFR 1910.1200).

p. 29 CFR 1910.

q. 29 CFR 1926.

r. 29 CFR 1926-SUBPART P, excavation measures.

s. Hazardous Noise

Provide a written hearing protection program which will include: hazardous noise signs, as directed, wherever equipment and work procedures produce sound levels greater than 84 dBA or 140 db peak sound level.

4. Certification that all Contractor employees are trained in accordance with Paragraph 3.1, as required.

5. Provide a copy of the Contractor's Heat or Cold Stress Monitoring Program.

6. List of all Contractor and Subcontractor personnel proposed to enter the site.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION

3.1 EMPLOYEE TRAINING

A. The Contractor shall certify that all employees, including subcontractor employees, engaged in decontamination activities: 1) are currently monitored under a medical surveillance program for respirator use in compliance with 29 CFR 1910.134; and 2) are fit tested for respirator use as necessary.

B. Employees that may come in contact with hazardous materials as part of this project shall receive an appropriate level of health and safety training in accordance with 29 CFR 1910.120, including classroom instruction, first aid and CPR training, and refresher training.

C. Employees who have not received the required training prior to the start of site operations are not to engage in site operations until such training has been completed.

3.1.1 Program Certification

A. The Contractor shall provide written certification of completed training and/or acquired experience for all employees designated to engage in on-site activities and shall be supplied prior to the start of site operations.

Such certification shall be endorsed by a member of top level management, a corporate officer, or the health and safety program manager.

3.2 PERSONNEL PROTECTION

The Contractor shall assume that initially Level D personal protective equipment (PPE) will be required.

A. The Contractor shall apply engineering and/or work practice controls as a means of protecting personnel in performance of site-specific tasks. Engineering controls shall be implemented to reduce and maintain employee exposure at or below safe levels for those tasks demonstrating known or suspected hazards. Work practice controls shall be applied when engineering controls are impractical.

1. Personal Protective Equipment and Levels of Protection

a. The Contractor shall use personal protective equipment (PPE) only when engineering and/or work practice controls have been deemed impractical or insufficient to protect employees during site operations.

b. The Contractor shall be directed to wear PPE based on an evaluation of performance- characteristics, site specific tasks, and known or suspected hazards. The Contractor shall assemble the PPE into levels of protection (LOP) or ensembles appropriate for the site (Level D and C).

c. The Contractor shall include a description of their respiratory protection program and the method of respirator fit testing employed.

d. d. The Contractor shall only make use of NIOSH/MSHA approved respiratory protective equipment.

3.3 MEDICAL SURVEILLANCE

A. Medical, Surveillance Program

1. The Contractor shall establish and implement a medical surveillance program (MSP) for employees engaged in on-site operation in accordance with 29 CFR 1910.

2. The MSP program shall include physical examinations administered by a board certified physician familiar with internal or occupational medicine.

B. Retention of Medical Records

1. The Contractor shall retain all medical records and personnel exposure monitoring data for an appropriate period as described in Subpart C of 29 CFR 1910.20 of the Occupational Safety and Health Administration.

C. Personnel Certification

1. The Contractor shall provide written certification of medical fitness for work of all employees designated to engage in on-site operations prior to the start of those operations.

2. Such certification shall be endorsed by a member of top level management, a corporate officer, or the health and safety program manager.

D. Employee Heat and Cold Stress Monitoring

1. As dictated by seasonal conditions, the Contractor shall implement an employee heat or cold stress monitoring program during site operations and shall provide OWNER'S REPRESENTATIVE with a copy of the program.

2. The program shall include employee awareness of the signs and symptoms of heat or cold stress, preventive measures, and employee parameters to be monitored.

3.4 SITE SAFETY BRIEFINGS

A. Contractor shall attend safety briefings prior to initiating any new site activity and a safety meeting held prior to each shift to ensure that employees are appraised of the requirements of the safety and health plan and that they are being followed.

3.5 INSPECTION

3.5.1 Inspection of Equipment

3.5.1.1 Respirators

Respirator users shall inspect their respirators in strict accordance with the instructions provided by the manufacturer. Respirators shall be in compliance with the Respiratory Protection Program as required by ANSI Z88.2 and 29 CFR 1910.134. Each respirator filter shall be in compliance with UL 586.

3.5.2 Personnel Inspection

3.5.2.1 Clothing

Personnel for Proper Attire Commensurate with Hazards Involved: Check for:

a. Clean clothing in good condition (wear freshly laundered clothing at the beginning of the job and at the start of each workday thereafter).
b. Boots and gloves of approved type and in good condition.

3.5.2.2 Gum or Tobacco Chewing

Gum or tobacco chewing is prohibited.

3.5.2.3 Physical Defects or Injuries

Ensure that people have no physical defects or injuries which may prevent their wearing respirators or which may cause rescue to be difficult. No beards, sideburns, or large mustaches shall be allowed on people who must wear respirators.

3.5.2.4 Alcoholic Beverages and Drugs

Ensure that people entering the site are not under influence of alcoholic beverages and drugs.

3.5.2.5 Counseling on Reproductive Hazards

Ensure that all employees have been counseled on and fully understand the reproductive hazards related to work in contaminated areas since chemical contaminants may seriously affect them.

3.6 SITE CONTROL

A. The Contractor shall be responsible for conducting operations at the site in a manner as to reduce the possibility of contact with any contaminants present and to prevent the removal of contaminants by personnel or equipment leaving the site.

B. The Contractor shall keep a daily log of site activities, Including: personnel visiting site, affiliation, date, arrival time, departure time and purpose of visit.

C. The Contractor shall provide the Owner's Representative with a list of all Contractor and subcontractor personnel proposed to enter the site prior to start of operations, updating the list as necessary.

D. In no case shall visitors (i.e., personnel not regularly assigned to work on the site who have legitimate business at the site) be allowed entrance to Excavation Areas. Contractor shall fence, barricade, and/or mark to prevent unauthorized personnel into Excavation Areas.

E. Transfer of contaminated wastes from the excavation areas to the designated waste storage area shall be performed in a manner to prevent spillage, leakage, contamination to unimpacted areas and shall prevent exposure to facility and other site personnel.

3.7 SANITATION

A. The Contractor shall provide toilet facilities, potable water, and washing facilities. These facilities shall be in near proximity to the Excavation Areas.

3.8 DEFECIENCIES

A. The Owner's Representative will stop any operation that the Contractor has been directed to correct and has not corrected. The Owner's Representative will stop any Contractor operations that pose an imminent or immediate health or safety hazard to Contractor employees, facility personnel, other on-site personnel, or the environment. If the Contractor does not comply with the stoppage and immediately correct a health or safety deficiency, then the Owner may at its discretion retain the services of another contractor to correct the deficiency. All liability and expenses resulting from such work stoppages and deficiency correction shall be the responsibility of the Contractor.

END OF SECTION 01560

SECTION 02000

ABOVEGROUND STORAGE TANK CLEANING & DECOMMISSIONING

PART I GENERAL

1.1 SUMMARY

A. This specification describes the minimum requirements of the Contractor to be provided for the cleaning and decommissioning activities for the existing 140 ft. diameter by 48 ft. high steel aboveground storage tank (AST), including the requirement to prepare a Cleaning and Decommissioning Work Plan.

B. The scope of work in this Section includes the cleaning and decommissioning of the AST, including the legal off-site disposal of all liquids and sludges.

The Contractor shall provide all materials, equipment, tools and labor necessary to complete the work, as described but not limited below:

1. Provide temporary facilities and protection including protective barriers and traffic control.

2. Disconnection, capping and removal of piping to be removed.

3. Removal and legal off-site disposal of specified components and debris from the property.

4. Cleaning and decommissioning of the AST following transfer by the Contractor of all re-useable fuel to the new AST. The Project Drawings are approximate only and do not attempt to show all facilities. It is the Contractor's responsibility to determine the full extent and dimensions of the site and project work by their own inspection of the site.

5. Obtain all necessary permits and inspections from the City of Hartford .

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

CODE OF FEDERAL REGULATIONS (CFR)

29 CFR 1910	Occupational Safety and Health Standards (OSHA)
29 CFR 1926	Occupational Safety and Health Standards (OSHA) for the Construction Industry

33 CFR 320 through 330	Army Corps of Engineers General Policies and Requirements - Navigation and Navigable Waters
40 CFR 112	Oil Pollution Prevention
40 CFR 260	Hazardous Waste Management Systems: General
40 CFR 261	Identification and Listing of Hazardous Waste
40 CFR 262	Standards Applicable to Generators of Hazardous Waste
40 CFR 263	Standards Applicable to Transporters of Hazardous Waste
40 CFR 268	Land Disposal Restrictions
49 CFR 171	General Information, Regulations and Definitions
49 CFR 172	Hazardous Materials Tables, Hazardous Materials Communication Requirements and Emergency Response Information Requirements
49 CFR 173	Shippers - General Requirements for Shipments and Packaging
49 CFR 178	Shipping Container Specifications

1.3 PROJECT CONDITIONS

The Contractor shall perform all work in compliance with all Federal, State, and Local regulations and requirements, including, but not limited to, Building Codes Health Codes, Fire Department, Fire Marshall provisions, and EPA regulations. The Contractor shall be responsible for obtaining and payment of fees for all permits and approvals required to perform the work. Applicable regulations and requirements may include, but are not limited to:

A. Connecticut Department of Environmental Protection Regulations.

B. Local and State of Connecticut Fire Prevention Codes.

C. API 2015, Cleaning of Petroleum Storage Tanks; API 2015A, A Guide for Controlling the Lead Hazard Associated with Tank Entry and Cleaning

D. National Fire Protection Association standards, including NFPA 30
E. National Institute for Occupational Safety and Health (NIOSH) Working in Confined Space

1.3.1 General

A. Condition of Structures: Owner and Design Consultant assume no responsibility for actual condition of structures.

B. Salvaged Materials: Items of salvable value to Contractor may be properly decontaminated, tested, and removed from structure as work progresses.

C. Noise: Noise levels shall be reduced to the maximum extent practical.

D. Traffic: Conduct operations to ensure minimum interference with roads and other adjacent occupied and used facilities. Do not close or obstruct roads or other occupied or used facilities without permission from the Owner.

E. Protections:

1) Ensure safe passage of persons around work areas.
2) Conduct operations to prevent damage to adjacent buildings, structures, improvements and other facilities, and injury to persons.
3) Barricade open floors, pits, or other openings occurring as part of this work and post with warning lights.
4) All protective barricades shall be constructed in accordance with applicable laws.
5) Protect all property from damage.
6) Do not discharge exhaust or offgas near windows or ventilation intakes.
7) The Contractor shall maintain adequate fencing to secure the work zone from unauthorized access.
8) Maintain access to existing adjacent, occupied or used facilities. Do not close or obstruct walkways, exits, or other occupied or used facilities without written permission from the Owner.
9) Protect storm drain inlets and catch basins from unauthorized discharges and sedimentation.

F. Damages: Report to the Owner's Representative and promptly repair damages caused to adjacent facilities.

G. Fire Protection: The Contractor shall provide fire protection in accordance with Fire Department of the City of Hartford requirements.

H. Utility Services: Confirm all utilities to be removed and utilities indicated to stay in service. Protect the latter against damage. Field verify all utility locations. Confirm that all utilities to be removed have been deactivated.

I. Do not interrupt existing utilities serving occupied or used facilities, except when authorized in writing by The Owner's Representative. Provide temporary services during interruptions to existing utilities when requested by the Owner's Representative.

J. Burning: Burning will not be permitted.

K. Hazardous Materials: If hazardous materials are suspected, immediately notify the Owner's Representative.

1.4 SUBMITTALS

1.4.1 Initial Submittals

No later than thirty (30) days prior to initiating any site work, the Contractor shall submit three (3) copies of a draft of each of the submittals listed below for review and comment. The Owner's Representative shall review the submittals for compliance with the project specifications, industry standards, and good engineering practice. The Owner's Representative shall provide comments on the submittals within fifteen (15) days of receipt. The Contractor shall, to the satisfaction of the Owner's Representative, address any comments or concerns that they have on the draft submittals and submit three (3) copies of final submittals to the Owner's Representative. Submittals shall be submitted as complete organized reports (including tables of contents), bound in durable, 3-ring, water resistant binders. The Contractor shall not be allowed to commence with any site work until the final submittals have been submitted to the Owner's Representative, and they have acknowledged that the Contractor has addressed all comments and concerns on the draft submittals.

1.4.1.1. Cleaning and Decommissioning Work Plan

a. The Work Plan shall include such aspects as the sequence, schedule and methods and materials for all phases of the work. The Work Plan shall include measures to protect the environment, workers, the public, and adjacent structures and utilities to remain. Include drawings showing proposed work zone, staging and stockpiling areas. Address issues such as health and safety, regulatory compliance, traffic control, and materials management and disposal.

1.4.1.2 Records, Permits, Licenses and Approvals

Submit proof of all applicable permits and approvals necessary prior to initiating any site work. Include copies of valid hazardous materials and contractor license, and copies of notifications to the local fire department.

1.4.1.3 Cleaning Agent Data

Submit manufacturer's catalog data and product literature for any and all cleaning agents proposed for the tank cleaning.

1.4.1.5 Waste Transporter and Disposal Facility Identification

Prior to starting work the Contractor shall identify the CTDEP permitted waste transporter that will transport off-site wastes generated by the tank cleaning. The Contractor shall also identify the disposal facility and which these materials will be shipped. If any product will be recycled, the proposed method shall be identified. The identified waste transporter, disposal facilities, and recycling methods shall be submitted to the Owner's Representative for approval prior to starting any work.

1.4.2 Progress Submittals

1.4.2.1 Waste Manifests

Submit records of waste manifests, Bills of Lading, and tipping receipts for the transport and disposal of waste from the site within 15 days of delivery.

1.5 QUALITY ASSURANCE

1. Firm Qualifications: A firm having experience with tank closures in Connecticut similar in material and extent to that indicated for this project.

2. Pre-Cleaning Conference: Conduct conference at project site with the Owner's Representative and subcontractors to review methods and procedures, related to cleaning and decommissioning, including sequence of work, access, and protections.

1.6 ENVIRONMENTAL PROTECTION

1. Conduct operations and provide environmental protection as required to prevent dust and debris from creating a nuisance or hazard and to prevent spills and pollution of the ground or water on and off-site during the Work.

1.6 ASSISTANCE WITH DOCUMENTATION

1. The Contractor shall provide assistance to the Owner's Representative upon request for obtaining information, such as photographs and measurements, needed for the tank closure report. The Contractor is responsible providing fully executed waste manifests for the tank closure report.

PART 2 PRODUCTS

NOT USED.

PART 3 EXECUTION

3.1 EXAMINATION

1. Prior to the start of the work, review Project Record Documents of existing construction from the Owner. The Owner does not guarantee that existing conditions are same as those indicated in Project Record Documents.

2. Prior to the start of the work, survey existing conditions and correlate with requirements indicated. If any suspected asbestos or asbestos containing materials are encountered, contact the Owner's Representative immediately. Prepare the Work Plan utilizing this initial survey.

3. Continually examine conditions as work progresses and conditions change in order to detect against hazards to safety.

4. Inventory and record the condition of items to be removed and salvaged.

5. When unanticipated mechanical, electrical, or structural elements are encountered, investigate and measure the nature and extent of the element.

3.2 CLEANING AND DECOMMISSIONING PROCESS

A. PRELIMINARY PROCEDURES

1. Notify appropriate USEPA office and the local fire department in writing, at least 30 days before tank cleaning and decommissioning, of scheduled dates and locations.

2. Collect and analyze any samples required to pre-characterize liquids (including both free product and wash water) and sludge for disposal at the approved facilities.

3. Provide all required submittals for review and approval by the Owner's Representative in accordance with the specified procedures and timeframes.

4. Contact "Call Before You Dig" at least 72 hours before any planned excavation.

5. Field locate all utilities specified for deactivation, disconnection, removal, in-place abandonment, and protection in coordination with the Owner's Representative.

6. Coordinate schedule and plans with on-site personnel. The Contractor is responsible for transferring re-useable fuel out of the tank to the new AST prior to cleaning and deactivate, lockout and tagout energized AST systems prior to initiation of tank cleaning activities. The Contractor is responsible for verifying deenergized state of all equipment prior to activities involving removal or abandonment of such equipment.

7. Mobilize, establish work zones and sediment and erosion controls, and install safety barricades.

8. Establish air monitoring programs in accordance with the approved Site Safety and Health Plan and planned tank abandonment procedures.

9. For the project duration, do not allow smoking, or operation of open-flame or spark producing equipment in the vicinity of the work zone. Control static electricity.

B. LIQUID AND SLUDGE REMOVAL

1. Drain and blow out (using compressed air) liquids from system piping into the tanks where practical, or other approved containers. All piping shall be drained/blown out prior to beginning cleaning activities.

2. Remove as much liquid and residue as possible from the tanks using appropriate equipment, such as a vacuum truck. Use explosion-proof or air driven equipment. The Contractor shall monitor for the possible presence of holes or cracks in the tanks. If a hole is discovered, the Contractor shall immediately: 1) notify the Owner's Representative, 2) document the hole setting, 3) photograph the hole, and The Contractor shall have appropriate spill containment materials on hand to address on-site spills.

C. DISCONNECTION AND/OR REMOVAL OF SPECIFIED COMPONENTS

1. Open the manways for access as needed, and disconnect and remove specified piping components and fixtures, including drop pipes, valves and heating units, for cleaning and offsite disposal or salvage. Only use non-sparking tools for cutting and other work. Temporarily stockpile such materials, if required, pending offsite disposal in a manner that does not allow contaminated runoff to occur or result in unauthorized discharges. Clean components before transfer to approved stockpile area.

2. Disconnect piping connected to the tanks (fill/fuel oil, fuel oil return, hot water, hot water return).

3. For purging, utilize diffused air blowers to maintain vapor-free conditions inside the tank, as monitored using a combustible gas meter. In any case, follow proper procedures regarding monitoring of tank atmospheres, bonding and grounding. Utilize combustible gas indicators and oxygen meters, as appropriate, which are thoroughly checked, maintained, and calibrated in accordance with manufacturer's instructions. Persons responsible for testing must be completely familiar with the use of the instruments and interpretations of the instruments readings. Do not use eductor type air movers for purging.

D. CLEANING OF TANKS, PIPING, AND APPURTENANCES

1. Use appropriate confined space entry procedures during cleaning activities. Do not allow personnel into tanks that have been inerted or purged without proper protective clothing, air supply, and masks.

2. Clean the tank interiors to a sound surface using a high-pressure spray rinse or other approved procedures. An API Level 1 cleaning shall be performed and shall meet the requirement of 40 CFR 112.2 following cleaning. Any solids residue shall be scraped, brushed, or squeegeed from the tank walls and containerized for removal. Flush and decontaminate piping, fixtures, and appurtenances regardless of whether removed or abandoned in place. Use the minimum amount of water and approved cleaning agents necessary to obtain the required level of cleaning.

3. For components where direct draining of cleaning fluids into the AST is not possible, utilize a portable, double-contained decontamination station and dispose of resulting decontamination liquids off site.

4. Collect and containerize any wash water in preparation for offsite disposal. Do not discharge any liquids on site.

5. After cleaning the tanks, assist the Owner's Representative with documentation of the final conditions of the tank interiors.

6. Facilitate inspection by the Fire Department.

F. OFFSITE DISPOSAL OF WASTE LIQUIDS, WASH WATER, AND SPECIFIED PIPING, FIXTURES AND APPURTENANCES

1. Legally dispose offsite all waste liquids, sludges, and wash water at the previously approved facility or facilities.

2. After flushing and decontamination, legally dispose, recycle, or salvage offsite all piping, fixtures and appurtenances removed as part of the cleaning process.

3. The Owner's representative will sign all manifests and bills of lading on behalf of the Owner and will retain copies of all such documentation.

END OF SECTION

SECTION 02010

ABOVEGROUND STORAGE TANK DEMOLITION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Contract Documents and general provisions of the Contract, including General and Supplementary Conditions, Section 02000 and other Division 1 Specification Sections, apply to this Section.

1.2 WORK COVERED BY CONTRACT DOCUMENTS

A. The project involves demolition and disposal of one above ground jet fuel storage tank (The Tank), the removal and disposal of associated aboveground piping and equipment, and site restoration activities.

1. The Tank is an above ground welded steel storage tank that was constructed in 1946. The Tank has a capacity of approximately five million (5,500,000) gallons and a wall thickness of approximately 0.3125 inch and floor thickness of approximately 0.125 inch. The tank is 140 foot diameter and approximately 48 feet tall at its highest point. The exterior painted surface contains lead base paint.

2. The Tank is currently in service and is used to store kerosene fuel for the on-site jet turbine generators. The Tank shall be cleaned and decommissioned in accordance with Section 02000 of these specifications prior to the start of work. All required vapor freeing/ventilation of the tank will be accomplished through the use of non-sparking exhaust fans (compresses air is not available from the owner). Contractor personnel shall be on site at all times during the vapor-freeing/ventilation process in order to monitor conditions of the area and progress of the operation. To determine the progress of vapor-freeing operations, the atmosphere in the tank and surrounding area should be tested continuously throughout the operation.

3. The Contractor shall demolish The Tank, cut the steel into sections capable of being transported for recycling/disposal, and then transport the steel to a recycling/disposal facility approved in advance by the Owner's Representative. The tank is located as shown on the Contract Drawings. The Contractor's shall perform all work without disturbing the soil beneath the tank as petroleum contaminated soils may exist beneath the surface. Any paint removal required as part of the demolition activities shall be done in a manner to prevent paint chips and paint dust from spreading or depositing onto the ground surface. All equipment, materials, and labor to perform the work necessary to complete the work shall be supplied by and at the expense of the Contractor.

4. Equipment associated with the fuel supply system, indicated to be removed, which is located above ground level, shall be cleaned, disconnected, removed, transported and disposed of.

5. The Contractor shall be responsible for demolishing the heater house located adjacent to the Tank on the North side, a set of steel stairs leading from the

bottom to the top of the tank, as well as all piping supports associated with piping that will be demolished as part of this project. Demolition of these items will be completed to grade level. No removal of foundations or slabs associated with these items will be included.

6. The Contractor shall be required to remove all piping indicated on the Contract Drawings and cap ends where shown. The Contractor is responsible for the removal and disposal of all residuals associated with the cleaning of the piping, equipment, and appurtenances should it be required. The Contractor is responsible for the removal and disposal of all aboveground fuel piping, steam piping, condensate piping and any other piping associated the Tank and fuel supply system to 1' below grade. Capping of the fuel piping, steam piping, and condensate piping at the limits of the work area shown on the Contract Documents shall be the responsibility of the Contractor. The Contractor shall verify, prior to the start of demolition activities, if any of the piping included in this scope of work will require cleaning. This shall be accomplished through physical inspection of all piping to be removed. The Contractor shall inform the Owner's Representative immediately of any piping that will require cleaning. The recovery of spilled or released fluids from piping and equipment contents and the decontamination of surfaces or materials that come in contact with them shall be the sole responsibility of the Contractor, at no extra cost to the Owner

7. The Contractor shall be responsible for the proper removal, handling, and disposal of asbestos containing materials associated with all any valves, gaskets, piping, and other equipment to be removed by the Contractor.

8. Prior to the start of work, the Contractor shall submit a work plan that details proposed work techniques, sequences, and schedules. Work shall not commence until the Owner's Representative has reviewed and approved such work plan. Furthermore, the Contractor shall submit a Site Specific Health and Safety Plan (HASP) for the work to be performed as part of this project. As with the work plan, no work shall commence until the HASP has been reviewed and approved by the Owner's Representative. The Contractor shall be responsible for all personal and perimeter monitoring required to ensure that workers and facility personnel are protected against contaminant exposures, such as, but not limited to, lead, PCB's, asbestos, and volatile organics.

9. The Contractor is hereby made aware that access to the areas immediately surrounding the tank may be limited by the location of the tank. Any damage caused by the Contractor's activities shall be repaired at the expense of the Contractor.

10. Access to the location of the tank is limited to a single the paved access road near the Tank. The Contractor shall prevent the tracking of sediment along this access road.

11. The Contractor shall be responsible for proper handling, storage, transportation, and disposal of all demolition debris, piping contents, and cleaning residuals in accordance with all State, Local, and Federal Regulations.

12. Access to hydrant water located approximately 250 from the Tank, but access may require a meter to be installed by the Contractor. Power will be available on a limited basis from a 110 Volt outlet approximately 100 feet from the Tank. Any additional power requirements will have to be supplied by the Contractor.

13. All work shall be performed in accordance with the American Petroleum Institute's (API) Recommended Practice 2009 – "Safe Welding, Cutting and Hot Work Practices in the Petroleum and Petrochemical Industries, Standard 2015 – "Safe Entry and Cleaning of Petroleum Storage Tanks," Recommended Practice 2016 – "Guidelines and Procedures for Entering and Cleaning Petroleum Storage Tanks," and Publication 2207 – "Preparing Tank Bottoms for Hot Work."

14. Project related health and safety and compliance with COVANTA Safety Procedure No. 5 is a requirement of this contract.

B. Regulatory agencies that may be involved in various stages of the decontamination process include the United States Environmental Protection Agency (USEPA), the Connecticut Department of Environmental Protection (CTDEP), and the Connecticut Department of Public Health (CTDPH). The Owner will serve as the necessary contact with these agencies. The Contractor will serve as the primary contact with local agencies, such as the Hartford Health Department, Hartford Building Department and Hartford Fire Departments, and will be responsible for obtaining all required permits.

F. The Contractor will include in his bid, all items required in order to carry out the intent of the Work as described, shown and implied in the Contract Documents, and secure all necessary permits required to perform the work.

G. It shall be the Contractor's responsibility upon discovery to immediately notify the Owner, in writing, of errors, omissions, discrepancies, and instances of non-compliance with applicable codes and regulations within the documents. Any additional costs arising from the Contractor's failure to provide such notification shall be borne by the Contractor.

H. The Work will be conducted under a single lump sum contract price for "Aboveground Storage Tank Demolition".

1.3 WORK SEQUENCE

A. Work shall include all labor and material, shown on the drawings and as specified hereinafter. The intent is to remove and dispose of the Tank and all associated piping, fittings, and appurtenances. Furthermore, all piping encasement, support foundations, pavement or concrete above the piping, and supports shall be removed and disposed of. The Contractor shall recycle all metals in accordance with state and federal regulations. The Contractor is to perform all tasks listed below. The Work will be performed as follows:

- Verify that The Tank is clean and vapor-free
- Inspect all piping and equipment to determine if any requires decontamination
- Remove all remaining solids, liquids, and sludges from contaminated piping, if necessary.
- Decontaminate all contaminated piping, if necessary
- Demolish Tank, piping, and associated equipment to the extents described in Section 1.2 (B) above.

1.4 CONTRACTOR USE OF PREMISE

A. General: Access to areas immediately surrounding the demolition areas will be limited such to allow for COVANTA's and NGS's continued operations of the facility. The Contractor shall not be allowed to interfere with facility operations unless prior approval is received from the Owner, NGS and COVANTA.

B. Use of the Site: Limit use of the premises to work in areas indicated. Confine operations to areas within contract limits indicated. Do not disturb portions of the site beyond the areas in which the Work is indicated.

1. The Contractor shall confine his operations including storage of waste, materials, supplies, equipment, and apparatus to the areas agreed upon by the Owner, NGS and COVANTA during demolition activities.

2. Existing roads, drives, walks, and parking areas are to be kept free and clear at all times. All deliveries for the project are to enter the South Meadows Station property from 8 AM – 3 PM. All Contractors are to check all roadways for accessibility and clearances for deliveries of all large material and equipment. They shall inform the Construction Administrator at least 72 hours in advance of these deliveries so they can be coordinated with the Facility Operator so appropriate traffic control, etc. can be provided. Do not use these areas for parking or storage of materials. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.

4. The Contractor shall be responsible for keeping the work area clean and shall pick up rubbish and debris and promptly remove from site.

5. Parking for the Contractor's employees will be limited to an area designated by the Facility Operator, and the Contractor may be required to provide identification stickers for all vehicles.

6. Special precautions shall be taken to protect all drainage systems near the work areas. Prevent any and all sediment, debris, or other materials from

getting into these systems. Should any sediment, debris, or other materials get into these systems or if any damage occurs to them the Contractor shall immediately contact the Owner's Representative and Facility Operator. The Contractor shall be fully responsible for all costs associated with additional cleaning and repairs caused by neglecting to protect these drainage systems.

7. The Contractor shall comply with local working hour restrictions, unless specifically approved otherwise in writing by the TRC. All work shall be done Monday thru Friday between 7AM and 5PM unless otherwise approved by the Owner.

8. No signs, other than those approved by TRC, will be visible on the premises.

9. All contractor personnel shall attend a briefing by COVANTA regarding safety and conduct on the premises.

1.5 MISCELLANEOUS PROVISIONS

A. Examination of Site:

1. It is not the intent of the Documents to show all existing conditions. The Contractor shall arrange to visit and examine the site with the Owner if deemed to be necessary.

2. The Contractor shall investigate and satisfy themselves as to the conditions affecting the work, including but not restricted to those bearing upon transportation, disposal, handling and storage of materials, availability of labor, water, electric power, uncertainties of weather, roads or similar physical conditions of the ground, the character of equipment, and facilities needed preliminary to and during the prosecution of the Work. The Contractor should further satisfy himself as to the character, quality, and quantity of surface and subsurface materials or obstacles to be encountered insofar as this information is reasonably ascertainable from an inspection of the site, as well as from information presented by the Contract Documents. Any failure by the Contractor to acquaint himself with the available information shall not relieve him from the responsibility for estimating properly the difficulty and cost of successfully performing the Work.

B. Project Documents

1. The Specifications and Drawings are intended to describe and illustrate the materials and labor necessary for the work of this Project.

C. Construction Responsibility

1. The Contractor shall be responsible for his construction means, methods, techniques, sequences, and procedures employed in the performance of his work and shall have full responsibility for failure to carry out any part of the work in accordance with the Contract Documents.

E. Overtime

1. The Contractor shall request approval from the Owner to work overtime. Said request shall be made 48 hours in advance. All costs for overtime are included in the Contract Sum as stated on the Bid Proposal Form. The Owner makes no guarantee that the facility owner and operator will allow work to be performed outside the hours of 7 AM and 5 PM Monday through Friday.

F. Disclosure of Information

1. These Contract Documents include reports, surveys and referenced construction drawings. The information is offered in good faith for information only. This data is not to be considered a part of Contract Documents. The owner does not warrant or represent that the information contained in these reports is complete or accurate, but only that it constitutes a disclosure of the information known to the owner at this time regarding these conditions.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 02010

SECTION 02112

EROSION AND SEDIMENT CONTROL

PART 1 GENERAL

1.1 DESCRIPTION

A. The work described herein and as shown in the details on the Contract Drawings shall consist of furnishing all labor, material and equipment and performing all operations required for furnishing and installing the erosion and sediment controls during construction activities. Staked haybales, silt fence and stone anti-tracking pad shall be required where indicated on the Contract Drawings and elsewhere as necessary to control sedimentation from disturbed area and soil stockpiles. Also maintain the erosion and sediment controls through the construction period until the site has been stabilized, as determined by the OWNER'S REPRESENTATIVE. The CONTRACTOR shall be responsible for maintaining compliance with all applicable erosion and sediment control regulations.

B. The work shall conform to the Soil Erosion and Sediment Control Contract Drawings. Site soil erosion and sediment controls must be in place before proceeding with any site disturbance activity.

C. The CONTRACTOR is solely responsible for the management of surface water runoff. The OWNER'S REPRESENTATIVE shall verify that all required sediment and erosion controls have been installed to specifications prior to the CONTRACTOR starting any construction activities at the site. The OWNER'S REPRESENTATIVE shall also periodically inspect sediment and erosion controls, including after rainfall events, and inform the CONTRACTOR of repairs or removal of accumulated sediments that are required to maintain the effectiveness of the sediment and erosion controls. The CONTRACTOR shall promptly perform these repairs and removal actions as directed by the OWNER'S REPRESENTATIVE. The CONTRACTOR is responsible for the costs associated with these repairs and removal actions.

1.2 REFERENCES

A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 185	(1997) Steel Welded Wire Fabric, Plain, for Concrete Reinforcement.
ASTM C 33	(1997) Concrete Aggregates

ASTM D 3787	(1989) Bursting Strength of Knitted Goods – Constant-Rate-or-Transverse (CRT) Ball Burst Test
ASTM D 4355	(1992) Deterioration of Geotextiles from Exposure to Ultraviolet Light and Water (Xenon-Arc Type Apparatus)
ASTM D 4533	(1991; R 1996) Trapezoid Tearing Strength of Geotextiles
ASTM D 4632	(1991; R 1996) Grab Breaking Load and Elongation of Geotextiles
ASTM D 5141	(1996) Determining Filtering Efficiency and Flow rate of a Geotextile for Silt Fence Application Using Site-Specific Soil

CONNECTICUT DEPARTMENT OF TRANSPOTATION (CDOT)

Form 816	Standard Specifications for Road, Bridges and Incidental Construction

CT Public Act No. 83-388 An Act Concerning Soil Erosion and Sediment Control

CT Council on Soil and Water Conservation (2002) Connecticut Guidelines for Soil Erosion and Sediment Control

1.3 SUBMITTALS

The CONTRACTOR shall furnish with copies of manufacturer's material data literature for silt fence.

A. OWNER'S REPRESENTATIVE shall prepare prior to mobilization, a Stormwater Pollution Control Plan prepared in accordance with the CTDEP's General Permit for the Discharge of Stormwater and Dewatering Wastewaters Associated with Construction Activities. This plan shall address temporary means needed to prevent discharge of sediment to water courses because of dewatering systems or erosion and off-site removal and disposal of all water that has contacted sub-surface soil material as a result of construction activities.

PART 2 PRODUCTS

2.1 SILT FENCE FABRIC

A. Fabric used in silt fence construction shall be non-rotting, ultraviolet light resistant woven polyester geotextile with sufficient strength for the purpose intended. The grab tensile strength shall exceed 150 pounds and puncture strength shall exceed 50 pounds.

2.2 STRAWBALES

A. Bales used in sedimentation control system shall be made of straw with forty pounds minimum weight and one hundred and twenty pounds maximum.

2.3 WOOD STAKES

A. Wood stakes used in sedimentation control system shall be a minimum 1 inch by 2 inch nominal size by a minimum 3 feet long.

2.4 ANTI-TRACKING PAD

A. Stone used for the anti-tracking pad shall be 1-inch to 2-inch crushed stone conforming to the requirement of Size #3 in CDOT Form 816 Section M.01.01.

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PART 3 EXECUTION

3.1 CONSTRUCTION METHODS

Construction of erosion and sediment control practices shall be sequenced to coordinate with the construction schedule. Perimeter erosion and sediment controls shall be in place and be completely functional prior to start of any land disturbing activities. All erosion and sediment controls shall be constructed and installed in accordance with the Contract Drawings and Soil Erosion and Sediment Control Plan approved by the Owner's Representative.

A. Silt Fence
   1. Furnish and install silt fence as needed to control sedimentation due to runoff from disturbed areas and soil stockpiles. The silt fence shall remain in place during the duration of the project and shall be removed with the approval of the OWNER'S REPRESENTATIVE.

B. Staked Hay Bales
   1. Furnish and install staked haybales as shown on the Contract Drawings and elsewhere as required to control sedimentation from surface runoff. Haybales shall be installed as detailed on the Contract Drawings with two wooden stakes and the lower 4 inches shall be buried below the soil surface.

C. Anti-Tracking Pad
   1. Excavate and install the stone pad to the dimensions and location shown on the Contract Drawings or as directed by the Owner's Representative at the edge of the paved road where construction equipment and hauling vehicles will enter and exit the disturbed work area. The stone material shall be removed and disposed of at the end of construction. The excavated area shall be refilled with topsoil and turf established.

D. Maintenance

1. The erosion and sediment control measures shall remain in place for the duration of the construction period and until turf has been established pursuant to Section 02900. The CONTRACTOR shall inspect all erosion and sediment control measures after each rainfall event and replace or repair as necessary for measures to remain functional and as directed by the OWNER'S REPRESENTATIVE.

3.2 BEST MANAGEMENT PRACTICES

A. Erosion and Sediment Control Devices

1. Soil erosion and sediment controls are measures that are used to reduce the amount of soil particles that are carried off of a land area and deposited in a receiving water. This section provides a general description of the most appropriate measures planned for this project. All applicable soil erosion and sediment control measures shall be implemented in accordance with the guidelines contained herein prior to commencement of construction activities. Measures shall be maintained during and after the demolition activity until final stabilization is accomplished, after which time all temporary soil erosion and sediment control measures will be removed.

    a. Temporary Stabilization
    Temporary stabilization consists of terracing, mulching, or reseeding vegetation in all disturbed, unvegetated areas that are exposed during prolonged periods of inactivity. Due to the relatively short nature of the proposed project activities, it is not likely that temporary stabilization will be required. However, temporary stabilization measures shall be implemented if construction halts for more than 14 days, where construction will not resume within 21 days, and where the area is not subject to traffic.

    b. Permanent Stabilization
    Permanent stabilization for the site consists of turf establishment as described in Section 02900.

    c. Temporary Erosion Control Practices
    Prior to initiating construction, all temporary erosion and sediment control practices shall be in place. This section discusses all temporary erosion and sediment control practices that are necessary for the construction practices.

        1. Construction Access
        Any material which is transported outside the contract boundaries and is deposited on public roadways shall be removed immediately. Material may be removed by shoveling, wet mopping, wet sweeping, or wet power brooming and shall be transported to the appropriate stockpile within the contract boundaries. Road washing shall be allowed only after the sediment is removed in the above manner and approved by the OWNER'S REPRESENTATIVE. Dry sweeping or dry power brooming shall not be allowed.

        2. Silt Fence and Straw Bales
        Silt Fence and straw bales will be used to intercept and retain small amounts of sediment carried by sheet flow from the disturbed areas during construction

activities in order to prevent sediment runoff from the project site. Silt fence and straw bales shall be placed within or around the work zones as shown on the Contract Drawings. Silt fence and straw bales are to be used in areas with slope except in drainageways. Silt fence and straw bales shall be placed perpendicular to the flow of runoff and parallel to the contours. The devices shall be placed down slope of disturbed areas where erosion would occur in the form of sheet or rill erosion. Construct silt fence and straw bale applications as shown on the Contract Drawings and elsewhere as necessary to control sedimentation from disturbed areas and soil stockpiles.

END OF SECTION 02112

SECTION 02225

STRUCTURAL FILL MATERIAL

PART 1 GENERAL

1.1 DESCRIPTION

A. Scope:

1. The work to be performed under this Section shall include materials, all labor, tools, equipment, and testing for furnishing, placing, grading, and compacting Structural Fill beneath the tank as shown on the Drawings or as otherwise directed by the OWNER'S REPRESENTATIVE.
2. The CONTRACTOR is solely responsible for the management of surface water runoff. The OWNER'S REPRESENTATIVE shall verify that all required sediment and erosion controls have been installed to specifications prior to the CONTRACTOR starting any construction activities at the site. The OWNER'S REPRESENTATIVE shall also periodically inspect sediment and erosion controls, including after rainfall events, and inform the CONTRACTOR of repairs or removal of accumulated sediments that are required to maintain the effectiveness of the sediment and erosion controls. The CONTRACTOR shall promptly perform these repairs and removal actions as directed by the OWNER'S REPRESENTATIVE. The CONTRACTOR is responsible for the costs associated with these repairs and removal actions.
3. All necessary testing of materials as required in the Contract Documents.
4. CONTRACTOR field test data shall indicate compliance with the Contract Documents in order to be accepted. The field data shall be certified by the OWNER'S REPRESENTATIVE.
5. CONTRACTOR shall provide the OWNER'S REPRESENTATIVE with access to the borrow pits or material sources upon request for the purposes of observing material source operations and obtaining samples. The CONTRACTOR shall be responsible for supplying all required samples for testing.
6. All soil layer thicknesses referenced in this Section represent the installed compacted thickness.
7. Items listed in Section 02226, Part 1 - General, 1.1 Description also apply.

B. Related Sections:

Section 02226, Excavation, Backfill and Compaction
Section 02228, Topsoil
Section 06645, Geotextile.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 421	1963 (Rev. 1990) Standard Practice for Dry Preparation of Soil Samples for Particle-Size Analysis and Determination of Soil Constants
ASTM D 422	1963 (Rev. 1990) Particle-Size Analysis of Soils
ASTM D 1140	1992 Amount of Material in Soils Finer than the No. 200 (75-micrometer) Sieve
ASTM D 1556	1990 Density of Soil in Place by the Sand Cone-Method
ASTM D 1557	1991 Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10-lb (4.54-kg) Rammer and 18-in. (457-mm) Drop
ASTM D 2487	1992 Classification of Soils for Engineering Purposes
ASTM D 2922	1981 Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D 3017	1988 (Rev. 1993) Moisture Content of Soil and Soil - Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D 4318	1993 Liquid Limit, Plastic Limit, and Plasticity Index of Soils

CONNECTICUT DEPARTMENT OF TRANSPOTATION (CDOT)

Form 815/816	Standard Specifications for Road, Bridges and Incidental Construction

REGULATIONS OF CONNECTICUT STATE AGENCIES (RCSA)

RCSA 22a-133k	Remediation Standard Regulations (RSRs)

ENVIRONMENTAL PROTECTION AGENCY (EPA)

EPA SW-846	1986 Test Methods for Evaluating Solid Waste, Current Edition.

1.3 QUALITY ASSURANCE

A. Tests:

1. The services of a qualified testing laboratory shall be engaged by the CONTRACTOR

to make tests and determine acceptability of the fill or material as listed below. The laboratory shall be acceptable to the OWNER'S REPRESENTATIVE.

2. Required Tests:
   a. Structural Fill Samples from Off-Site: Gradation, ASTM D 422, Priority Pollutant Semivolatile Compounds, EPA Method 8270, Priority Pollutant Volatile Organic Compounds, EPA Method 8260, Priority Pollutant Metals, EPA Method 6010 (HG Method), Pesticides, EPA Method 8081, PCBs, EPA Method 8082, Herbicides, EPA Method 8151. All test results shall be in conformance with the criteria for Industrial Direct Exposure Criteria (IDEC) and Class GB Groundwater Pollutant Mobility Criteria (GBPMC) of the CTDEP's Remediation Standard Regulations (RSRs), 22a-133k-l to k-3 of the Regulations of Connecticut State Agencies, modified as follows: multiply both of these criteria by a factor of 0.8 (except 1.0 is used when RDEC = IDEC and/or when GAPMC = GBPMC).
   b. Compacted Structural Fill: Compaction, ASTM D 1557, ASTM D 1556, ASTM D 2922 and ASTM D3017.

B. Permits and Regulations:
   1. CONTRACTOR shall obtain all necessary permits.

C. Reference Standards: Comply with applicable provisions and recommendations of the following except as otherwise shown or specified.
   1. ASTM D 422, Particle-Size Analysis of Soils.
   2. ASTM D 4318, Liquid Limit, Plastic Limit and Plasticity Index of Soils.
   3. ASTM D 1557, Moisture-Density Relations of Soils, using 10.0 lb (4.5 kg) Rammer and 18-in. (457 mm) Drop.
   4. ASTM D 2922, Density of Soil in Place by Nuclear Methods.
   5. ASTM D 3017, Water Content of Soil and Rock in Place by Nuclear Methods.
   6. Priority Pollutant Semivolatile Compounds by EPA Method 8270.
   7. Priority Pollutant Volatile Organic Compounds by EPA Method 8246.
   8. Priority Pollutant Metals by EPA Method 6010 (HG Method).
   9. Pesticides, EPA Method 8081.
   10. Herbicides, EPA Method 8151.
   11. PCBs/EPA Method 8082.

   Note: Items 6 through 11 as noted above will be referred to as "environmental testing" throughout these Specifications.

1.4 SUBMITTALS

A. Test Reports:
   1. Submit six (6) copies of the following reports directly to OWNER'S REPRESENTATIVE from the testing service, with copy to the CONTRACTOR:
      a. All tests for Structural Fill.
      b. Compliance testing during construction.
      c. Structures subgrade.
      d. Field density tests.
      e. Optimum moisture - maximum density curve for each material.
   2. Testing shall conform to the following as a minimum.

a. Tests on material
   1) Structural Fill: Environmental, particle size, and modified proctor tests for Structural Fill from off-site shall be performed at a frequency of 1 per 3,000 cubic yards if from a natural borrow/quarry source or 1 per source, whichever is more stringent. Material that is not from a natural borrow/quarry source shall be tested at a frequency of 1 per 200 cu.yds. for the first 1,000 cu.yds., then 1 per 500 cu.yds. for all parameters with concentrations that exceed 50% of DEC/PMC criteria.
b. Field density tests:
   1) Structural Fill: CONTRACTOR shall conduct six (6) tests per 6 inch lift. A Troxler Nuclear Moisture-Density gauge shall be used for all field density tests. Test locations shall be random and well spaced. Test reports shall note the grid location point and lift for each test. CONTRACTOR shall establish and maintain grid points for each lift of material placed.
c. Moisture-density curve for each Structural Fill used in construction.

B. Submit six (6) samples of all Structural Fills required.

C. OWNER'S REPRESENTATIVE shall prepare prior to mobilization, a Stormwater Pollution Control Plan prepared in accordance with the CTDEP's General Permit for the Discharge of Stormwater and Dewatering Wastewaters Associated with Construction Activities. This plan shall address temporary means needed to prevent discharge of sediment to water courses because of dewatering systems or erosion and off-site removal and disposal of all water that has contacted sub-surface soil material as a result of construction activities.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Not Applicable.

2.2 STRUCUTURAL FILL

A. STRUCTURAL FILL

1. Structural Fill shall be provided where shown beneath and surrounding the main tank and outer containment tank. Structural Fill shall be placed where shown or specified on the Drawings, or as otherwise directed by OWNER'S REPRESENTATIVE.
2. Structural Fill shall be quarried broken/crushed stone and stone dust particles conforming to the requirements of CDOT Form 815/816, Section M.02.06 Gradation "B" or "A" as shown on the drawings. The crushed stone and stone dust shall be either from native durable basalt or diabase rock quarry. Crushed bank run gravel or bank run sand and gravel will not be accepted. The material shall be completely free of crushed concrete, brick, soil or other material.
3. The CONTRACTOR shall submit to the OWNER'S REPRESENTATIVE product information, laboratory test results and all other necessary and applicable data.

4. Provide approved crushed stone aggregate materials for Structural Fill, free of contaminated soil, clay, rock or gravel, debris, waste, frozen materials, vegetable and other deleterious matter.

PART 3 - EXECUTION

3.1 INSTALLATION

A. The OWNER'S REPRESENTATIVE will examine the areas and conditions under which excavating, filling, and grading are to be performed and notify the CONTRACTOR of conditions CONTRACTOR may encounter that are detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected in an acceptable manner.

B. CONTRACTOR shall provide the OWNER'S REPRESENTATIVE with clean, unused, scalable 5-gallon pails with handles and lids to obtain samples. CONTRACTOR shall provide personnel to the OWNER'S REPRESENTATIVE to collect samples.

C. Prior to procurement of material and starting construction, the Contractor shall have submitted and received approvals for the materials based on the testing required in this Section.

D. Structural Fill shall be placed on all areas as shown on the Drawings or as directed by the OWNER'S REPRESENTATIVE and as described in these Specifications. The thickness of each lift prior to compaction of the Structural Fill shall be no greater than eight (8) inches. Total compacted thickness of the Structural Fill shall be as shown on the Drawings. Compaction of the Structural Fill shall be accomplished by suitable compaction equipment, subject to approval by the OWNER'S REPRESENTATIVE.

E. The Structural Fill shall be compacted to 95 percent of Modified Proctor. The moisture content of the material shall be maintained within 3 percent of optimum moisture.

F. The material delivered to the site shall be visually inspected by the OWNER'S REPRESENTATIVE during construction to check that it is consistently the same as the materials previously existent or delivered to the site. If changes in the material occur, the OWNER'S REPRESENTATIVE shall verify the material is from an approved source and the OWNER'S REPRESENTATIVE may require additional testing in accordance with Paragraph 1.3, Part A (2) of this Section. If the material is not from an approved source or if the material is determined to not be acceptable by the OWNER'S REPRESENTATIVE, the CONTRACTOR shall be notified that the material is not approved. The OWNER'S REPRESENTATIVE shall reject any work performed by the CONTRACTOR using the new material until the appropriate testing is conducted and the material is approved by the OWNER'S REPRESENTATIVE.

G. The CONTRACTOR shall be responsible to repair damage to the Structural Fill between testing and acceptance.

H. All Structural Fill samples are to be obtained under the direction of the OWNER'S

REPRESENTATIVE.

I. Final acceptance of Structural Fill is dependent upon:
   a. Satisfying the minimum requirement of compacted thickness and proposed surface grade of the Structural Fill layer measured by survey methods.
   b. Structural Fill meeting all the physical/analytical properties listed in Section 02225.
   c. Final inspection conducted by the OWNER'S REPRESENTATIVE. The CONTRACTOR will perform all work necessary to mitigate to acceptable Structural Fill conditions, at no additional cost to the OWNER.

J. Any damage, disturbance, or settlement that occurs as a result of the CONTRACTOR's stockpiling of material or equipment on site shall be the responsibility of the CONTRACTOR to repair and/or supply additional materials to compensate for settlement caused by the CONTRACTOR'S actions.

3.2 SOURCE QUALIFICATION TESTING

A. Prior to acceptance of the Structural Fill borrow or stockpile site, the CONTRACTOR shall provide the following soil analyses to the OWNER'S REPRESENTATIVE:
   1. Results of compaction tests conducted in accordance with ASTM D 1557 (latest revision), Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort.
   2. Results of Atterberg limits, plastic and liquid limit, and plasticity index conducted in accordance with ASTM D 4318 (latest revision), Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
   3. Results of the particle-size analysis conducted in accordance with ASTM D 421/422 (latest revision). Standard Practice for Dry Preparation of Soil Samples for Particle-Size Analysis and Determination of Soil Constants/Test Method for Particle Size Analysis of Soils.
   4. Results of chemical analyses conducted in accordance with the requirements of Section 02225.

3.3 STRUCTURAL FILL

A. Structural Fill:
   1. Quality Control Testing:
      a. The OWNER'S REPRESENTATIVE shall perform quality control testing during construction. This testing is in addition to all other tests required to be conducted by the CONTRACTOR.
      b. The OWNER'S REPRESENTATIVE shall collect representative samples from each material source of Structural Fill for testing at a frequency determined by the OWNER'S REPRESENTATIVE.

END OF SECTION 02225

SECTION 02226

EXCAVATION, BACKFILLING AND COMPACTION

PART 1 GENERAL

1.1 SUMMARY

The work under this section includes the excavation of soils from the site and the placement and compaction of backfill/fill to complete siteregrading, excluding tank foundation materials covered in separate sections of these specifications. The work also includes the handling, management, and loading of all solids and disposal of liquids generated during excavation activities. All excavated soil for this project shall be classified as "Soils that Contain Contaminants Above Regulatory Concern". All water removed from excavations shall be considered as "Water that Contain Contaminants Above Regulatory Concern".

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 422	1963 (Rev. 1990) Particle-Size Analysis of Soils
ASTM D 1140	1992 Amount of Material in Soils Finer than the No. 200 (75-micrometer) Sieve
ASTM D 1556	1990 Density of Soil in Place by the Sand Cone-Method
ASTM D 1557	1991 Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10-lb (4.54-kg) Rammer and 18-in. (457-mm) Drop
ASTM D 2487	1992 Classification of Soils for Engineering Purposes
ASTM D 2922	1981 Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D 3017	1988 (Rev. 1993) Moisture Content of Soil and Soil - Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D 4318	1993 Liquid Limit, Plastic Limit, and Plasticity Index of Soils

UNITED STATES ARMY CORPS OF ENGINEERS (COE)

EM385-1-1	1996 Safety and Health Requirements Manual

U.S. DEPARTMENT OF AGRICULTURE (USDA)

DOA SSIR — April 1984 Soil Survey Investigation Report No. 1, Soil Survey Laboratory Methods and Procedures for Collecting Soil Samples, Soil Conservation Service

ENVIRONMENTAL PROTECTION AGENCY (EPA)

EPA SW-846 — 1986 Test Methods for Evaluating Solid Waste, Current Edition.

STATE OF CONNECTICUT, DEPARTMENT OF ENVIRONMENTAL PROTECTION,

RCSA 22a-133k — Remediation Standard Regulations (RSRs)

1.2 DESCRIPTION

This section includes requirements for excavating and handling contaminated soil and other materials contaminated with TPH.

1.2.1 Requirements

Referenced Standard Specifications: Materials and workmanship specified herein shall be in accordance with the referenced articles, sections, and paragraphs.

1.3 DEFINITIONS

1.3.1 Backfill

Soil material used in refilling an excavation.

1.3.2 Compaction

Any method of mechanically stabilizing a material by increasing its density at a controlled moisture condition. "Degree of Compaction" is expressed as a percentage of the maximum density obtained by the test procedure described in ASTM D 1557 for general soil types or abbreviated in this specification as "95 percent ASTM D 1557 maximum density."

1.3.3 Excavation

The removal of soil, rock, or hard material to obtain a specified depth or elevation.

1.3.4 Fill

Specified material placed at a specified degree of compaction to obtain an indicated grade or elevation.

1.3.5 Hard Material

Weathered rock, dense consolidated deposits, or conglomerate materials that are not included in the definition of "rock" but which usually require the use of heavy excavation equipment, ripper teeth, or jack hammers for removal.

1.3.6 In-Situ Soil

Existing in place soil.

1.3.7 Lift

A layer or course of soil placed on top of unprepared subgrade or a previously prepared or placed soil in a fill or backfill.

1.3.8 Rock

Solid homogeneous interlocking crystalline material with firmly cemented, laminated, or foliated masses or conglomerate deposits, neither of which can be removed without systematic drilling and blasting, drilling and the use of expansion jacks or feather wedges, or the use of backhoe-mounted pneumatic hole punchers or rock breakers; also large boulders, buried masonry, or concrete other than pavement, pits and vaults exceeding one cubic yard in volume. Removal of "hard material" will not be considered rock excavation because of intermittent drilling and blasting that is performed merely to increase production.

1.3.9 Soil

The loose surface material of the earth's crust resulting from the chemical and mechanical weathering of rock and organic material.

1.3.10 Suitable Backfill Material

Backfill material that meets all of the requirements for its intended use as specified in this, and other, sections. Suitable material used to back fill excavations to include soil, topsoil, crushed rock, gravel, crushed brick, and crushed concrete having chemical concentrations that are less than the Industrial/Commercial Direct Exposure Criteria (I/C DEC) and the Pollutant Mobility Criteria For Groundwater Classification GB (GB PMC). All test results shall be in conformance with the criteria for Industrial Direct Exposure Criteria (IDEC) and Class GB Groundwater Pollutant Mobility Criteria (GBPMC) of the CTDEP's Remediation Standard Regulations (RSRs), 22a-133k-l to k-3 of the Regulations of Connecticut State Agencies, modified as follows: multiply both of these criteria by a factor of 0.8 (except 1.0 is used when RDEC = IDEC and/or when GAPMC = GBPMC). Areas to be vegetated will receive a layer of topsoil containing sufficient organic content to promote vegetative growth.

1.3.11 Unsatisfactory Material

In-situ soil or other material identified as having insufficient strength or stability to carry intended loads without excessive consolidation or loss of stability. Also backfill material that contains refuse, frozen material, large rocks, debris, and other material that could cause the

backfill not to compact. Materials containing contaminants above regulatory concern as defined in Article 1.3.13 of this Section. Materials classified as MH, CH, PT, OH, or OL by ASTM D 2487 are unsatisfactory.

1.3.12 Soils that Contain Contaminants Below Regulatory Concern

Soils are considered to contain contaminants below regulatory concern if the soils are considered a clean fill (rather than a waste material) and the contaminant levels are below the I/C DEC and GB PMC soil cleanup criteria established by the CTDEP. All test results shall be in conformance with the criteria for Industrial Direct Exposure Criteria (IDEC) and Class GB Groundwater Pollutant Mobility Criteria (GBPMC) of the CTDEP's Remediation Standard Regulations (RSRs), 22a-133k-l to k-3 of the Regulations of Connecticut State Agencies, modified as follows: multiply both of these criteria by a factor of 0.8 (except 1.0 is used when RDEC = IDEC and/or when GAPMC = GBPMC).Testing for contaminants will be as described in Article 1.3.14.

These soils shall be suitable for use as backfill on the site as long as all other gradation requirements are satisfied. Refer to CTDEP regulations and guidelines for requirements. A list of soil cleanup criteria is located in appendixes A through E of Sections 22a-133k-1 through 22a-133k-3 of the Regulations of Connecticut State Agencies.

1.3.13 Soils that Contain Contaminants Above Regulatory Concern

Soils are considered to contain contaminants above regulatory concern if contaminant levels or method detection limits are above either the I/C DEC or GB PMC soil cleanup criteria established by the CTDEP. Testing for contaminants is described in Article 1.3.15.

These soils shall not be suitable for use as backfill on the site. Refer to CTDEP regulations and guidelines for requirements.

1.3.14 Testing Definitions

Suitable material for use as fill will be obtained by the Contractor from a known borrow source and will be analyzed by the Contractor prior to acceptance for use on site. The Contractor shall test the soil for PCBs, TPH, VOCs, SVOCs, Herbicides, Pesticides and Metals using EPA SW-846 testing methods.

1.4 SUBMITTALS

Submit the following in accordance with the General Conditions.

1.4.1 Statements

Backfill Material. Provide certified test reports stating the material to be used as backfill meet the requirements in Article 2.1.1 of this section before the material is used onsite.

1.4.2 Provide laboratory and field test reports, as described below:

a. Laboratory Test for Moisture-Density Relation for Backfill Material Borrow Source: Submit 15 days prior to commencing excavation.

b. Laboratory Test for Gradation for Backfill Material Borrow Source: Submit 30 days prior to commencing excavation.

c. Laboratory Test for Liquid Limit, Plastic Limit and Plasticity Index for Backfill Material Borrow Source: Submit 15 days prior to commencing excavation.

d. Field Density and Moisture Tests of Backfill Material. Submit on test date.

e. Laboratory tests specified under 1.3.14.

1.5 REGULATORY REQUIREMENTS

Materials and workmanship specified herein shall be in accordance with the referenced articles, sections and paragraphs of the standard except that contractual and payment provisions do not apply.

1.6 DELIVERY AND STORAGE

Deliver and store materials in a manner to prevent contamination, segregation, freezing, and other damage.

1.7 MEASUREMENT AND PAYMENT

The Contractor's cost proposal shall be based on the following criteria:

a. Surface elevations are as indicated.

b. There shall be no measurement for payment for the excavation, handling, stockpiling, management and testing of soil for this project. Measurement for payment for offsite disposal of soil shall be based on the actual tons of material transported to the CRRA Hartford Landfill based upon the certified scale tickets at the facility.

c. Hard material shall not be considered as rock and removal of such material shall not give cause for a claim for additional compensation regardless of hardness or difficulty in removing. Rock as defined in paragraph entitled "Definitions," will not be encountered.

d. Ground water elevations indicated are those existing at the time subsurface investigations were made and do not necessarily represent ground water elevation at the time of construction.

e. Blasting will not be permitted.

1.8 PROTECTION

1.8.1 Utilities

The Contractor will contact Call Before You Dig (CBYD) a minimum of 72 hours in advance of commencing work at the site. The Contractor will use a private utility locator to locate utilities within the excavation areas. Protect existing utilities during excavation activities. Repair and reestablish any damaged utilities, at the Contractor's expense. Utilities identified on available site mapping are indicated on the Contract Drawings. Contractor shall assume all liabilities for damage to existing utilities, whether or not previously located by its utility locating service, during the course of work.

1.8.2 Structures and Surfaces

Protect newly backfilled areas and adjacent structures, slopes, or grades from traffic, erosion settlement, or any other damage. Repair and reestablish damaged or eroded grades and slopes and restore surface construction prior to acceptance.

PART 2 PRODUCTS

2.1 SOIL MATERIALS

Provide soil materials as described below free of debris, roots, wood, scrap material, vegetable matter, refuse, soft unsound particles, ice, or other deleterious and objectionable materials.

2.1.1 Backfill

Bring excavation to grade or subgrade indicated on the drawings using cohesionless material classified as GW, GM, SW, SM, by ASTM D 2487 with a maximum particle size of 3 inches. Backfill shall not be classified as Soils that Contain Contaminants Above Regulatory Concern as specified in Article 1.3.13 of this Section.

PART 3 EXECUTION

3.1 SITE PREPARATION

Refer to Section 01010, "Summary of Work" for a description of the sequencing and site preparation activities.

3.1.1 Erosion and Sediment Controls

Install in accordance with Section 02112, "Erosion and Sediment Control" and as shown on the Contract Drawings.

3.1.2 Stockpile Areas

Construct the soil stockpile areas, as needed, and place any excavated material and any other material Containing Contaminants Above Regulatory Concern on 6-mil polyethylene

sheeting and cover the pile with 6-mil polyethylene sheeting, anchored to prevent wind damage.

3.2 SURFACE PREPARATION

3.2.2 Saw Cut Bituminous Concrete or Concrete

In any location where the area to be excavated is covered with bituminous concrete or concrete, the Contractor shall saw cut around the perimeter of the initial excavation area and any lateral extension of the excavation area prior to commencing soil removal activities. Should any Contractor operations cause the saw cut edge to be compromised, the Contractor shall saw cut a new edge of pavement immediately adjacent to the damaged edge prior to surface restoration.

Bituminous concrete, removed as part of surface preparation, will be disposed of with the soil coming from the excavations on the project. Concrete will be stockpiled at the location designated by the Owner's Representative. The Contractor will be responsible for disposal of all waste materials. The Contractor shall load waste materials onto trucks for disposal.

3.3 EXCAVATION AND HANDLING OF POLLUTED SOIL

3.3.1 Excavation Areas Operations

The pre-construction sampling and testing program has been used as the basis to define the initial areas of excavation as detailed in Section 01010 – "Summary of Work" and on the Contract Drawings. Construction equipment such as excavators, front-end loaders, dozers and hauling vehicles, used within the Excavation Areas shall not be permitted to move outside the Excavation Areas until all visible soil has been removed. The Contractor shall not allow excavated materials to be tracked from the Excavation Areas and shall be responsible to remove any material tracked from Excavation Areas.

3.3.2 Dust Control

The Contractor shall be prepared to mobilize a water tanker trailer to the site for dust control if needed. The tanker shall hold at least 1,000 gallons of water for dust control. The tanker shall be equipped with a high-pressure water pump and sufficient fire hose and nozzle to spray water over soil excavation and stockpile areas. Water shall be applied liberally to keep fugitive dust under control as needed and as directed by the Owner's Representative. The Contractor will have access to water from one or more hydrants on-site. The Owner's Representative will coordinate access to hydrant water with the Owner. The Contractor shall request approval from the Owner's Representative before taking water from a hydrant, even if permission had been granted for that location on an earlier occasion.

3.3.3 Excavation

Excavation shall be carried out in such a manner so as to minimize the mixing of soils to underlying soils. No ripping, plowing, harrowing or mixing of soils shall be permitted. Only excavation equipment that provides precise depth control will be permitted. No crane mounted clamshell or dragline excavators will be allowed.

The Contractor shall prevent the undermining of pavements, foundations and slabs in all excavation areas. The Contractor shall slope banks where space permits. Any shoring or sheeting materials used by the Contractor on site shall not remain in place in completed work.

3.3.4 Personal Protective Equipment

At a minimum, all personnel working within the Excavation Areas shall be required to don Level D personal protective equipment. The Contractor will be responsible for assessing whether the level of personal protection shall be upgraded or can be downgraded and provide justification to the Owner's Representative.

3.4 BACKFILLING

3.4.1 Subgrade Preparation

Backfill all excavations created by removing material to the grades and subgrades indicated in the Specifications and Drawings. Use suitable uncontaminated material as specified in Part 2. Only clean decontaminated equipment shall be used for excavating, transporting, placing and compacting of backfill material. Use only approved materials in backfilling upon the prepared subgrade. Step, bench, or break up sloped surfaces steeper than one (1) vertical to four (4) horizontal so that the fill material will bond with or be securely keyed to the existing material. Scarify existing surface to a minimum depth of 6 inches if subgrade density is less than the degree of compaction specified and recompact. Place satisfactory material in horizontal lifts not exceeding 12 inches in loose depth and then compact. Do not place material on surfaces that are muddy, frozen, or contain frost. Compact with equipment well suited to the soil being compacted. Moisten or aerate material as necessary to provide the moisture content that will readily facilitate obtaining the specified compaction with the equipment used. Compact each lift as specified herein before placing the overlaying lift. Bring the backfill to the top of subgrade required. Complete surface restoration activities consisting of either topsoil and turf establishment or bituminous concrete.

3.4.3 Filling and Backfilling Beside Structures

Place backfill adjacent to structures and compact to prevent wedging action or eccentric loading upon or against the structures. Step or serrate slopes bounding or within areas to be backfilled to prevent sliding of the fill. Do not use equipment for backfilling operations or for the formation of embankments against structures that will overload the structure.

3.5 TESTING

No separate payment will be made for testing under Paragraph 3.5.1

3.5.1 Source Study Testing

Provide source testing for all materials proposed for use. Collect samples at each borrow source (Borrow from Off-Site) for determination of the following parameters and demonstration of specification compliance.

1. Moisture Density Relation (ASTM D 1557) at a minimum frequency of 3 tests per material per source.

2. Gradation (ASTM D422, ASTM D1140, and ASTM D2487) at a minimum frequency of 3 tests per material per source.

3. Liquid Limit, Plastic Limit, and Plasticity index (ASTM D4318) at a minimum frequency of 3 tests per material per source.

4. Laboratory tests for contaminants, PCBs, TPH, VOCs, SVOCs, Pesticides, Herbicides and metals using EPA SW-846 testing methods for material from off-site shall be performed at a frequency of 1 per 3,000 cubic yards if from a natural borrow/quarry source or 1 per source, whichever is more stringent. Material that is not from a natural borrow/quarry source shall be tested at a frequency of 1 per 200 cu.yds. for the first 1,000 cu.yds., then 1 per 500 cu.yds. for all parameters with concentrations that exceed 50% of DEC/PMC criteria.

3.5.2 Construction Phase Testing

During construction, provide testing as follows:

1. In place moisture content and density measurements (ASTM D1556 or ASTM D2922, D3017) shall be performed by the contractor. Test in place moisture content and density measurements at a frequency of one measurement per 2000 square feet of every soil backfill lift placed.

3.6 GENERAL COMPACTION

Use hand-operated, plate-type, vibratory, or other suitable hand tampers in areas not accessible to larger rollers or compactors. Compact material in accordance with the following unless otherwise specified. If necessary, alter, change, or modify selected equipment or compaction methods to meet specified compaction requirements

Table 3.6-1
Percent ASTM D 1557
Maximum Density

Backfill	Cohesive Material	Cohesionless Material
Under Concrete/Paving	95	95
Under grassed areas	85	85

3.7 FINISH OPERATIONS

3.7.1 Grading

Finish to grades indicated within one-tenth of a foot. Provide sod or topsoil in areas to be seeded and mulched as indicated and in accordance with requirements specified in Section 02900, "Turf Establishment". Grade areas to drain water away from structures and to provide suitable surfaces for mowing machines. Grade existing grades that are to remain but have been disturbed by the Contractor's operations.

All areas covered by the project, including excavated and filled sections and adjacent transition areas, shall be uniformly smooth-graded. The finished surface shall be reasonably smooth, compacted, and free from irregular surface changes. The degree of finish shall be that ordinarily obtainable from blade-grader operations, except as otherwise specified. Ditches and gutters shall be finished to permit adequate drainage. The surface of areas to be turfed shall be finished to a smoothness suitable for the application of turfing materials.

3.7.2 Disposition of Surplus Material

Surplus material is expected from the excavations to be performed. Surplus material that has tested as containing contaminants below regulatory concern shall may be used as backfill where permitted by the Owner's Representative. All Contaminated material shall not be stored or mixed with non-contaminated soils in any manner to cause contamination of otherwise non-contaminated soil. Soils that Contain Contaminants Above Regulatory Concern be kept in covered stockpiles or may be shipped to the CRRA Hartford Landfill at the direction of the Owner's Representative.

3.7.3 Protection of Surfaces

Protect newly graded areas from traffic, erosion, and settlements that may occur. Repair or reestablish damaged grades, elevations, or slopes.

END OF SECTION

SECTION 02227

TANK BEDDING SAND

PART 1 GENERAL

1.1 DESCRIPTION

A. Scope:

1. The work to be performed under this Section shall include all materials, labor, tools, equipment, and testing for furnishing, placing, grading, and compacting sand for bedding support beneath the main tank and outer containment tank as shown on the Drawings or as otherwise directed by the OWNER'S REPRESENTATIVE.
2. All necessary testing of materials as required in the Contract Documents.
3. CONTRACTOR field test data shall indicate compliance with the Contract Documents in order to be accepted. The field data shall be certified by the OWNER'S REPRESENTATIVE.
4. CONTRACTOR shall provide the OWNER'S REPRESENTATIVE with access to the borrow pits or material sources upon request for the purposes of observing material source operations and obtaining samples. The CONTRACTOR shall be responsible for supplying all required samples for testing.
5. All soil layer thicknesses referenced in this Section represent the installed compacted thickness.
6. Items listed in Section 02226, Part 1 - General, 1.1 Description also apply.

B. Related Sections:

Section 02226, Excavation and Backfill and Compaction
Section 02225, Structural Fill
Section 06645, Geotextiles

1.2 QUALITY ASSURANCE

A. Tests:

1. The services of a qualified testing laboratory shall be engaged by the CONTRACTOR to make tests and determine acceptability of all sand material as listed below. The laboratory shall be acceptable to the OWNER'S REPRESENTATIVE.
2. Required Tests:
   a. Sand material Samples from Off-Site: Gradation, ASTM D 422, Priority Pollutant Semivolatile Compounds, EPA Method 8270, Priority Pollutant Volatile Organic Compounds, EPA Method 8240, Priority Pollutant Metals, EPA Method 6010 (HG Method), Pesticides, EPA Method 8081, PCB, EPA Method 8082, Herbicides, EPA Method 8150. All test results shall be in conformance with the criteria for Industrial Direct Exposure Criteria (IDEC) and Class GB Groundwater Pollutant Mobility Criteria (GBPMC) of the CTDEP's Remediation Standard

Regulations (RSRs), 22a-133k-1 to k-3 of the Regulations of Connecticut State Agencies, modified as follows: multiply both of these criteria by a factor of 0.8 (except 1.0 is used when RDEC = IDEC and/or when GAPMC = GBPMC).

b. Compacted sand material: Compaction, ASTM D 1557, ASTM D 1556, ASTM D 2922 and ASTM D3017.

B. Permits and Regulations:
1. CONTRACTOR shall obtain all necessary permits for work.
2. CONTRACTOR shall perform excavation work in compliance with applicable requirements of governing authorities having jurisdiction.

C. Reference Standards: Comply with applicable provisions and recommendations of the following except as otherwise shown or specified.
1. ASTM D 422, Particle-Size Analysis of Soils.
2. ASTM D 1556, Density of Soil in Place by the Sand-Cone Method.
3. ASTM D 1557, Moisture-Density Relations of Soils, using 10.0 lb (4.5 kg) Rammer and 18-in. (457 mm) Drop.
4. ASTM D 2922, Density of Soil in Place by Nuclear Methods.
5. ASTM D 3017, Water Content of Soil and Rock in Place by Nuclear Methods.
6. Priority Pollutant Semivolatile Compounds by EPA Method 8270.
7. Priority Pollutant Volatile Organic Compounds by EPA Method 8260.
8. Priority Pollutant Metals by EPA Method 6010 (HG Method).
9. Pesticides, EPA Method 8080.
10. Herbicides, EPA Method 8151.
11. PCBs, EPA Method 8082.

Note: Items 6 through 11 as noted above will be referred to as "environmental testing" throughout these Specifications.

1.3 SUBMITTALS

A. Test Reports:
1. Submit six (6) copies of the following reports directly to OWNER'S REPRESENTATIVE from the testing service, with copy to the CONTRACTOR:
   a. All tests for sand material.
   b. Compliance testing during construction.
   c. Field density tests.
   d. Optimum moisture - maximum density curve for each soil.
2. Testing shall conform to the following as a minimum.
   a. Tests on material
      1) Sand material: Environmental, hydraulic conductivity, particle size and modified proctor, and material from off-site shall be performed at a frequency of 1 per source. Material that is not from a natural borrow source shall be tested at a frequency of 1 per 500 cubic yards.
   b. Field density tests:
      1) Cover Soil and Drainage Sand material: CONTRACTOR shall conduct six (6) tests evenly spaced over the tank footprint. A Troxler Nuclear Moisture-Density gauge shall be used for all field density tests. Test reports shall note

the grid location point and lift for each test. CONTRACTOR shall establish and maintain grid points for each lift of material placed.

c. Moisture-density curve for each cover soil and drainage sand material used in construction.

B. Submit six (6) samples of all Cover Soil and Drainage Sand materials required.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Not Applicable.

2.2 SAND

A. Sand

1. Sand shall be placed where shown or specified on the Drawings, or as otherwise directed by OWNER'S REPRESENTATIVE.
2. The material shall be clean free draining sand which is free of vegetation, ice or frozen material, wood, glass, metal, or other deleterious material. The maximum particle size shall be ¼ inch.
3. Sand material shall meet the following requirements:
   a. Cover Soil over Drainage Geocomposite
      1) Permeability: The coefficient of hydraulic conductivity, k, for sand shall be more permeable than 1.0×10^{-3} cm/s.
      2) U.S Standard Sieve analysis parameters:
         i. 100% passing ¼ inch
         ii. Less than or equal to 5% passing No. 200 sieve
      3) The Contractor shall submit to the Owner's Representative product information, laboratory test results and all other necessary and applicable data to the Owner's Representative.

PART 3 - EXECUTION

3.1 INSTALLATION

A. The OWNER'S REPRESENTATIVE or his representative will examine the areas and conditions under which excavating, filling, and grading are to be performed and notify the CONTRACTOR of conditions CONTRACTOR may encounter that are detrimental to the proper and timely completion of the Work. The CONTRACTOR shall not proceed with the Work until unsatisfactory conditions have been corrected in an acceptable manner.

B. CONTRACTOR shall provide the OWNER'S REPRESENTATIVE or his representative with clean, unused, scalable 5-gallon pails with handles and lids to obtain samples. CONTRACTOR shall provide personnel to the OWNER'S REPRESENTATIVE or his representative to collect samples.

C. Prior to procurement of material and starting construction, the CONTRACTOR shall have submitted and received approvals for the materials based on the testing required in this Section.

D. It is imperative that the CONTRACTOR makes every reasonable effort to minimize the potential for sand to adversely affect the underlying geotextile via penetration. Therefore, low pressure equipment shall be used to place sand. Equipment operators shall not be permitted to make sharp turns or quick stops.

E. Sand shall be placed on all areas as shown on the Drawings or as directed by the OWNER'S REPRESENTATIVE and as described in these Specifications. Compaction of the sand material shall be accomplished by suitable compaction equipment, subject to approval by the OWNER'S REPRESENTATIVE.

F. The sand shall be compacted to 95 percent of Modified Proctor. The moisture content of the material shall be maintained within 3 percent of optimum moisture. Contractor shall not work wet cover material that cannot support equipment.

G. If changes in the material occur, the OWNER'S REPRESENTATIVE shall verify the material is from an approved source and the OWNER'S REPRESENTATIVE may require additional testing in accordance with Paragraph 1.3, Part A (2) of this Section. If the material is not from an approved source or if the material is determined to not be acceptable by the OWNER'S REPRESENTATIVE, the CONTRACTOR shall be notified that the material is not approved. The OWNER'S REPRESENTATIVE shall reject any work performed by the CONTRACTOR using the new material until the appropriate testing is conducted and the material is approved by the OWNER'S REPRESENTATIVE.

H. The thickness of the in-place materials will be checked after the completion of the work on a grid pattern not to exceed 15-foot by 15-foot by digging, by hand in the presence of and as directed by the OWNER'S REPRESENTATIVE. The size of the test hole shall not be less than one-foot in diameter. The CONTRACTOR shall be responsible for digging holes in the sand material to allow for the measurements to be taken by the OWNER'S REPRESENTATIVE. After measurements have been made, the CONTRACTOR shall backfill the holes with sand, and hand tamp.

I. The CONTRACTOR shall be responsible to repair damage to the sand material until the entire tank bottom is installed.

J. All soil samples are to be obtained under the direction of the OWNER'S REPRESENTATIVE.

K. Final acceptance of sand material is dependent on:

a. Satisfying the minimum requirement of thickness as shown on the Contract Drawings.
b. Sand meeting all the physical/analytical properties listed in Section 02227.

L. Any damage, disturbance, or settlement that occurs as a result of the CONTRACTOR'S stockpiling of material or equipment on site shall be the responsibility of the CONTRACTOR to repair and/or supply additional materials to compensate for settlement caused by the CONTRACTOR'S actions.

3.2 SOURCE QUALIFICATION TESTING

A. Prior to acceptance of the borrow or stockpile site, the CONTRACTOR shall provide the following soil analyses to the OWNER'S REPRESENTATIVE:
1. Results of compaction tests conducted in accordance with ASTM D 1557 (latest revision), Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort.
2. Results of the particle-size analysis conducted in accordance with ASTM D 421/422 (latest revision). Standard Practice for Dry Preparation of Soil Samples for Particle-Size Analysis and Determination of Soil Constants/Test Method for Particle Size Analysis of Soils.
3. Results of hydraulic conductivity testing conducted in accordance with ASTM D 5084 (latest revision), Test Method for Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter.
4. Results of chemical analyses conducted in accordance with the requirements of Section 02227.

3.3 COVER SOIL AND DRAINAGE SAND

A. Sand
1. Quality Control Testing:
   a. The OWNER'S REPRESENTATIVE shall perform quality control testing during construction. This testing is in addition to all other tests required to be conducted by the CONTRACTOR.
   b. The OWNER'S REPRESENTATIVE shall collect representative samples from each material source of sand for testing at a frequency determined by the OWNER'S REPRESENTATIVE.

END OF SECTION 02227

SECTION 02228

TOPSOIL MATERIAL

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
1. CONTRACTOR shall furnish and place topsoil as shown on the Contract Drawings and wherever construction disturbances require turf establishment.
2. The CONTRACTOR is solely responsible for the management of surface water runoff. The OWNER'S REPRESENTATIVE shall verify that all required sediment and erosion controls have been installed to specifications prior to the CONTRACTOR starting any construction activities at the site. The OWNER'S REPRESENTATIVE shall also periodically inspect sediment and erosion controls, including after rainfall events, and inform the CONTRACTOR of repairs or removal of accumulated sediments that are required to maintain the effectiveness of the sediment and erosion controls. The CONTRACTOR shall promptly perform these repairs and removal actions as directed by the OWNER'S REPRESENTATIVE. The CONTRACTOR is responsible for the costs associated with these repairs and removal actions.

B. Related Sections:
1. Section 02226, Excavation and Backfill and Compaction.
2. Section 02900, Turf Establishment and Landscaping.

C. General:
1. CONTRACTOR is required to use approved material from off-site sources.

D. CONTRACTOR shall provide OWNER'S REPRESENTATIVE with access to the material source upon request for the purposes of observing material source operations and obtaining samples.

1.2 QUALITY ASSURANCE

A. Tests:
1. The services of a qualified testing laboratory shall be engaged by the CONTRACTOR to make tests and determine acceptability of the material as listed below. The laboratory shall be acceptable to the OWNER'S REPRESENTATIVE.
2. Required Tests:
   a. Topsoil from Off-Site: Gradation, ASTM D 422, Priority Pollutant Semivolatile Organic Compounds (SVOCs), EPA Method 8270, Priority Pollutant Volatile Organic Compounds (VOCs), EPA Method 8260, Priority Pollutant Metals, EPA Method 6010 (HG Method), Pesticides, EPA Method 8081, PCBs, EPA Method 8082, Herbicides, EPA Method 8151, Soil pH, EPA Method 9045D. All environmental test results shall be in conformance with the criteria for

Residential Direct Exposure Criteria (RDEC) and Class GB Groundwater Pollutant Mobility Criteria (GBPMC) of the CTDEP's Remediation Standard Regulations (RSRs), 22a-133k-l to k-3 of the Regulations of Connecticut State Agencies.

1.3 SUBMITTALS

A. Test Reports:
   1. Submit six (6) copies of the following reports directly to OWNER'S REPRESENTATIVE from the testing service, with copy to the CONTRACTOR:
      a. Environmental, particle size and pH tests for Topsoil material from off-site shall be performed at a frequency of 1 per 1,000 cubic yards or 1 per source, whichever is more stringent.
      b. Written statement giving the location of the properties from which the Topsoil is to be obtained, the names and addresses of the suppliers, and, if applicable, crops grown on the properties during the past 2 years.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Topsoil:
   1. Topsoil shall be placed where shown or specified or directed by OWNER'S REPRESENTATIVE.
   2. Provide approved soil materials for Topsoil, free of contaminated soil, clay, rock or gravel larger than 1/2 inch in any dimension, debris, waste, frozen materials, vegetable and other deleterious matter.
   3. See Section 02900 "Turf Establishment and Landscaping" for full specifications and additional topsoil properties and testing requirements.

PART 3 - EXECUTION

3.1 PLACING

A. OWNER'S REPRESENTATIVE will examine the areas and conditions under which Topsoil placing is to be performed and notify the CONTRACTOR of conditions he may find that are detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected in an acceptable manner. Placing of Topsoil shall conform to the requirements of Section 02226.

B. The thickness of the in-place Topsoil material will be checked after the completion of the work on a grid pattern not to exceed 50-foot by 50-foot in the presence of and as directed by the OWNER'S REPRESENTATIVE. The size of the test hole shall not be less than one-foot in diameter. Measurements shall be made perpendicular to the slope. The CONTRACTOR shall be responsible for digging holes in the Topsoil to allow for measurements to be taken by the OWNER'S REPRESENTATIVE. After measurements have been made, the CONTRACTOR shall backfill the holes with topsoil material, and

hand tamp.

3.2 INSPECTION

A. OWNER'S REPRESENTATIVE will examine the areas and condition of the Topsoil after it is placed on a periodic basis including after all rain events. The OWNER'S REPRESENTATIVE will instruct the CONTRACTOR to repair rills in the Topsoil that are greater than ½-inch deep and 1-wide. The CONTRACTOR shall be responsible for promptly performing the repairs and will be responsible for all costs associated with performing the Work.

END OF SECTION 02228

SECTION 02900

TURF ESTABLISHMENT AND LANDSCAPING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:
1. CONTRACTOR shall provide all labor, tools, materials, testing, equipment and incidentals as shown, specified and required to furnish and perform turf establishment and landscaping work.
2. The extent of the turf establishment and landscaping shall be as shown on the Contract Drawings and in all areas disturbed by construction activities where turf grass is damaged. Work shall be performed as shown and as specified in schedules.
3. The landscaping Work required includes the following:
   a. Importing topsoil from off-site sources if existing topsoil is unacceptable.
   b. Maintenance Work as specified until completion of the Contract.
   c. Soil amendments.
   d. Fertilizers.
   e. Grass materials.
   f. Guarantees.

B. Coordination:
1. Review installation procedures under other Sections and coordinate the installation of items that must be installed with the landscaping.
2. Notify other contractors in advance of the installation of the landscaping to provide the other contractors with sufficient time for the installation of items included in their contracts that must be installed before landscaping.

C. Related Sections:
1. Section 02226, Excavation and Backfill and Compaction.
2. Section 02228, Topsoil.
3. Section 02112, Erosion and Sediment Control.

1.2 QUALITY ASSURANCE

A. Landscape Subcontractor Qualifications:
1. Subcontract the turf establishment work to a single firm specializing in this type of work.
2. The landscape subcontractor shall have a minimum of five years of experience of performing substantially similar work.

B. Source Quality Control:
1. General:
   a. Ship all materials with certificates of inspection as required by governmental authorities.
   b. Comply with governing regulations applicable to all materials.

c. OWNER'S REPRESENTATIVE will request inspection of delivery slips for materials to verify specified quantities of bulk deliveries of soil amendments and fertilizers.

2. Analysis and Standards: Package standard products with manufacturer's certified analysis. For other materials, provide analysis by recognized laboratory made in accordance with methods established by the Association of Official Analytical Chemists, wherever applicable or as further specified.
3. Off-Site Topsoil: Obtain topsoil from local sources or from areas having similar soil characteristics to that found at the site of the Work. Obtain topsoil only from naturally well-drained sites where topsoil occurs in depth of not less than 4- inches; do not obtain from bogs or marshes.
4. Topsoil stockpiled for reuse: Existing cover soils will be inspected by OWNER'S REPRESENTATIVE prior to particle size testing to determine suitability for reuse. At the time of inspection OWNER'S REPRESENTATIVE will require representative soil samples to be tested for physical properties, pH value, organic matter, and available phosphoric acid and potassium if proposed for use as topsoil. Contractor shall supply twenty pound samples and perform tests at no additional expense to OWNER.
5. All Topsoil shall meet the testing requirements of Paragraph 1.3B.

C. Reference Standards: Comply with the applicable provisions and recommendations of the following, except as otherwise shown or specified.
1. ASTM C 602, Agricultural Liming Materials.
2. ASTM D 422, Method for Particle Size Analysis of Soils.
3. ASTM D 2487, Classification of Soils for Engineering.
4. Association of Official Analytical Chemists, Official Methods of Analysis.
5. American Joint Committee on Horticultural Nomenclature, Standardized Plant Names.
6. Official Seed Analysts of North America, Standards of Quality.
7. FSO-F-241D, Fertilizer, Mixed, Commercial.
8. FSO-F-166E, Peat Moss; Peat, Humus; and Peat, Reed-sedge.

1.3 SUBMITTALS

A. Shop Drawings: The CONTRACTOR shall submit six (6) copies of the following for approval:
1. Planting schedule showing scheduled dates for Turf Work in each area of site.
2. Before delivery of off-site topsoil, written statement giving the location of the properties from which the topsoil is to be obtained, the names and addresses of the suppliers, the depth to be stripped and the crops grown during the past 2 years.
3. Manufacturer's specifications and installation instructions for all materials required.

B. Test Reports: Submit for approval the following:
1. Topsoil test reports as required in Section 02228.

C. Certificates: Submit for approval the following:
1. Certificates of inspection as may be required by governmental authorities to accompany shipments, and manufacturer's or vendors certified analysis for soil amendments and

fertilizer materials. For standard products submit other data substantiating that materials comply with specified requirements.

2. Certificates from seed vendors certified statement for each seed mixture required, stating botanical and common name, percentage by weight and percentages of purity, germination, and weed seed for each species.

D. Operation and Maintenance Data: Submit for approval the following:

1. Typewritten instructions recommending procedures to be established by OWNER for the maintenance of landscape Work for one full year. Submit prior to expiration of required maintenance period(s). Include moisture requirements of each type of planting and insect prevention measures including types of spray and application instructions, and special winter protection measures required for each planting.

E. Guarantee: Submit for approval a written guarantee, in the terms specified under "Guarantee" provision of these Specifications, signed by CONTRACTOR.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Delivery of Materials:

1. Deliver packaged materials in original, unopened containers showing weight, analysis and name of manufacturer. Protect materials from deterioration during delivery.
2. Furnish seed in sealed, standard containers.
3. Notify OWNER'S REPRESENTATIVE of delivery schedule in advance so materials may be inspected upon arrival at job site.
4. Remove unacceptable material immediately from project site.

B. Storage of Materials:

1. Store and cover materials to prevent deterioration. Remove packaged materials which have become wet or show deterioration or water marks from the site. Replace at no further cost to OWNER.
2. Seed that is wet or moldy or that has been otherwise damaged in transit or storage is not acceptable. Replace at no further cost to OWNER.

1.5 JOB CONDITIONS

A. Environmental Requirements:

1. Proceed with and complete the Work as rapidly as portions of the Site become available, working within the seasonal limitations for each kind of landscape Work required.
2. Do not spread seed when wind velocity exceeds 5 miles per hour.
3. Do not plant when drought, or excessive moisture, or other unsatisfactory conditions prevail.

B. Scheduling:

1. Plant or install materials only during normal planting seasons for each type of landscape Work required. Correlate planting with specified maintenance periods to provide maintenance until occupancy by OWNER.

1.6 ALTERNATIVES

A. Substitutions are not allowed.

1.7 GUARANTEE

A. Guarantee turf through the specified maintenance period, until Final Acceptance of the Work.

B. Immediately remove and replace turf found to be dead or in unhealthy condition during guarantee period and through the specified maintenance period. Make replacements during growth season following end of guarantee period. Furnish and plant replacements which comply with requirements shown and specified. OWNER'S REPRESENTATIVE will make another inspection at end of extended guarantee period, if any, to determine acceptance or rejection. Only one replacement will be required at end of guarantee period, except for losses or replacements due to failure to comply with specified requirements.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Topsoil:
1. Existing cover soils shall be analyzed in accordance with Part 1.2 B Paragraph 4 of the Section to determine the suitability for reuse as topsoil. Soils approved by the OWNER'S REPRESENTATIVE for use as topsoil shall be stockpiled by the CONTRACTOR for reuse in landscape Work. If quantity of stockpiled topsoil is insufficient, the CONTRACTOR shall provide additional topsoil as required to complete landscape Work.
2. Provide off-site topsoil as required, which is fertile, friable, natural loam, surface soil, capable of sustaining vigorous plant growth, free of any admixture of subsoil, clods of hard earth, plants or roots, sticks or other extraneous material harmful to plant growth. Supply topsoil with the following analysis:
   a. 1/2 -inch Mesh: 100 percent passing.
      #4 Sieve: 90 to 100 percent passing.
      #200 Sieve: 0 - 1 0 percent passing.
   b. Clay content of material passing #200 sieve not greater than 60 percent, as determined by hydrometer tests.
   c. pH 5.0 to pH 6.5. If approved by OWNER'S REPRESENTATIVE, natural topsoil not having the pH value specified may be amended by CONTRACTOR at his own expense.
   d. Organic content not less than 5 percent, as determined by ignition loss.
   e. Free of pests and pest larvae.

B. Soil Amendments:
1. Lime: Natural limestone containing not less than 85 percent of total carbonates, ground so that not less than 90 percent passes a 10-mesh sieve and not less than 50 percent passes a

100-mesh sieve.

2. Peat Humus: Provide peat humus which is a natural product of with sphagnum moss, reed, or sedge peat, taken from a fresh water site. Supply shredded material, fee from lumps, roots, stones and other extraneous foreign matter, capable of passing through a 1/2-inch screen, which can easily be incorporated with the topsoil. Supply material which has been conditioned in storage piles after excavation for at least 6 months, including one freezing and thawing period. Supply peat humus with the following analysis:
   a. Not less than 90 percent organic matter by weight on an oven dry basis.
   b. pH range 5 to 7.5.
   c. Moisture content 35 percent at time of incorporation into soil.
   d. Water absorbing ability 150 percent to 350 percent by weight.
3. Sand: Washed of fine to medium texture.
4. Ferrous Sulfate: Commercial grade and unadulterated.

C. Commercial Fertilizers:
   1. Complete fertilizer of neutral character, with a minimum of 75 percent nitrogen derived from natural organic sources or urea form; 40-50 percent of the nitrogen shall be water soluble. Available phosphoric acid derived form superphosphate, bone, or tankage. Potash derived from muriate of potash, containing 60 percent potash. Uniform in composition, freeflowing and suitable for application with approved equipment. Provide fertilizer with the following percentages of available plant nutrients.
      a. For lawns, provide fertilizer with not less than 4 percent phosphoric acid and not less than 2 percent potassium, and the percentage of nitrogen required to provide not less than 1.5 pounds of actual nitrogen per 1000 square feet of lawn area. Provide nitrogen in a form that will be available to the lawn during the initial period of growth.
   2. Bonemeal: Commercial, raw, finely ground; 4 percent nitrogen and 20 percent phosphoric acid.
   3. Superphosphate: Soluble mixture of treated minerals; 20 percent available phosphoric acid.
   4. Hydroseeding Fertilizer:
      a. Commercial designation of 18-24-6. Provide a complete fertilizer of neutral character with a minimum of 75 percent nitrogen derived from natural organic sources.
      b. Minimum 40-50 percent of nitrogen shall be water soluble.
      c. Uniform in composition, free-flowing and suitable for application with approved equipment.
      d. Product and Manufacturer: Provide one of the following:
         1) Scotts Starter Fertilizer by the Scotts Company.
         2) Or equal.

D. Grass Materials:
   1. Grass Seed Mixture: Provide fresh, clean, new-crop seed complying with the, tolerance for purity and germination established by the Official Seed Analysts of North America. Provide seed of the grass species, proportions and minimum percentages of purity, germination, and maximum percentage of weed seed, as specified. Birdsfoot trefoil shall be inoculated before planting.
   2. The "Schedule of Grass Seed Requirements" is as follows:

GRASS SEED MIX SEEDING SCHEDULE

BOTANICAL NAME	COMMON NAME	MIXTURE PERCENT BY WEIGHT	MINIMUM PERCENT PURITY/ GERMINATION
Agrastis tenuis	Colonial Bentgrass	5%	95/90%
Festuca rubra	Chewings Fescue	35%	97/80%
Festuca longifolia	Hard Fescue	30%	96/85%
Lotus corniculatus	Birdsfoot Trefoil	10%	96/90%
Lolium perenne	Perennial Ryegrass	20%	98/90%

The seeding rate for the mixture shall be 175 pounds per acre. The acceptable planting periods are from April 1 through June 15 and September 1 through October 15.

E. Miscellaneous Landscape Materials:
1. Hydromulch:
   a. On areas and slopes as shown on Contract Drawings, provide a hydraulically applied flexible growth medium (FGM) at the rate of 3,500 pounds per acre.
   b. Provide the following:
      1) Product and manufacturer:
         a) Flexterra FGM by Profile Products, LLC
         b) or equal.
2. Water: Potable.

PART 3 - EXECUTION

3.1 INSPECTION

A. CONTRACTOR and his installer shall examine the subgrade, verify the elevations, observe the conditions under which Work is to be performed, and notify OWNER'S REPRESENTATIVE of unsatisfactory conditions. Do not proceed with the Work until unsatisfactory conditions have been corrected in a manner acceptable to the OWNER'S REPRESENTATIVE.

3.2 PREPARATION

A. Soil Preparation:
1. Loosen subgrade of turfbed areas as required to prepare seedbed. Remove debris over 1-1/2 inches in any dimension and sticks, roots, rubbish and other extraneous matter. Limit preparation to areas which will be planted promptly after preparation.
2. Spread topsoil to minimum depth of 6-inches after natural settlement and light rolling to 85 percent Modified Proctor density.
   a. Do not spread topsoil while in frozen condition or when moisture content is so great that excessive compaction will occur nor when so dry that dust will form in the air or that clods will not break readily.
3. Apply ground limestone, by machine, over all areas to receive turf, as required, to bring the soil to a neutral pH. Work lightly into the top 3 inches of topsoil at least five days before applying the commercial fertilizers.
4. Apply commercial fertilizers in the following quantities:

a. For grass apply only at a rate sufficient to supply 1.5 pounds of nitrogen per 1000 square feet. For 5-10-5 use 30 pounds per 1000 square feet.

5. Apply commercial fertilizers within 10 days of seeding.
6. Apply commercial fertilizers in 2 operations. First application shall be 3/4 of total amount.
7. Thoroughly and evenly incorporate commercial fertilizers with the soil to depth of 3 inches by disking, or other approved method.
   a. In areas inaccessible to power equipment, use hand tools.
8. Apply superphosphate for grass areas at the rate of 20 pounds per 1000 square feet and incorporate into the top 3 inches of topsoil.
9. Grade turfbed areas to smooth, even surface with loose, uniformly fine texture-Remove all stones and extraneous foreign material in excess of 3/4 inch in diameter. Roll and rake and remove ridges and fill depressions, as required to meet finish grades. Limit fine grading to areas which can be planted immediately after grading.
10. Apply a second dressing of fertilizer. Use 1/4 of the total amount.
11. Moisten prepared turfbed areas before planting if soil is dry. Water thoroughly and allow surface moisture to dry before planting. Do not create a muddy soil condition.
12. Restore turfbed areas to specified condition if eroded or otherwise disturbed after fine grading and prior to planting.

B. Adequate sedimentation and erosion control management measures, practices and devices, such as phased construction, vegetated filter strips, geotextile silt fences, or other devices shall be installed and properly maintained to reduce erosion and retain sediment on-site during and after construction. These devices shall be capable of preventing erosion, of collecting sediment, suspended and floating materials, and of filtering fine sediment. These devices shall be removed upon completion of work and the disturbed areas shall be stabilized. The sediment collected by these devices shall be removed and placed at an upland location, in a manner that will prevent its later erosion into a waterway or wetland. If the OWNER'S REPRESENTATIVE determines that the on-site placement of the collected sediment may adversely affect the integrity of the site, the collected sediment will be removed and disposed of at no additional cost to the OWNER. All exposed soil and other fills shall be permanently stabilized at the earliest practicable date. See Section 02112 "Sedimentation and Erosion Controls".

3.3 INSTALLATION

A. Hydroseeding

1. Strictly comply with manufacturer's installation instructions and recommendations. For optimum pumping and application performance use approved mechanically agitated, hydraulic seeding/mulching machines with a fan-type nozzle (50-degree tip). Apply FGM from opposing directions and to achieve best soil coverage. The OWNER'S REPRESENTATIVE shall inspect all areas prior to, during, and following the application of the hydroseed mix and instruct the CONTRACTOR to reapply the seed mix to areas that are not acceptable. The CONTRACTOR shall be responsible for the Work and costs associated with additional Hydroseed

application.

2 Erosion Control and Revegetation:
   a. For maximum performance, apply FGM in a two-step process:
   b. Step One: Mix and apply seed and soil amendments with small amount of FGM for visual metering.
   c. Step Two: Mix and apply FGM at a rate of 50 lb per 125 gallons (23 kg/475 liters) of water over freshly seeded surfaces. Confirm loading rates with equipment manufacturer. Do not leave seeded surfaces unprotected, especially if precipitation is imminent.
   d. Depending upon site conditions FGM may be applied in a one-step process where all components may be mixed together in single tank loads. Consult with manufacturer for further details.

3 Mixing:
   A mechanically agitated hydraulic-application machine is recommended:
   a. Fill tank to middle of agitator shaft or tank about 1/3 full of water. Turn on pump to wet or purge lines. Begin agitating. Keep adding water slowly while adding the FGM at a steady rate.
   b. Consult application and loading charts to determine number of bags to be added. Mix at a rate of 50 lbs. of FGM per 125 gallons (23kg/475 liters). Contact equipment manufacturer to confirm optimum FGM mixing rates.
   c. All FGM should be loaded when the tank is approximately 3/4 full.
   d. Fertilizer should be added once the tank is nearly full.
   e. Before applying, mix the slurry for at least 10 minutes after adding the last amount of FGM. This is very important to fully activate the bonding additives and to attain proper viscosity.
   f. Turn off recirculation valve to minimize potential for air entrainment within the slurry.

4. Application:
   a. Use a fan-type nozzle (50-degree tip) whenever possible for best soil surface coverage. Apply FGM from opposing directions to soil surface, reducing the "shadow effect" and assuring a minimum of 95% of soil surface coverage. Slope interruption devices or water diversion techniques are recommended when slope lengths exceed 100 ft (30m).
   b. Install materials at an application rate of 3500 pounds per acre.
   c. Increase application rates on highly erosive soils or chiseled, disked, furrowed or tracked slopes. Contact Manufacturer for additional details.
   d. Material should not be applied in channels, swales or other areas where concentrated flows are anticipated, unless installed in conjunction with a temporary erosion control blanket or non-degradable turf reinforcement mat.
   e. After application, thoroughly flush the tank, pumps and hoses to remove all FGM material. Wash all material from the exterior of the machine and remove any slurry spills. FGM will be more difficult to remove once it dries.

5. Prevent foot or vehicular traffic, or the movement of equipment over the seeded areas. Reseed areas damaged as a result of such activity.

6. Prevent the seeded areas from drying out. After seedlings appear in about 2-3 weeks reseed all bare spots larger than 18-inches in diameter. Areas to be reseeded shall be hand raked to scarify the surface and seed shall be applied by cyclone spreader. Lightly

rake the seed into the soil.

B. Reconditioning Existing Turf:

1. Recondition existing turf areas damaged by CONTRACTOR'S operations including storage of materials and equipment and movement of vehicles. Also recondition existing turf areas where minor regrading is required.
2. Provide fertilizer, seed or sod, soil amendments, and erosion control matting as specified for new turf and as required to provide a satisfactorily reconditioned turf. An additional fertilizer application will be made following seed germination and growth. For the additional application, the CONTRACTOR shall apply fertilizer to the entire turf establishment area with a rating of 10 (N): 10 (P_2O_5): 10 (K_2O). Provide new topsoil as required to fill low spots and meet new finish grades.
3. Cultivate bare and compacted areas thoroughly to provide a satisfactory planting bed.
4. Remove diseased and unsatisfactory turf areas; do not bury into soil. Remove topsoil containing foreign materials resulting from CONTRACTOR'S operations including, but not limited to oil drippings, stone, gravel and other loose building materials.
5. In areas approved by OWNER'S REPRESENTATIVE, where substantial turf remains (but is thin), mow, rake, aerate if compacted, fill low spots, remove humps and cultivate soil, fertilize, and seed. Remove weeds before seeding or if extensive, apply selective chemical weed killers as required. Apply a seedbed mulch, if required, to maintain moist conditions.
6. Water newly planted areas and keep moist until new turf is established.

3.4 MAINTENANCE

A. Begin maintenance immediately after planting.

B. Maintain turf for not less than the period stated below, and longer as required to establish an acceptable stand, as determined by OWNER'S REPRESENTATIVE.

1. Grass seed lawns, not less than 60 days.
2. If seeded in fall and not given a full 60 days maintenance, or if not considered acceptable at that time, continue maintenance the following spring until acceptable lawn is established.

3.5 CLEANUP AND PROTECTION

A. During landscape Work, store materials and equipment where directed. Keep pavements clean and work area in an orderly condition.

B. Protect landscape Work and materials form damage due to landscape operations, operations by other contractors and trades and trespassers. Maintain production during installation and maintenance periods. Treat, repair or replace damaged landscape Work as directed.

C. Take all precautions to insure that hydroseed slurry, is only placed on the areas designated. Completely clean any overspray, on areas not designated to receive slurry, to the satisfaction of OWNER'S REPRESENTATIVE.

D. Remove all rubbish, equipment and rejected materials from the site.

E. Protection includes all temporary fences, barriers and signs and other Work incidental to proper maintenance.

3.6 INSPECTION AND ACCEPTANCE

A. When the landscape Work is completed, including maintenance, the OWNER'S REPRESENTATIVE will make an inspection to determine acceptability.

B. Where inspected landscape Work does not comply with the requirements, replace rejected Work and continue specified maintenance until re-inspected by OWNER'S REPRESENTATIVE and found to be acceptable. Remove rejected plants and materials promptly from the project site.

C. Any damage, disturbance, or settlement that occurs as a result of the CONTRACTOR'S stockpiling of material or equipment on site shall be the responsibility of the CONTRACTOR to repair and/or supply additional materials to compensate for settlement caused by the CONTRACTOR'S actions.

END OF SECTION 02900

SECTION 03300

CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.1 SUMMARY

1.1.1 The extent of concrete work is shown on the drawings including, but not limited to:

a. Ringwall Footings and Foundations
b. Pile supported slabs-on-grade
c. Pipe support footings

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO M182	(2005) Burlap Cloth Made From Jute or Kenaf

AMERICAN CONCRETE INSTITUTE (ACI)

ACI 117	(2010) Standard Specifications for Tolerances for Concrete Construction and Materials
ACI 211.1	(1991) Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete
ACI 301	(2005) Standard Specification for Structural Concrete
ACI 302.1R	(2004) Guide for Concrete Floor and Slab Construction
ACI 304R	(2000) Guide for Measuring, Mixing, Transporting, and Placing Concrete
ACI 304.2R	(1996) Placing Concrete by Pumping Methods
ACI 305R	(1999) Hot Weather Concreting
ACI 306R	(1988) Cold Weather Concreting

ACI 308R	(2001) Standard Practice for Curing Concrete
ACI 315	(1999) Details and Detailing of Concrete Reinforcement
ACI 318/318R	(2002) Building Code Requirements for Structural Concrete
ACI 347R	(2003) Guide to Formwork for Concrete

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 82	(2007) Steel Wire, Plain, for Concrete Reinforcement
ASTM A 185	(2007) Steel Welded Wire Fabric, Plain, for Concrete Reinforcement
ASTM A 496	(2007) Steel Wire, Deformed, for Concrete Reinforcement
ASTM A 497	(2007) Steel Welded Wire Fabric, Deformed for Concrete Reinforcement
ASTM A 615	(2009b) Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM A 996	(2009b) Standard Specification for Rail-Steel and Axel Steel Deformed for Concrete Reinforcement
ASTM C 31	(2009) Making and Curing Concrete Test Specimens in the Field
ASTM C 33	(2008) Concrete Aggregate
ASTM C 39	(2009a) Compressive Strength of Cylindrical Concrete Specimens
ASTM C 94	(2009a) Ready-Mixed Concrete
ASTM C 143	(2010) Slump of Hydraulic Cement Concrete
ASTM C 150	(2009) Portland Cement
ASTM C 171	(2007) Sheet Materials for Curing Concrete
ASTM C 172	(2008) Sampling Freshly Mixed Concrete

ASTM C 173	(2010) Air Content of Freshly Mixed Concrete by the Volumetric Method
ASTM C 231	(2009b) Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C 260	(2006) Air-Entraining Admixtures for Concrete
ASTM C 309	(2007) Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C 494	(2010) Chemical Admixtures for Concrete
ASTM C 595	(2010) Blended Hydraulic Cements
ASTM C 618	(2008a) Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete.
ASTM C 881	(2002) Epoxy-Resin-Base Bonding Systems for Concrete
ASTM C 920	(2010) Elastomeric Joint Sealants
ASTM C 989	(2009a) Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars.
ASTM C 1017	(2007) Chemical Admixtures for Use in Producing Flowing Concrete
ASTM C 1107	(2008) Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
ASTM D 1190	(1997) Concrete Joint Sealer, Hot-Applied Elastic Type
ASTM D 1751	(2004) Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
ASTM D 1752	(2004a) Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction
ASTM D 1850	(1974; R 1979) Concrete Joint Sealer, Cold-Application Type
ASTM D 4397	(2009) Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications

ASTM E 1155 (1996) Determining Floor Flatness and Levelness Using the F-Number System

AMERICAN WELDING SOCIETY, INC. (AWS)

AWS D1.4 (2005) Structural Welding Code-Reinforcing Steel

CONCRETE REINFORCING STEEL INSTITUTE

MSP-1 (2001) Manual of Standard Practice

U.S. DEPARTMENT OF COMMERCE

PS 1 (2007) Construction and Industrial Plywood

DEPARTMENT OF TRANSPORTATION (DOT)

FORM 816 (2004) State of Connecticut DOT Standard Specifications for Roads, Bridge, and Incidental Construction

1.3 DEFINITIONS

a. "Cementitious material" as used herein shall include all Portland cement, pozzolan, fly ash, and ground iron blast-furnace slag.

b. "Exposed to public view" means situated so that it can be seen from eye level from a public location after completion of construction. A public location is accessible to persons not responsible for operation or maintenance of the building.

1.4 SUBMITTALS

Submit to the Owner's Representative the following;

1.4.1 Mix Design Data

a. Concrete mix design: Thirty days minimum prior to concrete placement, submit a mix design for each strength and type of concrete. Submit a complete list of materials including type; brand; source and amount of cement, fly ash, pozzolan, ground slag, and admixtures; and applicable reference specifications. Submit additional data regarding concrete aggregates if the source of aggregate changes. Submittal shall clearly indicate where each mix design will be used when more than one mix design is submitted. Comply with ACI proportioning requirements.

b. Laboratory Test Results: Submit copies of test reports and statistical supporting data in compliance with ACI 318 requirements showing that each mix has been

successfully tested to produce concrete with the properties specified and each mix will be suitable for the job conditions. Do not begin concrete production until mixes have been reviewed.

c. Fly Ash, Pozzolan, and Ground Iron Blast-Furnace Slag: Submit test results in accordance with ASTM C618 for fly ash and pozzolan, and ASTM C989 for ground iron blast-furnace slag. Submit test results performed within 6 months of submittal date.

1.4.2 Manufacturer's Catalog Data

a. Materials for curing concrete
b. Epoxy cement filler
c. Bonding agents.
d. Adhesives.
e. Repair materials.

Include specifications and installation instructions, and laboratory rest reports and other data to show compliance with specifications.

1.4.3 Drawings

a. Reinforcing steel
b. Formwork
c. Construction joint locations and details
d. Construction and doweled construction joint details

Copies or reproductions of contract drawings will not be accepted or reviewed as shop drawings, and shall be rejected if submitted. Resubmitted shop drawings shall have revisions circled or clouded to clearly identify the changes.

1.4.3.1 Reinforcing Steel

Shop drawings for fabrication, bending, and placement of reinforcement, accessories, and concrete cover. Comply with ACI 315 "Manual of Standard Practice for Detailing Reinforced Concrete Structures" and CRSI's "Manual of Standard Practice" showing material, grade, bar schedules, stirrup spacing, bending diagrams, assembly diagrams, splicing and bar laps, placing plans and wall elevations showing arrangement of concrete reinforcement. Do not scale dimensions from structural drawings to determine lengths of reinforcing bars. Fabrication of any material or performance of any work shall not proceed until shop drawings have been reviewed.

1.4.3.2 Formwork

When requested by the Owner orOwner's Representative, submit formwork shop drawings prepared by or under the supervision of a qualified professional engineer, licensed in the State of Connecticut, detailing fabrication, assembly, and support of formwork. Design and engineering of formwork are Contractor's responsibility. Indicate proposed schedule and sequence of stripping formwork, shoring removal, and installing and removing reshoring.

1.4.4 Certificates of Compliance

a. Aggregates
b. Admixtures
c. Reinforcement
d. Cement
e. Fly ash
f. Pozzolan
g. Ground slag

Materials certificates shall be signed by the manufacturer and Contractor, certifying that each material item complies with, or exceeds, specified requirements. Provide certificates from admixture manufacturers that chloride content complies with specification requirements

1.4.5 Records

Batch ticket information, per Article 3.5.

1.4.6 Qualifications for Welding Work

When welding of reinforcement is permitted on the Project, qualify welding processes and welding operators in accordance with AWS "Standard Qualification Procedure." Provide certification that welders to be employed in work have satisfactorily passed AWS qualification tests within previous 12 months. If recertification of welders is required, retesting will be Contractor's responsibility.

1.4.7 Cold Weather Concrete Placement Program

Detailed written procedures demonstrating familiarity with ACI 306. Approved procedures shall be the basis for determining compliance with Project requirements and to evaluate the quality of concrete structures constructed and cured during cold-weather conditions

1.4.8 Hot Weather Concrete Placement Program

Detailed written procedures demonstrating familiarity with ACI 305. Approved procedures shall be the basis for determining compliance with Project requirements and to evaluate the quality of concrete structures constructed and cured during cold-weather conditions

1.5 MODIFICATION OF REFERENCES

Accomplish work in accordance with ACI publications except as modified herein. Consider the advisory or recommended provisions to be mandatory, as though the word "shall" had been substituted for the words "should" or "could" or "may", wherever they appear. Interpret reference to the "Building Official", the "Structural Engineer", and the "Architect/Engineer" to mean the Owner's Representative.

1.6 QUALITY ASSURANCE

1.6.1 Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, each aggregate from one source, and each admixture from the same manufacturer.

1.6.2 Materials and installed work may require testing and retesting at any time during progress of work. Retesting of rejected materials for installed work shall be done at Contractor's expense.

1.7 DELIVERY, STORAGE, AND HANDLING

Do not deliver concrete until geotextile, forms, reinforcement, embedded items, and chamfer strips are in place and ready for concrete placement. Follow ACI 301 for job site storage of materials. Store reinforcement of different sizes and shapes in separate piles or racks raised above the ground to avoid excessive rusting. Protect materials from contaminants such as grease, oil, and dirt. Ensure materials can be accurately identified after bundles are broken and tags removed. Avoid damaging any coatings on steel reinforcement. Repair or replace damaged coated steel reinforcement. Repair damaged epoxy coatings on steel reinforcement according to ASTM D 3963

PART 2 PRODUCTS

2.1 CONCRETE

2.1.1 Contractor-Furnished Mix Design

ACI 211.1, ACI 301, ACI 318, ACI 304.2R and ACI 213R except as otherwise specified. The specified compressive strength of the concrete, f'c, for each portion of the structure shall be as indicated. For portions whose strength is not indicated, concrete shall be as specified below.

Location	f'c (Min. 28-Day Comp. Strength) psi	ASTM C33 Aggregate Size No.	Range of Slump inches	Water-Cement Ratio by weight	Air Entr. (percent)
Pile-Supported Reinforced Slab	4,000	67	1-3	0.50	4-8
Reinforced Ringwalls and Footings	4,000	67	1-3	0.50	4-8
Pipe Support Footings	3,000	67	1-3	0.50	4-8
Other Concrete	3,500	67	1-3	0.50	4-8

Maximum slump shown above may be increased one inch for methods of consolidation other than vibration. Slump may be increased to 7 inches when superplasticizers are used.

2.1.1.1 Required Average Strength of Mix Design

The selected mixture shall produce an average compressive strength exceeding the specified strength by the amount indicated in ACI 301. When a concrete production facility has a record of consecutive tests, the standard deviation shall be calculated and the required average compressive strength shall be determined in accordance with ACI 301 and ACI 318/318R §5.3. When a concrete production facility does not have a suitable record of tests to establish a standard deviation, the required average strength shall determined in accordance with ACI 301 and ACI 318/318R §5.3.

2.1.1.2 If trial batch method is used, use an independent testing facility acceptable to Owner's Representative for preparing and reporting proposed mix designs. The testing facility shall not be the same as used for field quality control testing. Materials used in test mixes shall be the same as those to be installed in the work. Reports of proposed concrete mixes shall indicate the maximum amount of water (if any) that may be added at the project site for slump adjustment without exceeding the required water/cement ratio

2.1.1.3 Chloride Ion Concentrations

Maximum water soluble chloride ion concentrations in hardened concrete shall not exceed 0.30 percent (0.003) by weight of cement. This includes, but is not limited to, contributions from water, aggregates, cementitious materials, and admixtures. Testing for water soluble chloride ion content shall conform with AASHTO T 260.

2.2 MATERIALS

Each chemical admixture shall be certified by each manufacturer to be compatible with all other required admixtures.

2.2.1 Cement

ASTM C150, Type I, or ASTM C595, Type IP or IS blended cement except as modified herein. The blended cement shall consist of a mixture of ASTM C150 cement and one of the following materials: ASTM C618 pozzolan or fly ash, or ASTM C989 ground iron blast-furnace slag. The pozzolan or fly ash content shall not exceed 25 percent by weight of the total cementitious material. The ground iron blast-furnace slag shall not exceed 50 percent by weight of total cementitious material. For exposed concrete, use one manufacturer for each type of cement, ground slag, fly ash, and pozzolan.

2.2.1.1 Fly Ash and Pozzolan

ASTM C618, Type N, F, or C, except that the maximum allowable loss on ignition shall be 6 percent for Types N and F. Add with cement.

2.2.1.2 Ground Iron Blast-Furnace Slag

ASTM C989, Grade 120.

2.2.2 Water

Water shall be fresh, clean, and potable, complying with ASTM C 94.

2.2.3 Aggregates

ASTM C33, except as modified herein. Furnish aggregates for exposed concrete surfaces from one source. Aggregates shall not contain any substance which may be deleteriously reactive with the alkalies in the cement.

2.2.4 Nonshrink Grout

ASTM C1107; premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents.

2.2.5 Admixtures

Calcium chloride shall not be used as an admixture. Do not use chemicals that will result in soluble chloride ions in excess of 0.1 percent by weight of cement. Calcium chloride thyocyanates or admixtures containing chloride ions which will exceed the maximum total concentrations specified herein are not permitted.

2.2.5.1 Air-Entraining

ASTM C260

2.2.5.2 Water Reducing Admixtures

a. Water Reducing Admixtures: ASTM C 494/C 494M Type A.
b. High Range Water Reducing Admixtures: ASTM C 494/C 494M Type F.
c. Water Reducing and Accelerating Admixture: ASTM C 494/C 494M Type E.
d. Water Reducing and Retarding Admixture: ASTM C 494/C 494M Type D

2.2.6 Materials for Forms

Provide wood, plywood, or steel. Use plywood or steel forms where a smooth form finish is required. Lumber shall be square edged or tongue-and-groove boards, free of raised grain, knotholes, or other surface defects. Plywood: U.S. Product Standard PS-1 "B-B (Concrete Form) Plywood," Class 1, Exterior Grade or better, mill-oiled and edge-sealed, with each piece bearing legible inspection trademark. Steel form surfaces shall not contain irregularities, dents, or sags. Furnish forms in largest practicable sizes to minimize number of joints.

2.2.6.1 Form Coatings

Provide commercial formulation form-coating compounds that will not bond with, stain, nor adversely affect concrete surfaces, and will not impair subsequent treatment of concrete surfaces

2.2.6.2 Form Ties and Accessories

Factory-fabricated, adjustable-length, removable or snap-off metal form ties, designed to prevent form deflection and to prevent spalling of concrete upon removal. Provide units which will leave no metal closer than 1-1/2" to surface. The use of wire alone is

prohibited. Form ties and accessories shall not reduce the effective cover of the reinforcement.

2.2.7 Reinforcement

2.2.7.1 Reinforcing Bars

ACI 301 unless otherwise specified. ASTM A615 and ASTM A617/617M with the bars marked A, Grade 60; or ASTM A616/A616M with the bars marked R, Grade 50 or 60.

2.2.7.2 Weldable Reinforcing Bars

ACI 301 unless otherwise specified. ASTM A706 and ASTM A706M with the bars marked A, Grade 60.

2.2.7.3 Welded Wire Fabric

ASTM A185 OR ASTM A497. Provide flat sheets of welded wire fabric for slabs and toppings.

2.2.7.4 Wire

ASTM A82 or ASTM A496.

2.2.7.5 Reinforcement Accessories

a. Supports for Reinforcement: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire fabric in place. Manufacture bar supports or use pre-manufactured supports in compliance with CRSI specifications.
b. For welded wire fabric support in slabs-on-grade, use supports with sand plates or horizontal runners where base material will not support chair legs.
c. Concrete bricks shall not be used as supports for reinforcement without Owner's Representative's prior approval, except for footing reinforcement where thickness of footings equals of exceeds 8 inches.

2.2.8 Materials for Curing Concrete

2.2.8.1 Impervious Sheeting

ASTM C171; waterproof paper, clear or white polyethylene sheeting, or polyethylene-coated burlap.

2.2.8.2 Pervious Sheeting

AASHTO M182

2.2.8.3 Liquid Membrane-Forming Compound

ASTM C309, Type 1, Class B or ATM C 1315, Type 1, Class A.

2.2.9 Epoxy Bonding Compound (if applicable)

ASTM C881, Type I, II or III, Grade 1, Class A if placement temperature is below 40 degrees F; Class B if placement temperature is between 40 and 60 degrees F; or Class C if placement temperature is above 60 degrees F. Provide Grade 1 or 2 for horizontal surfaces and Grade 3 for vertical surfaces. Use Type I for bonding hardened concrete to hardened concrete; Type II for bonding freshly mixed concrete to hardened concrete; and Type III as a binder in epoxy mortar or concrete, or for use in bonding skid-resistant materials to hardened concrete.

PART 3 EXECUTION

3.1 EXAMINATION

Concrete Installer shall examine areas and conditions under which concrete is to be placed, and notify Contractor in writing of conditions detrimental to proper and timely completion of work. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to the Installer and Owner's Representative.

a. Identify required lines, levels, contours, and datum locations.
b. Verify subdrainage, subbase, base, and all other items and systems required to be installed prior to concrete placement has been inspected.
c. Verify structural ability of unsupported walls to support loads imposed by the wet concrete.

3.2 GENERAL PROJECT CONDITIONS

Protection of Footings and Subgrade Against Freezing: Cover completed work at footing level with sufficient temporary or permanent cover as required to protect footings and adjacent subgrade against possibility of frost or freezing. Provide supplemental heat as required. Concrete shall not be placed on or against frozen subgrade. Maintain such cover and temporary heat for the time period as necessary, and in compliance with ACI recommendations.

3.3 FORMS

Provide forms, shoring, and scaffolding for concrete placement unless indicated or specified otherwise. Design, erect, support, brace, and maintain formwork according to ACI 301, to support vertical and lateral, static, dynamic, and construction loads that might be applied until such loads can be supported by the concrete structure. Set forms mortar-tight and true to line and grade. Chamfer above grade exposed joints, edges, and external corners of concrete 0.75 inch unless otherwise indicated. Provide formwork with clean-out openings to permit inspection and removal of debris. Forms submerged in water shall be watertight.

3.3.1 Fabrication

Construct forms in accordance with ACI 347 to sizes, shapes, lines, and dimensions indicated, and to obtain accurate alignment, location, grades, level and plumb work in finished structures. Construct formwork to meet tolerance limits specified in ACI 117. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush plates or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces where slope is too steep to place concrete with bottom forms only. Kerf wood inserts for forming keyways, reglets, recesses, and the like to prevent swelling and for easy removal.

3.3.2 Cleaning

Thoroughly clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, or other debris just prior to concrete placement. Forms and adjacent surfaces shall be clean of all foreign material and debris that will interfere with bond-breakers or bonding-agents.

3.3.3 Coating

Before concrete placement, coat the contact surfaces of forms with a nonstaining mineral oil, nonstaining form coating compound, or two coats of nitrocellulose lacquer. Apply in compliance with manufacturer's instructions. Do not use mineral oil on forms for surfaces to which adhesive, paint, or other finish material is to be applied.

3.3.4 Removal of Forms and Supports

After placing concrete, forms shall remain in place for the time periods specified in ACI 347R. Prevent concrete damage during form removal.

3.3.4.1 Special Requirements for Reduced Time Period

Forms may be removed earlier than specified if ASTM C39 test results of field-cured samples from a representative portion of the structure indicate that the concrete has reached a minimum of 85 percent of the design strength.

3.4 PLACING REINFORCEMENT AND MISCELLANEOUS MATERIALS

ACI 301. Provide bars, wire fabric, wire ties, supports, and other devices necessary to install and secure reinforcement. Reinforcement shall not contain rust, scale, oil, grease, clay, or foreign substances that would reduce the bond. Rusting of reinforcement is a basis of rejection if the effective cross-sectional area or the nominal weight per foot of the reinforcement has been reduced to less than that specified in paragraph of this section entitled "Reinforcing Bars". Remove loose rust prior to placing steel. Tack welding is prohibited.

3.4.1 Positioning

CRSI MSP-1. Accurately position, support, and secure reinforcement with galvanized or non-corrodible chairs, runners, bolsters, spacers, and hangers, as required, to prevent displacement by formwork, construction, or concrete placement operations. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces.

3.4.2 Tolerances

ACI 117. Place reinforcement accurately to match spacings indicated, and to achieve not less than minimum concrete coverage required for protection.

3.4.3 Splicing

As indicated. Install reinforcement and welded wire fabric in maximum possible lengths. Offset end laps of welded wire fabric in both directions. For splices not indicated in the contract documents, ACI 301. Do not splice at points of maximum stress. Overlap welded wire fabric the spacing of the cross wires, plus 2 inches. Shop or field weld reinforcement only where indicated or approved by Owner's Representative; comply with AWS D1.4.

3.4.4 Future Bonding

Plug exposed, threaded, mechanical reinforcement bar connectors with a greased bolt. Bolt threads shall match the connector. Countersink the connector in the concrete. Caulk the depression after the bolt is installed.

3.4.5 Cover

ACI 301 for minimum coverage, unless otherwise indicated.

3.4.6 Setting Miscellaneous Material

Accurately place and secure in position other items to be cast integrally with concrete structures, including but not limited to anchors rods and bolts, pipe sleeves, conduits, and items of other trades, before concrete placement. Plumb anchor bolts and check location and elevation. Temporarily fill voids in sleeves with readily removable material to prevent the entry of concrete. "Wet-setting" of anchors and dowels is prohibited.

3.4.7 Construction Joints

Locate joints to least impair strength. Construct joints true to line with faces perpendicular to surface plane of concrete and perpendicular to main reinforcement. Form keyed joints from preformed galvanized steel, plastic keyway-section forms, bulkhead forms with keys, or field fabricated wood strips. Unless noted otherwise on the drawings, wood strips shall be straight, 1-1/4" deep minimum, no wider than 1/3 the wall thickness, trapezoidal in cross-section securely fastened to inside face of formwork, and stripped with forms. Continue reinforcement across joints unless otherwise indicated. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

3.4.8 Grooved and sawcut joints

a. Grooved Joints: Form joints after initial floating by grooving and finishing each edge of joint to a radiused corner of not less than 1/8 inch (3 mm). See drawings for required radius. Repeat grooving of joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.

b. Sawed Joints: Form joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/ joints into concrete when cutting action will not tear, abrade, or otherwise damage surface. Joints shall be 1/8 inch (3 mm) wide, unless noted otherwise.

3.5 BATCHING, MEASURING, MIXING, AND TRANSPORTING CONCRETE

ASTM C94, ACI 301, ACI 302.1R and ACI 304R, except as modified herein. Batching equipment shall be such that the concrete ingredients are consistently measured within the following tolerances: 1 percent for cement and water, 2 percent for aggregates, and 3 percent for admixtures. Furnish mandatory batch ticket information for each load of ready mix concrete.

3.5.1 Measuring

Make measurements at intervals as specified in paragraphs of this Section entitled "Sampling" and "Testing".

3.5.2 Mixing

ASTM C94 and ACI 301. Machine mix concrete. Begin mixing within 30 minutes after the cement has been added to the aggregates. Place concrete within 90 minutes of either addition of mixing water to cement and aggregates or addition of cement to aggregates if the air temperature is less than 85 degrees F. Reduce mixing time and place concrete within 60 minutes if the air temperature is greater than 85 degrees F except as follows: if set retarding admixture is used and slump requirements can be met, limit for placing concrete may remain at 90 minutes. Additional water may be added, provided that both the specified maximum slump and water-cement ratio are not exceeded. When additional water is added, an additional 30 revolutions of the mixer at mixing speed is required. If the entrained air content falls below the specified limit, add a sufficient quantity of admixture to bring the entrained air content within the specified limits. Dissolve admixtures in the mixing water and mix in the drum to uniformly distribute the admixture throughout the batch.

3.5.3 Transporting

Transport concrete from the mixer to the forms as rapidly as practicable. Prevent segregation or loss of ingredients. Clean transporting equipment thoroughly before each batch. Do not use aluminum pipe or chutes. Remove concrete which has segregated in transporting and dispose of as directed.

3.5.4 Adjustments to Concrete Mixes

Do not add water to concrete after adding high-range water reducing admixtures to mix.

3.5.4.1 Mix design adjustments may be requested by Contractor when characteristics of materials, job conditions, weather, test results, or other circumstances warrant, at no additional cost to Owner and as accepted by Owner's Representative. Laboratory test data for revised mix design and strength results when requested must be submitted to and accepted by Owner's Representative before using in work.

3.5.4.2 Addition of water to the concrete mix at the delivery site, to achieve the required slump, shall only be done with the permission of the Owner's Representative, provided the specified water cement ratio for the concrete is not exceeded and the concrete is mixed for at least thirty additional revolutions at mixing speed to ensure thorough mixing of the water into the concrete. Further addition of water after this initial slump adjustment will not be permitted. The amount of additional water shall be documented for verification that the water/cement ratio is not exceeded.

3.6 PLACING CONCRETE

3.6.1 Pre-placement Inspection

Before placing concrete, inspect formwork installation, reinforcing steel placement, and items to be embedded or cast-in. Complete any incomplete installations or placements. Correct any deficiencies, misplacements, or misinstallations. Notify other crafts to permit installation of their work. Ensure reinforcement, inserts, waterstops, embedded parts, and formed construction joint devices will not be disturbed during concrete placement.

3.6.2 Placement

3.6.2.1 Place concrete as soon as practicable after the forms and the reinforcement have been inspected and approved. Do not place concrete when weather conditions prevent proper placement and consolidation; in uncovered areas during periods of precipitation; or in standing water. Prior to placing concrete, remove dirt, construction debris, water, snow and ice from within the forms. Deposit concrete as close as practicable to the final position in the forms. Do not exceed a free vertical drop of 3 feet from the point of discharge. Place concrete in one continuous operation from one end of the structure towards the other. Position grade stakes on 10-foot centers maximum in each direction when pouring interior slabs and on 20-foot centers maximum for exterior slabs.

3.6.2.2 Deposit concrete such that no new concrete will be placed on concrete which has hardened sufficiently to cause the formation of seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as herein specified; however, all joint locations shall be approved by the Owner's Representative in advance of concrete placement.

3.6.3 Vibration

ACI 301. Furnish a spare vibrator on the job site whenever concrete is placed. Consolidate concrete slabs greater than 4 inches in depth with high frequency, internal, mechanical vibrating equipment supplemented by hand spading and tamping. Consolidate concrete slabs 4 inches or less to depth by wood tampers, spading, and settling with a heavy leveling straightedge. Operate vibrators with vibratory element submerged in the concrete, with a minimum frequency of not less than 6000 impulses per minute when submerged. Do not use vibrators to transport the concrete in the forms. Insert and withdraw vibrators approximately 18 inches apart. Penetrate the previously placed lift at least 6 inches with the vibrator when more than one lift is required. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. Place concrete in 18-inch maximum vertical lifts. External vibrators shall be used on the exterior surface of the forms when internal vibrators do not provide adequate consolidation of the concrete.

3.6.4 Cold Weather

ACI 306R. Do not allow concrete temperature to decrease below 50 degrees F. Obtain approval prior to placing concrete when the ambient temperature is below 40 degrees F or when concrete is likely to be subjected to freezing temperatures within 24 hours. Cover concrete and provide sufficient heat to maintain 50 degrees F minimum adjacent to both the formwork and the structure while curing. Limit the rate of cooling to 5 degrees F in any 1 hour, and 50 degrees F per 24 hours, after heat application. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials. Do not use calcium chloride, salt, and other materials containing antifreeze agents or chemical accelerators, unless otherwise accepted in mix designs

3.6.5 Hot Weather

ACI 305R. Maintain required concrete temperature using Figure 2.1.5 in ACI 305R to prevent the evaporation rate from exceeding 0.2 pounds of water per square foot of exposed concrete per hour. Cool ingredients before mixing, or use other suitable means to control concrete temperature and prevent rapid drying of newly placed concrete. Shade the fresh concrete as soon as possible after placing. Start curing when the surface of the fresh concrete is sufficiently hard to permit curing without damage. Provide water hoses, pipes, spraying equipment, and water hauling equipment where job site is remote to water source, to maintain a moist concrete surface throughout the curing period. Provide burlap cover or other suitable, permeable material with fog spray or continuous wetting of the concrete when weather conditions prevent the use of either liquid membrane curing compound or impervious sheets. For vertical surfaces, protect forms from direct sunlight and add water to top of structure once concrete is set.

3.7 SURFACE FINISHES EXCEPT FLOOR AND SLAB FINISHES

3.7.1 Defects

Repair formed surfaces by removing minor honeycombs, pits greater than 1-square inch surface area or 0.25-inch maximum depth, or otherwise defective areas. Provide edges perpendicular to the surface and patch with non-shrink gout. Patch tie holes and defects when the forms are removed. Concrete with extensive honeycomb including exposed steel reinforcement, cold joints, entrapped debris, separated aggregate, or other defects which affect the serviceability or structural strength will be rejected, unless correction of defects is approved. Obtain approval of corrective action prior to repair. The surface of the concrete shall not vary more than the allowable tolerance of ACI 347R. Exposed surfaces shall be uniform in appearance and finished to a smooth form finish unless otherwise specified.

3.7.2 Surfaces Not Against Forms (Top of Walls)

Surfaces not otherwise specified shall be finished with wood floats to even surfaces. Finish shall match adjacent finishes.

3.7.3 Formed Surfaces

3.7.3.1 As-Cast Rough Form for Surfaces Not Exposed to Public View

Remove fins and other projections exceeding 0.25 inch in height; level abrupt irregularities.

3.7.3.2 As-Cast Smooth Form for Surfaces Exposed to Public View

Form facing material shall produce a smooth, hard, uniform texture on the concrete. Remove fins and other projections completely.

3.8 FLOOR AND SLAB FINISHES AND MISCELLANEOUS CONSTRUCTION

ACI 302.1R, unless otherwise specified. Level surface to match adjacent existing slab surfaces. Slope floors uniformly to drains where drains are provided, and as shown on the Contracted Drawings. Depress the concrete base slab where indicated. Where straightedge measurements are specified, Contractor shall provide straightedge.

3.8.1 Finish

Place, consolidate, and immediately strike off concrete to obtain proper contour, grade, and elevation before bleedwater appears. Permit concrete to attain a set sufficient for floating and supporting the weight of the finisher and equipment. If bleedwater is present prior to floating the surface, drag the excess water off or remove by absorption with porous materials. Do not use dry cement to absorb bleedwater.

3.8.1.1 Scratched

Use for surfaces intended to receive bonded applied cementitious applications. After the concrete has been placed, consolidated, struck off, and leveled to a Class C tolerance as defined below, and while still plastic, the surface shall be roughened with stiff brushes or rakes before final set.

3.8.1.2 Floated

Use for surfaces to receive trowel finish and other finishes, slab surfaces which are to be covered with membrane or elastic waterproofing, membrane or elastic roofing, and as otherwise indicated, and where finish is not otherwise specified. After the concrete has been placed, consolidated, struck off, and leveled, do not work the concrete further, until

ready for floating. Whether floating with a wood, magnesium, or composite hand float, with a bladed power trowel equipped with float shoes, or with a powered disc, float shall begin when the surface has stiffened sufficiently to permit the operation. During or after the first floating, surface shall be checked with a 10-foot straightedge applied at no less than two different angles, one of which is perpendicular to the direction of strike off. High spots shall be cut down and low spots filled during this procedure to produce a surface level within 1/4 inch in 10 feet, unless other flatness and levelness tolerances are specified elsewhere. Immediately after leveling, refloat surface to a uniform, smooth, granular texture

3.8.1.3 Steel Troweled

Use for slab surfaces to be exposed to public view, and floors intended as walking surfaces. First, provide a floated finish. The finish shall next be power troweled two times, and finally hand troweled. The first troweling after floating shall produce a smooth surface which is relatively free of defects but which may still show some trowel marks. Additional trowelings shall be done by hand after the surface has hardened sufficiently. The final troweling shall be done when a ringing sound is produced as the trowel is moved over the surface. The surface shall be thoroughly consolidated by the hand troweling operations. The finished surface shall be essentially free of trowel marks and uniform in texture and appearance. The finished surface shall produce a surface level to within 1/4 inch in 10 feet tolerance, unless other flatness and levelness tolerances are specified elsewhere.

3.8.1.4 Broomed

Use on surfaces of exterior walks, platforms, patios, and ramps, unless otherwise indicated. Perform a floated finish, then draw a fiber bristle broom or burlap belt across the surface to produce a coarse scored texture. Permit surface to harden sufficiently to retain the scoring or ridges. Orientation of broom finish shall be transverse to traffic or at right angles to the slope of the slab.

3.9 CURING AND PROTECTION

ACI 301 and ACI 308 unless otherwise specified. Begin curing immediately following placement. Protect concrete from injurious action by sun, rain, flowing water, frost, mechanical injury, tire marks, and oil stains. Do not allow concrete to dry out from time of placement until the expiration of the specified curing period. Do not use membrane-forming compound on surfaces where appearance would be objectionable, on any surface to be painted, where coverings are to be bonded to the concrete, or on concrete to which other concrete is to be bonded. If forms are removed prior to the expiration of the curing period, provide another curing procedure specified herein for the remaining portion of the curing period. Provide moist curing for those areas receiving liquid chemical sealer-hardener or epoxy coating.

3.9.1 Moist Curing

Remove water without erosion or damage to the structure.

3.9.1.1 Ponding or Immersion

Continually immerse the concrete throughout the curing period. Water shall not be more than 20 degrees F less than the temperature of the concrete. For temperatures between 40 and 50 degrees F, increase the curing period by 50 percent.

3.9.1.2 Fog Spraying or Sprinkling

Apply water uniformly and continuously throughout the curing period. For temperatures between 40 and 50 degrees F, increase the curing period by 50 percent.

3.9.1.3 Pervious Sheeting

Completely cover surface and edges of the concrete with two thicknesses of wet sheeting. Overlap sheeting 8 inches over adjacent sheeting. Sheeting shall be at least as long as the width of the surface to be cured. During application, do not drag the sheeting over the finished concrete nor over sheeting already placed. Wet sheeting thoroughly and keep continuously wet throughout the curing period.

3.9.1.4 Impervious Sheeting

Wet the entire exposed surface of the concrete thoroughly with a fine spray of water and cover with impervious sheeting throughout the curing period. Lay sheeting directly on the concrete surface and overlap edges 12 inches minimum. Provide sheeting not less than 18 inches wider than the concrete surface to be cured. Secure edges and transverse laps to form closed joints. Repair torn or damaged sheeting or provide new sheeting. Cover or wrap columns, walls, and other vertical structural elements from the top down with impervious sheeting; overlap and continuously tape sheeting joints; and introduce sufficient water to soak the entire surface prior to completely enclosing.

3.9.2 Liquid Membrane-Forming Curing Compound

Seal or cover joint openings prior to application of curing compound. Prevent curing compound from entering joints. Apply in accordance with the recommendations of the manufacturer immediately after any water sheen which may develop after finishing has disappeared from the concrete surface. Provide and maintain compound on the concrete surface throughout the curing period. Do not use this method of curing where the use of Figure 2.1.5 in ACI 305R indicates that hot weather conditions will cause an evaporation rate exceeding 0.2 pound of water per square foot per hour.

3.9.2.1 Application

Unless the manufacturer recommends otherwise, apply compound immediately after the surface loses its water sheen and has a dull appearance, and before joints are sawed. Mechanically agitate curing compound thoroughly during use. Use approved power-spraying equipment to uniformly apply two coats of compound in a continuous operation. The total coverage for the two coats shall be 200 square feet maximum per gallon of undiluted compound unless otherwise recommended by the manufacturer's written instructions. The compound shall form a uniform, continuous, coherent film that will not check, crack or peel. Immediately apply an additional coat of compound to areas where the film is defective. Respray concrete surfaces subjected to rainfall within 3 hours after the curing compound application.

3.9.2.2 Protection of Treated Surfaces

Prohibit pedestrian and vehicular traffic and other sources of abrasion at least 72 hours after compound application. Maintain continuity of the coating for the entire curing period and immediately repair any damage.

3.9.3 Curing Periods

ACI 301 except as otherwise specified. Begin curing immediately after placement. Protect concrete from premature drying, excessively hot temperatures, and mechanical injury; and maintain minimal moisture loss at a relatively constant temperature for the period necessary for hydration of the cement and hardening of the concrete. The materials and methods of curing shall be subject to approval by the Owner's Representative.

3.10 FIELD QUALITY CONTROL

Sampling and testing shall be performed by an independent, qualified testing and inspection agency. Agency shall submit reports of observations and findings within 48 hours after testing to Owner's Representative, and any others designated as recipients. Reports shall minimally identify identification name and number, name of concrete testing service, date of concrete placement, concrete type and class, location of concrete batch in structure, and 28 day design strength, in addition to test results for the specific test(s) performed All costs associated with testing and inspection are to be included by the Contractor in the Contract Price for the Project.

3.10.1 Sampling

ASTM C172. Collect samples of fresh concrete to perform tests specified. ASTM C31 for making test specimens.

3.10.2 Testing

3.10.2.1 Slump Tests

ASTM C143. Take concrete samples during concrete placement. The maximum slump may be increased as specified with the addition of an approved admixture provided that the water-cement ratio is not exceeded. Perform tests at commencement of concrete placement, when test cylinders are made, and for each batch (minimum) or every 10 cubic yards (maximum) of concrete.

3.10.2.2 Temperature Tests

Test the concrete delivered and the concrete in the forms. Perform tests in hot or cold weather conditions (below 50 degrees F and above 80 degrees F) for each batch (minimum) or every 10 cubic yards (maximum) of concrete, until the specified temperature is obtained, and whenever test cylinders and slump tests are made.

3.10.2.3 Compressive Strength Tests

ASTM C39. Make five test cylinders for each set of tests in accordance with ASTM C31. Precautions shall be taken to prevent evaporation and loss of water from the specimen. Test two cylinders at 7 days, two cylinders at 28 days, and hold one cylinder in reserve. Samples for strength tests of each mix design of concrete placed each day shall be taken not less than once a day, nor less than once for each 100 cubic yards of concrete, nor less than once for each 1000 square feet of surface area for pile-supported slabs or walls. For the entire project, take no less than four sets of samples and perform strength tests for each mix design of concrete placed. Each strength test result shall be the average of two cylinders from the same concrete sample tested at 28 days. If the average of any three consecutive strength test results is less than f'c or if any strength test result falls below f'c by more than 500 psi, testing of the in-place work shall be required using a testing method approved by the Owner and Owner's Representative.

3.10.2.4 Air Content

ASTM C231 for normal weight concrete. Test air-entrained concrete for air content at the same frequency as specified for slump tests.

3.10.2.5 Additional Tests

When test results indicate specified concrete strengths and other characteristics have not been attained in the structure, additional tests of in-place concrete shall be made as directed by the Owner's Representative. Contractor shall pay for such tests when unacceptable concrete is verified.

3.11 DEFECTIVE CONCRETE

"Defective concrete" is defined as concrete not conforming to required lines, details, dimensions, tolerances or specified requirements. Repair or replacement of defective concrete will be determined by the Owner or his Representative, or the Owner's Representative. The cost of repair or replacement, and additional testing shall be borne by Contractor when defective concrete is identified

END OF SECTION

SECTION 06645

GEOTEXTILE

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope: CONTRACTOR shall provide all labor, materials, tools, equipment, testing, and services necessary for the placement of geotextile as shown on the Contract Drawings beneath the tank and specified, or as otherwise directed by the OWNER'S REPRESENTATIVE.

1.2 QUALITY ASSURANCE

A. Manufacturer's Qualifications:
   1. Geosynthetic manufacturer shall be a specialist in the manufacture of the particular geosynthetic.

B. Submittals:
   1. Shop Drawings:
      a. CONTRACTOR shall submit six (6) copies of manufacturer's data, specifications, installation instructions and dimensions.
      b. CONTRACTOR shall submit six (6) copies of an affidavit certifying that each geosynthetic furnished complies with all requirements specified herein.
      c. No geosynthetic shall be shipped until the affidavit is submitted to OWNER'S REPRESENTATIVE.

1.3 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Each roll of geosynthetic delivered to the site shall be labeled by the manufacturer identifying the manufacturer's name, product identification, lot number, roll number and roll dimensions.

B. All geosynthetics shall be protected from ultraviolet light exposure, precipitation or other inundation, mud, dirt, dust, puncture, cutting or any other damaging or deleterious conditions. Geosynthetic rolls shall be shipped and stored in relatively opaque and watertight wrappings.

C. CONTRACTOR shall provide all labor and equipment required to assist OWNER'S REPRESENTATIVE in inspection of materials upon delivery to the site.

PART 2 - PRODUCTS

2.1 GEOTEXTILE

A. Geotextile shall be a needle punched, nonwoven fabric composed of filaments which are formed into a stable network such that the filaments retain their relative position. Filter

fabric shall be inert to biological degradation and naturally encountered chemicals, alkalis, and acids. The geotextile shall conform, as a minimum, to the following:

Fabric Property	Unit	Typical Test Method	Value[1]
Unit Weight (mass per unit area)	oz/yd^2	ASTM D 5261	12
Thickness	mils	ASTM D 5199	110
Grab Tensile Strength	lb	ASTM D 4632	320
Grab Tensile/Elongation	%	ASTM D 4632	50
Puncture Strength	lb	ASTM D 4833	190
Trapezoid Tear Strength (MD)	lb	ASTM D 4533	125
Apparent Opening Size	mm	ASTM D 4751	0.150
Falling Head Permeability, "k"	cm/sec	ASTM D 4491	0.29
UV Resistance (500 hrs)	%	ASTM D 4355	70

NOTES:

1. Values listed represent minimum values each roll delivered to the site shall meet when tested in accordance with the specified ASTM test method.

B. Geotextile filter fabric shall be:
   1. NW12 produced by GSE Lining Technology, Inc.
   2. Or equal.

PART 3 - EXECUTION

3.1 INSTALLATION - GENERAL

A. All geosynthetics shall be weighted with sandbags or the equivalent when required. Such sandbags shall be installed during placement and shall remain until replaced with the overlying material.

B. If white or light colored geotextile is used, precautions shall be taken against "snowblindness" of personnel.

C. CONTRACTOR shall take any necessary precautions to prevent damage to underlying layers during placement of each geosynthetic.

D. During placement of geosynthetics, care shall be taken not to entrap in the geosynthetics stone, excessive dust, or moisture that could generate clogging, or hamper subsequent seaming.

E. Geosynthetics shall not be exposed to precipitation prior to being installed, and shall not be exposed to direct sunlight for more than 15 days. Any materials not complying with this requirement shall be removed and replaced at no cost to the OWNER.

F. CONTRACTOR shall not operate equipment on geosynthetics without the specified depth

of cover.

G. Excavation of fill material over geosynthetics shall be completed by hand with plastic shovels.

3.2 GEOTEXTILE

A. Geotextile fabrics shall be deployed in the direction of the slope unless otherwise directed by OWNER'S REPRESENTATIVE.

B. Geotextile fabrics shall be overlapped 3 inches and sewn as detailed on Contract Drawings unless otherwise approved by OWNER'S REPRESENTATIVE. Overlaps shall be oriented in the direction of filling.

C. Any bum mark, material defect or tear in the fabric shall be repaired as follows:
1. A fabric patch shall be sewn into place using a double sewn lock stitch (1/4 inch to 3/4 inch apart and no closer than 1 inch from any edge).
2. On slopes with a grade less than 8%, the CONTRACTOR may use a fabric patch heat welded in place with a minimum of 24 inches overlap in all directions.
3. Should any damaged area exceed 10 percent of the width of the roll, the roll shall be cut, overlapped and sewn to form a new seam.

3.4 PLACEMENT OF OVELYING MATERIALS

A. Placement of the overlying material is recommended to proceed immediately following placement and inspection of the geotextile.

B. When applying Cover Soil Material, no equipment generally speaking shall drive directly across geotextile. If a vehicle has to be driven on top of the geotextile, the vehicle shall be driven in a fashion not to damage the geotextile. Acceleration or deceleration shall be in a smooth and gentle manner. Operator shall not make any sudden turns or stops when driving on the geotextile. If any tear or local damage occurs to the geotextile, patching technique as described in the above section shall be used.

C. Compaction of the initial lift placed over the geocomposite must be performed in a manner that does not damage the geocomposite.

END OF SECTION 06645

SECTION 13100

FIELD FABRICATED FUEL TANK & CONTAINMENT TANK

PART 1 – GENERAL

1.1 DESCRIPTION

This specification describes the fabrication, erection, and testing of one 50 foot diameter 550,000 gallon (operating volume) fuel oil (kerosene) storage tank and one 60 foot diameter outer containment tank. This tank supplies fuel to four nominal 40 MW Pratt & Whitney "Twin Pack" simple cycle gas turbine generator packages.

This specification describes minimum standards for the design, supply, fabrication, erection, and testing of field erected welded steel fuel oil storage tanks. The operating tank and outer containment tank shall be complete, including all interior and exterior coatings, supports, covers, manholes, gaskets, hand holds, vents, drains, piping connections, provisions for cathodic protection, instrument connections, stairways, platforms, walkways, and other appurtenances as required per this specification and the tank general arrangement drawings. The tanks shall be designed and fabricated per the standards listed as references, OSHA, and all governing local codes. The location, size, type, and quantity of all openings, connections, including instrument connections, and fittings shall be as shown on the Bid Document drawings. Location, size, type, and quantity of all openings and connections as shown on Manufacturer's drawings will be subject to change during engineering and design review prior to release of the Manufacturer's drawings for fabrication. Such changes shall be at no cost to the Owner.

1.2 OPERATING REQUIREMENTS AND CHARACTERICSTICS:

The storage tank and outer containment provided under this section shall conform to the following:

a.	Operating capacity, gallons, minimum	Approx. 550,000
b.	Height overall	45 feet
c.	Diameter overall	50 feet
d.	Outer Containment Diameter	60 feet

1.3 QUALITY ASSURANCE

1.3.1 References

This section contains references to the following documents. They are part of this section as specified and modified. The latest edition and addenda of the following publications in effect on the date of Contract Award are part of this specification and where referred to by title or basic designation only are applicable to the extent indicated by specific reference.

In case of conflict between the requirements of this section and those of the listed documents, the requirement of this section shall prevail.

AMERICAN PETROLEUM INSTITUTE (API)

API RP 2350	Overfill Protection for Storage Tanks in Petroleum Facilities
API Std 2015	Safe Entry and Cleaning of Petroleum Storage Tanks
API RP 2009	Safe Welding, Cutting, and Hot Work Practices in the Petroleum and Petrochemical Industries
API RP 2003	Protection Against Ignition Arising Out of Static, Lightning and Stray Currents
API Std 2000	Venting Atmospheric and Low-Pressure Storage Tanks: Nonrefrigerated and Refrigerated
API Std 653	Tank Inspection, Repair, Alteration and Reconstruction
API Std 651	Cathodic Protection of Aboveground Petroleum Storage Tanks
API Std 650	Welded Steel Tanks for Oil Storage
API Std 570	Piping, Inspection Code: Inspection, Repair, Alteration and Rerating of in-service Piping Systems

ASME INTERNATIONAL (ASME)

ASME Boiler and Pressure Vessel Code Section IX, Welding and Brazing Qualifications

ASME B16.11	Forged Fittings, Socket-Welding and Threaded
ASME B16.21	Nonmetallic Flat Gaskets for Pipe Flanges
ASME B16.5	Pipe Flanges and Flanged Fittings
ASME B31.1	Power Piping

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C135.30	Zinc-Coated Ferrous Ground Rods for Overhead or Underground Line Construction

ASTM INTERNATIONAL (ASTM)

ASTM A36/A36M-04	Standard Specification for Carbon Structural Steel
ASTM A105	Forgings, Carbon Steel for Piping Components
ASTM A106	Seamless Carbon Steel Pipe for High Temperature Service
ASTM A181	Standard Specification for Carbon Steel Forgings, for General-Purpose Piping
ASTM A283	Low and Intermediate Tensile Strength Carbon Steel Plates, Shapes and Bars
ASTM A307	Carbon Steel Externally Threaded Standard Fasteners
ASTM A563	Carbon and Alloy Steel Nuts

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE Std 81	Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System (Part 1) Normal Measurements

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-C-4556	(Rev F; Notice 1) Coating Kit, Epoxy, for Interior of Steel Fuel Tanks

NACE INTERNATIONAL (NACE)

NACE RP0188	Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA FU 1	Low Voltage Cartridge Fuses
NEMS TC 2	Electrical Polyvinyl Chloride (PVC) Tubing and Conduit

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 30	Flammable and Combustible Liquids Code, 2003 Ed.
NFPA 70	National Electrical Code

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC QP 1	Standard Procedure for Evaluating Painting Contractors (Field Application to Complex Industrial Structures)
SSPC SP 5	White Metal Blast Cleaning
SSPC SP 6	Commercial Blast Cleaning

UNDERWRITERS LABORATORIES (UL)

UL 467	Grounding and Bonding Equipment
UL 506	Specialty Transformers
UL 510	Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape
UL 514A	Metallic Outlet Boxes
UL 6	Rigid Metal Conduit

OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION (OSHA)

29 CFR 1910-SUBPART Z	Toxic and Hazardous Substances
29 CFR 1910.23	Guarding Openings and Holes
29 CFR 1910.1000	Air Contaminants
29 CFR 1910.134	Respiratory Protection
29 CFR 1910.59	Hazard Communication
29 CFR 1926	Safety and Health Regulations for Construction

Building Code of Connecticut (2005 with 2009 amendments)

Fire Code of Connecticut (2005 with 2009 amendments)

1.3.2 Manufacturer's Qualifications:

Tanks and appurtenances shall be the product of a firm regularly engaged in the design and fabrication of this type of item. The tank manufacturer shall be one of the following:

Fisher Tank
3131 W. 4th Street
Chester, PA 19013
610-494-7200

Witherup Fabrication & Erection, Inc.
431 Kennerdell Road
P.O. Box 55
Kennerdell, PA 16374-0055
800-909-6601

American Boiler Tank & Welding Co.
53 Pleasant Street
Albany, NY 12207
518-463-5012

Pittsburg Tank Corp.
1500 Industrial Drive
Monongahela, PA 15063
724-258-0200

Matrix Service Company
5100 E. Skelly Dr., Suite 700
Tulsa, OK 74135
866-367-6879

Pittsburgh Tank & Tower Company
1 Watertank Place
Henderson, KY 42420
808-325-2133

Chicago Bridge and Iron
CBI Services, Inc.
24 Reads Way
New Castle, DE 19720
302-325-8401

Cardinal Tank
700 Hicks Street
Brooklyn, NY 11231
718-625-4350

Other potential tank supplies must be approved by the Owner.

1.4 SUBMITTALS:

1.4.1. SD-01, Data

a. Materials of construction of all tanks including steel plate, beams and gaskets

b. Manual tank gauge

c. Cathodic protection system manufacturer's descriptive literature and catalog cuts for items described in paragraph 1.4.2. Engineering calculations for the proposed system including life of the anodes, and anode geometry (showing areas of coverage) shall also be submitted.

d. Manufacturer's literature for all interior and exterior coatings

e. Spare parts

1.4.2 SD-04, Drawings

a. Tank Shop Drawings:

Contractor shall submit copies of the fabrication shop drawings and literature for each tank and all accessories. Drawings certified by a Connecticut Professional Engineer shall include all critical dimensions and show locations of all the plates, structural steel supports, fittings, and accessories, i.e., manways, etc. Materials of construction shall be in accordance with this specification. Drawings shall include all:

1) structural steel
2) steel plate
3) welds (type and location)
4) reinforced piping connectors
5) manways and other tank connections
6) stairways, platforms and railings
7) vent

b. Cathodic Protection System Shop Drawings (Required for Rammed Aggregate Pier Foundation)

Cathodic protection system including complete list of materials, schematics and wiring diagrams. The drawings shall provide tank dimensions and show anode arrangement for both elevated and sectional views of the tank, anode size and number, anode material, anode-suspension details, conduit size, wire size, rectifier size (if used) and location, handhole details, wiring diagram, and any other pertinent information considered necessary for the proper installation and performance of the system. Shop drawings shall also contain complete wiring and schematic diagrams and any other details required to demonstrate that the system has been coordinated and will function as a unit. The list of materials and equipment shall include diagrams, and other descriptive data required for the following list of material. Partial lists submitted from time to time will not be allowed.

a) Anodes
b) Anode backfill
c) Conductors
d) Coating material in areas where welding and other work is accomplished
e) Insulated resistance wire
f) Layout of anodes in tanks, test stations and isolation points, and grounding
g) Special details
h) Certified experience data of installing firm
i) Exothermic weld equipment and material

j) Test boxes
k) Welding method for electrical connections and steel ring connections

1.4.3 SD-06, Instructions

a) Application of coatings

1.4.4 SD-08, Statements

a) Coating Application Work Plan

1.4.5. SD-09, Test Reports

a) Cathodic protection system testing (Required for Rammed Aggregate Pier Foundation).

Test reports in booklet form tabulating all field tests and measurements performed, upon completion and testing of the installed system and including potential survey, final system test verifying protection, and holiday coating test. Each test report shall indicate the final position of controls.

b) Protective Coatings application test reports.
c) Fill test report to include settlement data?
d) Welder qualifications
e) Welding procedures
f) Welding log QA of welds performed
g) NDT reports

1.4.6 SD-10, Operation and Maintenance Data

a) Cathodic Protection System (Required for Rammed Aggregate Pier Foundation)

Six copies of operating manual outlining the step-by-step procedures required for system startup, operation, and shutdown. The manuals shall include the manufacturer's name, model number, service manual, parts list, and brief description of all equipment and their basic operating features. Six copies of maintenance manual listing routine maintenance procedures, recommendation for maintenance testing, possible breakdowns and repairs, and troubleshooting guides. The manuals shall include single line diagrams for the system as installed, instructions in making diagrams for the system as installed, instructions in making tank-to-reference call potential measurements, and describe the frequency of monitoring. The instructions shall include precautions to ensure safe conditions during repair of system.

b) Training

The proposed Training Course Agenda (including topics and dates of discussion) indicating that all of the items contained in the operating and maintenance instructions, as well as demonstrations of routine maintenance operations, including testing procedures include in the maintenance instructions, are to be covered.

1.4.7 SD-13, Certificates

a) A copy of the tank manufacturer's warranty

b) Qualification of "corrosion specialist"

The "corrosion specialists" name and qualifications shall be certified in writing to the Owner's Representative prior to the start of construction.

Certification shall be submitted giving the name of the firm, the number of years of experience, and a list of not less than five (5) of the firm's installations three (3) or more years old that have been tested and found satisfactory.

c) Qualifications of cathodic protection tester

d) Qualifications of coating contractor

e) Qualifications of the Certified Industrial Hygienist (CIH)

f) Welders qualifications and certifications

1.4.8 SD-14, Samples

a) Specialized Vacuum Box

1.4.9 SD-15, Quality Assurance

a) A detailed quality assurance/quality control plan (QA/QC) shall be submitted to the Owner's Representative for review and approval prior to the commencement of the work.

1.5 ITEMS SHIPPED LOOSE:

Items shipped with the equipment and not mounted directly on the fuel storage tanks shall be carefully boxed, palletized, labeled and shipped together with the main equipment package. Two packing lists shall be furnished with each crate or container. One inside the container and one outside the container.

1.6 HANDLING AND WARRANTY

The equipment and materials shall be protected during shipping and handling in

accordance with the manufacturer's written recommendations. All equipment and materials shall be delivered to the site in original, unbroken and unopened crates or containers.

Provide a full, written 30-year warranty for each fuel storage tank. Provide a copy of the tank warranty with the submittals.

1.7 TANK DESIGN LOAD REQUIREMENTS

Refer to the Contract Drawings, specifically Drawing No. S-1 for a complete list of all design assumptions for the tank and foundation systems. The following is a summary of those requirements. If there are discrepancies, then the Contract Drawing No. S-1 shall govern. The latest version of all referenced codes and standards apply. The structure shall be classified as I.B.C. -03 Structure Classification IV - High Hazard.

Wind, Snow and Seismic Loads:

Wind
Wind loads shall be determined in accordance with ASCE 7 02. The basic wind speed for the determination of the wind loads shall be 95 mph as given by the Connecticut State Building Code (I.B.C. - 03) or ASCE 7 02, whichever is higher.

Snow
The minimum ground snow load to be used in determining the design snow loads shall be 30 psf, as given in I.B.C – 03 and Connecticut Building Code Supplement.

Seismic
Every structure and portion thereof, shall as a minimum, be designed and constructed to resist the effects of seismic motions. The Seismic Design shall, as a minimum, be in accordance with the more conservative requirements of the Building Code of Connecticut Supplement, I.B.C. - 03 and A.P.I 650. The I.B.C. Seismic Classification shall be 3 and the A.P.I. Seismic Use Group shall be 3.

Load Combinations
Load combinations shall be, at a minimum, those of the Applicable Code of the State of Connecticut and, as a minimum, shall include, but not be limited to the following:

1) American Petroleum Institute (API) 650

2) Any other applicable statutory codes/standards, regulations

PART 2 – PRODUCTS

Aboveground tank shall be furnished as shown on Project Plans.

2.1 TANK MATERIALS

All tank and tank equipment materials shall be chemically inert to kerosene fuel and related petroleum products. Threaded fittings shall be made of material that is consistent with the UL label.

2.1.1 Tank Shell and Reinforcement

As shown on the project plans. The fuel oil storage tank and outer containment tank shall be a vertical, cylindrical, welded joint, crowned bottom (with a slope of 1 inch in 10 feet), fixed conical roof, aboveground, atmospheric storage tank in accordance with API 650. The tank shall be designed for a minimum of a 30-year life. The Manufacturer shall furnish a self-supporting dome or umbrella roof. Lateral braces between outer bay rafters must be provided if asymmetrical structural shapes are used for rafters. The bracing must be adequately sized for the seismic zone specified. Certified mill test reports, covering all steel plates and structural shapes to be used in the work, shall be furnished as evidence that such materials are new and in compliance with the governing specifications.

The tanks shall be designed for the appropriate seismic zone in accordance with the requirements of API 650 and the Connecticut Building Code.

2.1.2 Interior Tank Bottom Lining

Provide the main tank bottom (including internal supports) with an interior protective lining. The lining shall be applied in accordance with the lining manufacturer's recommendations. Linings shall include the bottom of the main tank and the lower 24 inches of the shell, all nozzles within the lower 24 inches of the shell out to and including the exterior face of nozzle flanges where piping or manway covers have been removed. The lining shall be a glass-reinforced system compatible with the specified fuel oil. Acceptable systems include: Epoxy lining with chopped glass, International Coatings Interline 985 or equal. One laminate coat (50 -56 mils DFT) and one gel coat (10 - 20 mils DFT). Apply lining system in accordance with instructions from the coating manufacturer for application, including surface preparation, application equipment, and appropriate safety precautions. Surface preparation for the area to be coated shall include the following:

a. Grind rough surfaces on welded seams, sharp edges, and corners to a minimum of a 3 mm (1/8 inch) radius.

b. Abrasive blast surfaces to white metal in accordance with SSPC SP 5 unless otherwise required by the coating supplier and approved by the Owner's Representative.

c. Clean blasted surfaces to remove oil, dust, sand, or other blasting residue and moisture.

d. Apply prime coat within eight hours after cleaning. If visible rusting occurs after cleaning, regardless of the time interval, re-blast rusted surfaces prior to applying primer coat.

Prepare and mix primer and finish coats in accordance with the manufacturers written instructions and apply following manufacturers instruction, allowing proper curing time between prime and finish coats. After completion of finished coat, surfaces shall be inspected by the tank manufacturer for pinholes, skips, inadequate coating thickness, and other defects. The lining shall be checked for pinholes, holidays, and bare areas with a low voltage wet sponge holiday detector such as a Tinkor Rasor Model M-1 Holiday Detector or equivalent. Any pinholes shall be removed by grinding out the coating area to the shell plate, followed by an inspection to assure the appropriate surface profile exists before reapplication of the coating. Repair imperfections found in accordance with the coating manufacturers instructions. Following hydrostatic tank testing and drying, the interior of the tank, including underside of roof, above the lining shall be sprayed with oil after blast cleaning has been completed.

The words "DO NOT WELD - LINED TANK" shall be stenciled on the outside of the lined tank. The words shall be visible from all sides of the tank.

2.1.3 Exterior Tank Coating

The tank shall be cleaned in accordance with the requirements of SSPC-SP6 - Commercial Blast Cleaning for the interior and exterior. Existing structures and equipment shall be protected from overspray by the tank Manufacturer. The tank exterior shall be painted after erection in accordance with the following:

a. One coat of a re-coatable, rust inhibitive, high build, catalyzed polyamide/bisphenol A epoxy primer (gray in color), 4.0 to 6.0 mil DFT. Sherwin Williams #B67A5 or equal.

b. Two coats of two-component, acrylic high solids polyurethane enamel, 3.0 to 4.0 mils DFT per coat. Sherwin Williams #B65-300 or equal. Finish color shall be determined by the Owner and shall be given to the Manufacturer when certified drawings are approved.

2.1.4 Coating Application Work Plan

The Contractor shall submit a written plan describing in detail all phases of the coating operations. The plan shall address work sequencing, surface preparation, coating application, recoat and cure time projections, as well as how each step will be controlled, tested, and evaluated. The plan shall describe equipment and methods used to measure tank temperatures and humidity during application. Provide detailed procedures, including manufacturer's instructions, for repairing defects in the coating film such as runs, drips, sags, holidays, overspray, etc. Address safety measures, work scheduling, and record keeping. Safety measures shall be designed, implemented, and enforced by a Certified Industrial Hygienist (CIH). The Plan shall contain language that will be enforced by the CIH to ensure that employees are trained in all aspects of the safety plan. Specified coatings may have potential health hazards if ingested or improperly handled. The coating manufacturer's written safety precautions shall be followed throughout

mixing, application, and curing of the coatings. During tank cleaning, cleanup, surface preparation, and paint application phases, ensure that employees are protected from toxic and hazardous chemical agents which exceed concentrations in 29 CFR 1910.1000. Comply with respiratory protection requirements in 29 CFR 1910.134. The CIH shall approve work procedures and personal protective equipment.

2.1.5 Qualifications of Certified Industrial Hygienist (CIH)

Submit name, address, telephone number, FAX number, and e-mail address of the CIH. Submit documentation that hygienist is certified by the American Board of Industrial Hygiene in comprehensive practice, including certification number and date of certification/recertification. Provide evidence of experience with hazards involved in industrial coating application work.

2.1.6 Qualifications of Coating Contractors

All contractors and subcontractors that perform surface preparation or coating application shall be certified by the Society for Protective Coatings (formerly Steel Structures Painting Council) (SSPC) to the requirements of SSPC QP 1 prior to contract award, and shall remain certified while accomplishing any surface preparation or coating application. The contractors and subcontractors must remain so certified for the duration of the project. If a contractor's or subcontractor's certification expires, the firm will not be allowed to perform any work until the certification is reissued. Requests for extension of time for any delay to the completion of the project due to an inactive certification will not be considered. Immediately notify the Owner's Representative of any change in contractor certification status.

Submit the name, address, telephone number, FAX number, and e-mail address of the contractor that will be performing all surface preparation and coating application. Submit evidence that key personnel have successfully performed surface preparation and application of tank linings in welded petroleum storage tanks on a minimum of three separate projects within the past three years. List information by individual and include the following:

a. Name of individual and proposed position for this work.
b. Information about each previous assignment in a welded petroleum storage tank including: position or responsibility; employer (if other than the Contractor); name of tank owner, mailing address, telephone number, and telex number (if non-US) of tank owner; name of individual in tank owner's organization who can be contacted as a reference; location, size and description of tank; dates work was carried out; and description of work carried out in tank.

2.2 TANK EQUIPMENT

2.2.1 Piping and Connections

Tanks shall be provided with internal piping for connections indicated on the Bid document drawings. All internal piping shall be in accordance with ASME B31.1. All internal piping shall be supported to ensure rigidity during operation. Supports shall be designed to permit thermal expansion of internal piping for the design temperature. The suction/fill line from the fuel oil storage tank to the fuel oil pumps shall be fitted with a fixed suction device positioned 24 inches above the floor, turned downward and located inside the tank to prevent drawing water from the fuel oil storage tank.

Piping connections shall be supplied as specified on the tank arrangement drawing. Flanges shall be raised face ANSI Class 150 weld neck type. All flanged piping connections shall be furnished with 150lb. blind flanges, gaskets and bolts. Bolt holes in flanged nozzles shall straddle the vertical centerline ("two holed"). Tolerance in bolt hole location and in bolt circle diameter shall be ± 1/16 inch. Nozzle projection shall extend 9 inches from outside face of tank to face of flange Unless otherwise required, tank connections 2 inches and smaller shall be Class 3000 Threadolets or Sockolets. The tank shall be electrically isolated from cathodically protected pipe by insulating flanges or dielectric unions.

Internal and external piping shall be supported as required to meet code allowable stresses to support the dead load, wind load, and seismic load for pipes including their contents.

2.2.2 Access Manholes

One roof access manhole shall be provided and shall have a nominal diameter of 24 inches. Two shell access manholes shall be provided in the outer containment tank and each shall have a nominal diameter of 30 inches. Each manhole shall be provided with a davit or hinged cover. No shell manhole shall be furnished for the inner main tank. One spare set of permanent gaskets for all manhole covers shall be furnished and labeled as such for each tank. The tank(s) shall be provided with all necessary gaskets, bolts, nuts, and platforms. Gaskets shall be 1/8 inch thick, full faced, and shall be compatible with the fluid in the tank.

2.2.3 Grounding

Each tank shall be provided with four grounding pads equally spaced around the exterior of the tank, and 6 inches above the bottom. Grounding pads shall be Type 304 stainless steel and shall be welded to the tank. The contact surface shall be flat and smooth and shall be protected during shipment and erection to maintain the contact surface quality. Grounding rods meeting National Electrical Code requirements shall be furnished.

2.2.4 Stairway and Roof Walkway

Stairways, landing platforms, ladders, and hand railing shall be in compliance with OSHA regulations. Stairways shall be double stringer type supported by a minimum number of brackets. Handrails shall be provided on both sides of the stairway if the

clearance between the tank shell and stringer exceeds eight inches. Each intermediate platform shall be not less than 2 feet 6 inches wide. Platform design shall incorporate the best access and most economical use of space. A 4 foot wide grated walkway with safety gate at ladder access shall be provided on the tank roof. The walkway shall extend from the ladder termination to the roof-mounted appurtenances. The walkway shall be completely enclosed with handrails and kick plates except at the ladder access opening. Handrail details and fabrication shall comply with OSHA, part 1910.23.

2.2.5 Vent Flame Arrestor

The fuel oil storage tank and outer containment tank shall be furnished with a vent flame arrestor.

2.2.6 External Gauge Board

The main tank shall be provided with a stainless steel gauge board level gauge system. The stainless steel gauge boards provided shall be a complete system including all necessary appurtenances such as the float, guide wires, indicator board, target, piping, supports, etc. The gauge board shall be located so the tank levels can be viewed from the side of the outer containment tank. The manual gauge board shall be VAREC Model 6700 Series Liquid Level Indicator, for Closed Top Tank and Guided Float or approved equal.

2.2.8 Tank Marking

- A stainless steel nameplate shall be attached to the tank in a clearly visible, easily accessible location as described in API Standard 650.
- The nameplate shall be the API Standard 650 monogrammed nameplate carrying the information prescribed in API Standard 650 and as per CT DEP requirements. NGS/CRRA identifying tank number and information shall be included.
- Tank numbers, tank inlet and tank outlet piping labels shall be marked clearly on the tank wall. Detailed font size and design shall be coordinated with NGS/CRRA prior to tank fabrication.
- All special plates that are cut to shape prior to shipment to the work site shall be marked as shown on the fabrication drawings.

2.2.9 Material Requirements

The following material minimum requirements shall apply:

Shell Plate	ASTM A36
Nozzles & Manhole Necks	ASTM A53 or A106 Grade B, seamless. Manhole necks may be rolled from the same steel plate as the shell plate
Structural Shapes	ASTM A36, except where otherwise required

Forged Steel Flanges	ASTM A181 Grade I or II; ASTM A105 Grade I or II
Plate Flanges & Covers	As listed above under shell plates
Gaskets & O-Rings	Buna-N
Platform Grating	ASTM A36 (Hot-dip galvanized)
Grating Fasteners	Stainless steel
Hand Railing	1-1/2" diameter steel pipe
Stairways & Components	ASTM A36 (Hot-dip galvanized)
Appurtenance Flange	ASTM A307 Grade A bolts with hexagon heads and ASTM A563 Grade A hexagon nuts; all galvanized

2.3 CATHODIC PROTECTION (Required for Rammed Aggregate Pier Foundation)

The tanks if installed using the Rammed Aggregate Pier foundation shall be cathodically-protected steel tanks used for aboveground storage of petroleum and shall meet or exceed one of the following design and manufacturing standard:

a. API No. 651

In addition, such steel tanks must be cathodically protected with sacrificial anodes which is designed, fabricated and installed in accordance with the above standard

The cathodic protection system must be designed to provide a minimum of thirty (30) years of protection

A qualified engineer or corrosion specialist must supervise the installation of the cathodic protection system where this is necessary to assure that the system has been installed as designed.

Each cathodic protection system must have a monitor which enables the owner or operator to check on the adequacy of cathodic protection.

Tanks which are protected by sacrificial anodes must be electrically insulated from the piping system with dielectric fittings, bushings, washers, sleeves or gaskets which are chemically stable when exposed to petroleum, petroleum additives, or corrosive soils.

2.3.1 Corrosion Specialist

The Contractor shall obtain the services of a "corrosion specialist" to supervise and

inspect the installation and performance of the cathodic protection system. "Corrosion specialist" refers to a person, who, by reason of thorough knowledge of the physical sciences and the principles of engineering and mathematics acquired by professional education and related practical experience, is qualified to engage in the practice of corrosion control on steel tanks. Such a person must be accredited or certified by the National Association of Corrosion Engineers (NACE) as a NACE Accredited Corrosion Specialist or a NACE certified Cathodic Protection (CP) Specialists or be a registered professional engineer who has certification or licensing that includes education and experience in corrosion control on steel petroleum tanks, if such certification or licensing included 5 years experience in corrosion control on steel tank of the type under this contract. The "corrosion specialist" shall ensure that the cathodic protection system is installed, tested, and placed into service in accordance with the requirements specified; and shall also design, make calculations, and assure quality control as required.

2.3.2 Cathodic Protection Tester

The Contractor shall obtain the services of a "cathodic protection tester", who can demonstrate an understanding of the principals and measurements of all common types of cathodic protection systems as applied to buried metal piping and tank systems and who has education and experience in soil resistivity, stray current, structure-to-soil potential, and component electrical isolation measurements of buried metal piping and tank systems. The person shall be certified as being qualified by NACE International, Steel Tank Institute (STI), or any other organization that is acceptable to the Owner's Representative.

2.3.3 Verification of Site Conditions

The Contractor shall coordinate and properly relate this work to the work of all trades. The general locations of the structures to receive protection are shown. The Contractor shall visit the premises and become familiar with all details of the work and working conditions, shall verify existing conditions in the field, determine the exact locations of structures to be protected, and advise the Owner's Representative of any discrepancy before performing any work.

2.3.4 Spare Parts

The Contractor shall submit spare parts data for each different item of material and equipment specified, after approval of the detail drawings and not later than one month prior to the date of tank commissioning. The data shall include a complete list of parts, special tools, and supplies with current unit prices and source of supply. One spare anode of each type shall be furnished.

PART 3 - EXECUTION

3.1 INSTALLATION

3.1.1 Oil Storage Tanks

The fuel storage tank and outer containment tank shall be constructed in accordance with all approved submittals, and as required by the project plans and specifications.

- The Contractor shall furnish all labor, supervision, materials, tools, and equipment necessary to complete this work.
- Laydown area shall be outside the construction site and the location shall be agreed with the Owner's Representative before commencement of work. Laydown area within Owner's property is minimal. Contractor shall plan his work and provide off-site storage as necessary.
- The fabrication and erection recommendations of API Standard 650 shall be followed.
- The Contractor shall obey all regulations while conducting work at the NGS/CRRA facility including QA/QC Plan, and safety, fire, traffic, and security regulations.

3.1.2 Fabrication

When the tank material requires straightening, the work shall be done by pressing or other non-injurious methods prior to any layout or shaping. Heating or hammering is prohibited unless the material is maintained at forging temperature during the straightening process. The edges of plates may be sheared, machined, chipped or machine gas cut. Shearing shall be limited to plates less than or equal to 3/8" thick used for butt welded joints and to plates less than or equal to 5/8" thick used for lap welded joints. When edges of plates are gas cut, the resulting surfaces shall be uniform and smooth and shall be free from scale and slag accumulations before welding. After cut or sheared edges are wire brushed, the fine film of rust adhering to the edges need not be removed before welding. Circumferential edges of roof and bottom plates may be manually gas cut. Shell plates shall be shaped to suit the curvature of the tank and the erection procedure.

3.1.3 Shipping and Storage

Plates and tank material shall be loaded in a manner that ensures delivery without damage. Bolts, nuts, and other small parts shall be boxed or put in kegs or bags and clearly marked for shipment. Contractor shall notify the Owner's Representative one week prior to shipment of materials/components to site.

Plates, assemblies and other tank components shall be stored in such manner that prevents damage but permits accessibility during construction activities.
Storage of materials on site shall be coordinated through the Owner's Representative.

3.1.4 Welding

- All welding procedures, welders, and welding operators shall be qualified in accordance with these specifications and the requirements of ASME.
- Welder qualifications and welding procedures shall be submitted to the Owner's Representative for approval prior to the start of any work

- All welding shall be performed in accordance with this specification and the requirements of API Standard 650.
- All welds shall be inspected, tested and repaired in accordance with this specification and the requirements of API Standard 650.
- The qualifications of the field inspection personnel engaged by the Contractor shall be submitted for approval by the Owner's Representative.
- No welding of any kind shall be performed when the surfaces of the parts to be welded are wet from rain, snow, or ice; when rain or snow is falling on such surfaces; or during periods of high winds unless the welder and the work are properly shielded. Also, no welding of any kind shall be performed when the temperature of the base metal is less than 0°F. When the temperature of the base metal is 0°F to 32°F or the thickness of the base metal is in excess of 1 ¼ in., the base metal within 3 in. of the place where welding is to be started shall be heated to a temperature warm to the hand.
- Each layer of weld metal or multilayer welding shall be cleaned of slag and other deposits before the next layer is applied.
- The edges of all welds shall merge with the surface of the plate without a sharp angle. For vertical butt joints, the maximum acceptable undercutting is 1/64 in. of the base metal. For horizontal butt joints, undercutting not exceeding 1/32 in. in depth is acceptable. The reinforcement of the welds on all butt joints on each side of the plate shall not exceed the following thicknesses:

Maximum Reinforcement Thickness - inches

Plate Thickness	Vertical Joints	Horizontal Joints
≤ ½	3/32	1/8
> ½ to 1	1/8	3/16
> 1	3/16	1/4

- During the welding operation, plates shall be held in close contact at all lap joints.
- The method proposed by the Contractor for holding the plates in position for welding shall be submitted to the Owner's Representative for approval.
- Tack welds used during the assembly of vertical joints of tank shells shall be removed and shall not remain in the finished joints when the joints are welded manually. When such joints are welded by the submerged-arc process, the tank welds shall be thoroughly cleaned of all welding slag but need not be removed if they are sound and are thoroughly fused into the subsequently applied weld beads.
- Whether tack welds are removed or left in place, they shall be made using a fillet-weld or butt-weld procedure qualified in accordance with Section IX of the ASME Code. Tack welds to be left in place shall be made by welders qualified in accordance with Section IX of the ASME Code and shall be visually examined for defects, which shall be removed if found (refer to API 650 Section 6.5 for criteria for visual examination).
- If protective coatings are to be used on surfaces to be welded, the coatings shall be included in welding-procedure qualification tests for the brand formulation and maximum thickness coating to be applied. After the bottom plates are laid out and tacked, they shall be joined by welding the joints in a sequence that the manufacturer has found to result in the least distortion from shrinkage and thus to provide as nearly

as possible a plane surface.

- The welding of the shell to the bottom shall be practically completed before the welding of bottom joints that may have been left open to compensate for shrinkage of any welds previously made is completed. Shell plates may be aligned by metal clips attached to the bottom plates, and the shell may be tack welded to the bottom before continuous welding is started between the bottom edge of the shell plate and the bottom plates.
- Shell plates to be joined by butt welding shall be matched accurately and retained in position during the welding operation. Misalignment in completed vertical joints for plates greater than 5/8 in. thick shall not exceed 10% of the plate thickness or 1/8 in., whichever is less; misalignment for plates less than or equal to 5/8 in. thick shall not exceed 1/16 in.
- In completed horizontal shell butt joints, the upper plate shall not project beyond the face of the lower plate at any point by more than 20% of the thickness of the upper plate, with a maximum projection of 1/8 in.; however, for upper plates less than 5/16 in. thick, the maximum projection shall be limited to 1/16 in.
- The reverse side of double-welded butt shell joints shall be thoroughly cleaned in a manner that will leave the exposed surface satisfactory for fusion of the weld metal to be added, prior to the application of the first bead to the second side. This cleaning may be done by chipping; grinding; melting out; or where the back of the initial bead is smooth and free from crevices that might entrap slag, another method that, upon field inspection, is acceptable to the Owner's Representative.
- For circumferential and vertical joints in tank shell courses constructed of material more than 1 ½ in. thick (based on the thickness of the thicker plate at the joint), multi-pass weld procedures are required, with' no pass over 3/4 in. thick permitted. A minimum preheat of 200°F is required for these welds.
- Permanent and temporary attachments to shells containing API 650 Group IV, IVA, V, or VI material shall be welded with low-hydrogen electrodes. The welds of permanent attachments (not including shell-to-bottom welds) and areas where temporary attachments are removed shall be examined visually and by the magnetic particle method (or at the option of NGS/CRRA, by the liquid penetrant method) (refer to API 650 Sections 6.2, 6.4, or 6.5 for the appropriate inspection criteria). Both permanent and temporary attachments shall be welded by a procedure that does not cause underbead cracking. The necessity of preheat for thick plates or because of a low atmospheric temperature during welding shall be considered when the procedure is selected.

3.1.5 Cathodic Protection System (Required for Rammed Aggregate Pier Foundation)

Install all components in accordance with manufacturer's instructions, approved shop drawings, and all applicable codes and regulations.

3.2 TESTING & INSPECTION

3.2.1 Tank and Weld Testing

During installation and following completion of installation, the equipment shall be completely

tested by the Contractor to demonstrate compliance with operating requirements as specified. Inspection forms, testing procedures and completion forms, and certification forms shall be used. Certified mill test reports for pressure retaining materials shall be provided in accordance with ASTM specifications and shall include actual mechanical and chemical properties. The Owner's Representative reserves the right to witness field tests. The Contractor shall notify the Owner's Representative of the field tests at least fifteen (15) days in advance of the dates of the tests. Methods of inspecting joints shall be stated in the approved QA/QC Plan. The methods shall be in accordance with API Standard 650.

- After any stress-relieving but before hydrostatic testing of a tank, welds attaching nozzles, manholes, and cleanout opening shall be examined visually and by the magnetic particle method [or at the option of the Owner's Representative, by the liquid penetrant method (refer to API 650 Sections 6.2, 6.4, or 6.5 for the appropriate inspection and repair criteria)].
- Flush-type connections shall be inspected according to API 650 Section 3.7.8.11.
- For the shell to bottom weld, the initial weld pass inside the shell shall have all slag and non-metals removed from the surface of the weld and then examined for its entire circumference prior to welding the first weld pass outside the shell (temporary weld fit-up tacks excepted), both visually and by one of the following methods to be agreed to by the Owner's Representative and the Contractor:

A. Magnetic particle.

B. Applying a solvent liquid penetrant to the weld and then applying a developer to the gap between the shell and the bottom and examining for leaks after a minimum dwell time of one hour.

C. Applying a water soluble liquid penetrant to either side of the joint and then applying a developer to the other side of the joint and examining for leaks after a minimum dwell time of one hour.

D. Applying a high flash point penetrating oil such as light diesel to the gap between the shell and the bottom, letting stand for at least four hours, and examining the weld for evidence of wicking.
Note: Residual oil may remain on the surfaces yet to be welded even after the cleaning required below and contamination of the subsequent weld is possible.

E. Applying a bubble-forming solution to the weld, using a right angle vacuum box and examining for bubbles.

Thoroughly clean all residual examination materials from the as yet to be welded surfaces and from the un-welded gap between the shell and bottom. Remove defective weld segments and re-weld as required. Reexamine the repaired welds and a minimum of 6 in. to either side in the manner described above. Repeat this clean-remove repair-examine-and-clean process until there is no evidence of leaking. Complete all welding passes of the joint both inside and outside the shell. Visually examine the

finished weld surfaces of the joint both inside and outside the shell for their entire circumference.

By agreement between the Owner's Representative and the Contractor, the examinations above may be waived if the following examinations are performed on the entire circumference of the weld(s):

A. Visually examine the initial weld pass (inside or outside).

B. Visually examine the finished joint welded surfaces, both inside and outside the shell.

C. Examine either side of the finished joint weld surfaces by magnetic particle, or liquid penetrant, or right angle vacuum box.

3.2.1.1 Butt Welds

Complete penetration and complete fusion are required for welds joining shell plates to shell plates. Inspection for the quality of the welds shall be made using the visual method. In addition, the Owner's Representative may visually inspect all butt welds for cracks, arc strikes, excessive undercuts, surface porosity, incomplete fusion, and other defects. Acceptance and repair criteria for the visual method are specified in API 650 Section 6.5.

3.2.1.2. Fillet Welds

Fillet welds shall be inspected by the visual method. Acceptance and repair criteria are specified in API 650 Section 6.5.

3.2.1.3. Radiographic Testing

All costs for making radiographs and any necessary repairs shall be borne by the Contractor; however, if the Owner's Representative requires radiographs in excess of the number specified in API 650 Section 6, or requires chipouts of fillet welds in excess of one per 100 ft of weld and no defect is disclosed, then the cost of the additional inspections and associated work shall be borne by the Owner.

3.2.1.4. Vacuum Testing

Vacuum testing is performed using a metal testing box, 6 in. side by 30 in. long with a glass window in the top. The open bottom is sealed against the tank surface by a sponge-rubber gasket. Suitable connections, valves, and gauges should be provided. Approximately 30 in. of the seam under test is brushed with a soap solution or linseed oil. In freezing weather, a nonfreezing solution may be necessary. The vacuum box is place over the coated section of the seam, and a vacuum is applied to the box. The presence of porosity in the seam is indicated by bubbles or foam produced by air sucked through the welded seam. A vacuum can be drawn on the box by any convenient method, such as connection to gasoline- or diesel-motor intake manifold or to an air ejector of special vacuum pump. The gauge should register a partial vacuum of at least 3 lbf/in.^{2} gauge. As an alternate to vacuum box testing, a suitable tracer gas and compatible detector can be

used to test the integrity of welded bottom joints for their entire length provided that an appropriate tracer gas testing procedure has been reviewed and approved by the purchaser.

3.2.1.5. Inspection of Tank Bottom Welds

Upon completion of welding of the tank bottom, the welds shall be inspected by vacuum applied to the joints, and a soap film, linseed oil, or another material suitable for the detection of leaks shall be used to detect any leaks. This shall also include the tank sidewall to bottom weld.

3.2.1.6. Inspection of Reinforcement-Plate Welds

After fabrication is completed but before the tank is filled with test water, the reinforcement plates shall be tested by applying up to 15 lbf/in.^{2} gauge pneumatic pressure between the tank shell and the reinforcement plate on each opening using the telltale hole specified in API 650 Section 3.7.5.1. While each space is subjected to such pressure, a soap film, linseed oil, or another material suitable for the detection of leaks shall be applied to all attachment welding around the reinforcement, both inside and outside the tank.

3.2.1.7. Testing of the roof

Upon completion, the roof shall receive only visual inspection of its weld joint.

3.2.1.7. Tightness Test and Settlement

After the inspections and testing of a tank as described above has been successfully completed, including inspection and testing of all welds, the tank shall be hydrostatically tested by filling the tank with water supplied from the on-site available potable water system via hydrant connection, water meter, hose and other appurtenances furnished and installed by the Contractor.

Upon completion of the entire tank, including outer containment, and prior to the connection of any permanent external piping, the main tank and outer containment tank shells shall be filled with water and hydrostatically tested in accordance with API Standard 650. All connections, pumping, blind flanges, nuts, bolts, and gaskets as required to perform the test shall be provided, installed and removed by the Contractor. Contractor shall remove water from the tank after completion of the test and shall thoroughly dry the tank interiors. Contractor shall dispose of the test water as directed by the Owner's Representative. The Contractor shall be required to furnish all pumps, meter, pipe, hoses, connections and other appurtenances needed to effect the draining and discharge of the test water to the sanitary sewer. The Contractor shall be required to test all water prior to disposal in accordance with permit conditions for the discharge to sanitary sewer.

Shell settlement measurements shall be made after tank erection prior to hydrostatic testing and during water filling at each third and full levels corresponding to the maximum filling height of the tank. Settlement measurements shall be taken at equally

spaced intervals of approximately 30 ft around the tank shell on well marked locations on the annular plate or on chips welded to the shell.

Tank filling for a tank built on a Rammed Aggregate Pier foundation shall be performed in a series of four steps to allow settlement to occur slowly. This process involves filling the first quarter of the tank and allowing settlement to occur over a five (5) day period, filling the second quarter of the tank and allowing settlement to occur over a five (5) day period, filling the third quarter of the tank and allowing settlement to occur over a (5) day period and filling the final quarter of the tank and allowing settlement to occur over at least a five (5) day and up to a fifteen (15) day period.

3.2.2 Cathodic Protection System Testing (Required for Rammed Aggregate Pier Foundation)

Records of testing and inspection of cathodic protection systems must demonstrate compliance with the testing criteria specified by the corrosion expert or corrosion engineer that designed the cathodic protection system.

Steps that were followed in arriving at whether the cathodic protection system is or is not performing adequately to protect the tank system against corrosion must be included in the documentation. This documentation must provide enough information about the testing that any qualified cathodic protection tester would be able to perform the same steps and arrive at the same conclusion, when performing the test within a reasonably short period of time. These steps must also provide an adequate number of measurements that will properly determine the adequacy of the protection provided. A simple statement to the effect that the system "passed" or did not "pass" the test is not adequate documentation for a cathodic protection system test.

For galvanic systems, current-on measurements are the only option possible because the anodes are permanently attached. The current-on measurements indicate the distribution of current on the structure and where the weak spots in terms of protection may be located.

Galvanic current system testing must include continuity determination measurements. In addition, voltage measurements at a minimum should be made with the reference cell in at least three locations.

3.2.3 Coating Holiday Testing

No sooner than 48 hours after application of the topcoat, perform holiday testing in accordance with the low voltage wet sponge method of NACE RP0188. Repair holidays per paragraph entitled "Procedure for Holiday and Spot Repairs of Newly Applied coating." Do not allow moisture from sponge to remain on the coated surfaces more than ten minutes. Remove excess moisture with a clean rag when testing top coat.

3.2.4 Quality Assurance

- Installation shall be in compliance with approved Quality Assurance/Quality Control

Plan (QA/QC) and American Petroleum Institute (API) publications, NFPA-30, and all manufacturers' current requirements.

- The Owner's Representative shall be permitted free entry to all parts of the Contractor's plant concerned with the contract whenever any work under the contract is being performed.
- Mill and shop inspection shall not release the Contractor from responsibility for replacing any defective material and for repairing any defective workmanship that may be discovered in the field.
- The workmanship and finish shall be first class in every respect and subject to the closest inspection by the Contractor even if the Owner's Representative has waived any part of the inspection.
- Any material or workmanship that in any way fails to meet the requirements of API Standard 650 or the quality plan may be rejected by the Owner's Representative and the specific material may not be used. Material that shows injurious defects subsequent to its acceptance at the mill, acceptance at the Contractor's shop or during erection and testing of the tank will be rejected. The Contractor will be required to furnish new material promptly and make the necessary replacements or suitable repairs.
- Before acceptance, all work shall be completed to the satisfaction of the Owner's Representative and the entire tank when filled with fuel oil (kerosene) shall be tight and free from leaks.

3.3 REPAIRS AND FINAL ADJUSTMENTS

- All defects found in welds shall be called to the attention of the Owner's Representative, and their approval shall be obtained before the defects are repaired. All complete repairs shall be subject to the approval of the Owner's Representative. Acceptance criteria are specified in API 650 Sections 6.2, 6.4, and 6.5, as applicable.
- Pinhole leaks or porosity in a tank bottom joint may be repaired by applying an additional weld bead over the defective area. Other defects or cracks in tank bottom or tank roof joints shall be repaired as required by 6.1.7. Mechanical caulking is not permitted.
- All defects, cracks, or leaks in shell joints or the shell-to-bottom joint shall be repaired in accordance with API 650 Section 6.1.7.
- Repairs of defects discovered after the tank has been filled with water for testing shall be made with the water level at least 1 foot below any point being repaired or, if repairs have to be made on or near the tank bottom, with the tank empty. Welding shall not be done on any tank unless all connecting lines have been completely blinded. Repairs shall not be attempted on a tank that is filled with oil (kerosene) or that has contained oil (kerosene) until the tank has been emptied, cleaned, and gas freed. Repairs on a tank that has contained oil (kerosene) shall not be attempted by the Contractor unless the manner of repair has been approved in writing by the Owner's Representative and the repairs are made in the presence of the Owner's Representative.

After the testing has been completed, all necessary corrections, repairs, and final adjustments should be completed to render the tank ready for service with the cathodic

protection system functioning as designed and in accordance with all regulatory requirements.

3.4 TRAINING

During the commissioning period, the Contractor shall train CRRA and NGS personnel in the operating and maintenance procedures for the storage tanks and equipment provided under this section for not less than 8 hours. Training shall include safety procedures, preventative maintenance, corrective maintenance, parts procurement, and operations and maintenance manuals.

END OF SECTION

SECTION 13350

TANK LEVEL MONITORING SYSTEM

PART 1 – GENERAL

1.1 DESCRIPTION

Scope:

This section specifies the automated electronic level control monitoring system for the fuel oil storage tank.

Type:

The automated electronic level control sensing and monitoring system shall be a remote, microprocessor based tank gauging, monitoring and alarm system. The system control and communications shall be incorporated into a programmable logic control (PLC) panel with user interface and display. A PLC panel shall be located within the nearby Jet Shop and at the Pump house with audible and visual high level alarms at the Jet Shop and the fuel loading area. The fluid level sensor shall be of the ultrasonic type and shall be mounted on the top of the main tank in the location indicated on the Contract Drawings

The entire system and all components shall be intrinsically safe as approved by Factory Mutual for Class 1, Div. 1, Group C & D hazardous locations.

The general requirements applicable to all electrical equipment are applicable to the equipment specified in this section.

1.2 QUALITY ASSURANCE

This section contains references to the following documents. They are part of this section as specified and modified. In case of conflict between the requirements of this section and those of the listed documents, the requirement of this section shall prevail.

Reference	Title
ASTM A36/A36M	Carbon Structural Steel
NFPA 30	Flammable and Combustible Liquids Code
UBC	Uniform Building Code
UL 1709	Rapid Rise Fire Tests of Protection Materials for Structural Steel
UFC	Uniform Fire Code

Manufacturer's Qualifications:

Level control sensing and monitoring equipment shall be the product of a firm regularly

engaged in the design and fabrication of this type of item for large field fabricate fuel storage tanks.

Factory Test:

The level control module and PLC panel shall be factory tested. As a minimum, the factory test report shall contain the date and time of test, step-by-step test procedures, test results, and any corrective action taken by the manufacturer.

1.3 SUBMITTALS:

a. Shop Drawing & Catalog Data: Contractor shall submit copies of the shop drawing and literature for the level sensing, PLC panel and alarm system components. Drawings shall include all critical dimensions and show locations of all the fittings. Materials of construction shall be in accordance with this specification. Shop drawings shall include detailed electrical termination diagrams.

b. A copy of the level control system warranty.

PART 2 – PRODUCTS

2.1 TANK LEVEL ULTRASONIC SENSOR

Provide and install for mounting on a 6 inch diameter flanged fitting on top of the fuel oil tank an intrinsically safe (for FM Class I, Division 1 Groups C, D), narrow beam ultrasonic type, tank top mounted level gauging sensor with a range of 50 feet. The sensor flange fitting shall have a ball swivel fitting that allows the sensor angle to be adjusted inside the tank. The unit sensor system shall be a pre-packaged watertight system with a two-wire 4-20mA current transmitter. The sensor shall be unaffected by temperatures ranging from minus 40 degrees to 200 degrees Fahrenheit. Excitation voltage shall be nominal 24VDC. The unit shall be Siemens Model XPS-15 or approved equal.

2.1.1 Material of Construction

Materials of construction shall be compatible with kerosene.

2.1.2 Temperature Range.

-40°F to 200°F

2.1.3 Accuracy

Actuation depth nominal 1 ft. Resolution 0.5".

2.1.5 Mounting

The sensor housing shall be mounted on the end of a 1" metal galvanized pipe inserted 24" below the tank roof through a standard 6" blind flange fitting drilled and tapped to accept the pipe. Flexible conduit shall be connected from the top of the blind flange to the junction box mounted on the adjacent grated platform structure.

2.1.6 Current Transmitter and Control Function

The current transmitter shall be a compact 2-wire, 4-20mA innage output. The unit shall be provided with nominal 24VDC excitation. Transmitter stability shall be +/- 0.005% / °C.

2.1.7 Programmable Logic Control (PLC) Panel Unit and Manufacturer

The 4-20mA output signals, proportional to liquid level height, from the level sensor will be interpreted by the PLC panel located within the Jet Shop and a second slave unit located at the Pump House near the fuel unloading area. The PLC will:

1. use internal algorithms to determine the height of the fuel oil in feet, and volume of fuel oil in gallons,
2. display the level and volume in the tank on the digital display interface, and
3. actuate the high level alarm at 90% tank capacity and the high-high level alarm at 95% tank capacity.
4. Provide 24 volt DC power supply for the level sensor/transmitter system.

Siemens Model SITRANS LU02 or approved equal.

2.3 Overfill Alarms:

Install on the outside of the Pump Station building wall immediately adjacent to the tank unloading area and inside the Jet Shop overfill alarm horns. The alarm station shall have NEMA 4 construction and contain weatherproof horn. A high level alarm signal from the PLC shall actuate the horn. If the operator does not manually silence the bell, in one minute it will silence automatically. The station will have a test function to insure the tank gauge and fill alarms are operational. A silence button will be located inside the Jet Shop directly adjacent to the PLC panel display.

2.4 Fill Alarm Sign

Provide and install where directed a Fil-A-Larm Sign. The sign shall be 20 inches wide by 14 inches high of 18 gauge steel with porcelain baked enamel finished bright yellow background and minimum 2 inch high black lettering. Sign shall be as manufactured by Preferred Utilities Mfg. Corp. Model FA-S. Caution Sign Shall Read:

CAUTION
WHEN ALARM BELL SOUNDS
OIL TANK FILLED TO CAPACITY

DO NOT OVERFILL

PART 3 - EXECUTION

3.1 INSTALLATION

The fuel oil level control sensing, monitoring and alarm system shall be aligned, connected and installed at the locations specified and in accordance with the manufacturer's written recommendations and the Uniform Fire Code. All components shall be installed and tested under the direction of factory-trained personnel.

3.2 TESTING

After completion of installation, the equipment shall be completely tested by the Contractor to demonstrate compliance with operating requirements as specified. Inspection forms, testing procedures and completion forms, and certification forms shall be used. A letter from the installer shall be provided to the Owner stating that the system received its factory start up and that all components are in working order.

3.3 TRAINING

During the commissioning period, the Contractor shall secure the services of a factory-trained representative of the level control system supplier to train the Owner's personnel in the operating and maintenance procedures for the storage tank and equipment provided under this section for not less than 4 hours. Training shall include safety procedures, preventative maintenance, corrective maintenance, parts procurement, and operations and maintenance manuals

END OF SECTION

SECTION 15060

PROCESS PIPING, VALVES AND APPURTENANCES

PART 1 GENERAL

1.1 DESCRIPTION

All materials supplied and the installation shall conform to the applicable standards referenced in paragraph 1.3 below. All materials provided shall be new.

Related Sections:

Section 13100, Field Fabricated Steel Fuel Tank & Containment Tank

1.2 QUALITY ASSURANCE

Provide materials and equipment that are standard products of manufacturers regularly engaged in the manufacture of such products, which are of similar material design and workmanship. Standard products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2 year use shall include applications of equipment and materials under similar circumstances and of similar size.

1.3 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI B31	(latest revision) Code for Pressure Piping
ANSI B31.3	(1999) Process Piping
ASME/ANSI B31.9	(1996) Building Service Piping

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A53	Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A106	Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service
ASTM A126	(1995; Rev 2001) Gray Iron Castings for Valves, Flanges, and Pipe Fittings

ASTM A240	(2001) Standard Specification for Heat Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels
ASTM A668	Standard Specification for Steel Forgings, Carbon and Alloy, for General Industrial Use

AMERICAN PETROLEUM INSTITUTE (API)

API 570	Piping, Inspection Code: Inspection, Repair, Alteration and Rerating of in-service Piping Systems
API 598	Valve Inspection and Testing
API603	Corrosion-Resistant, Bolted Bonnet Gate Valves - Flanged and Butt-Welding Ends
API 650	Welded Steel Tanks for Oil Storage

ASME INTERNATIONAL (ASME)

ASME	Boiler and Pressure Vessel Code Section IX, Welding and Brazing Qualifications
ASME B16.11	Forged Fittings, Socket-Welding and Threaded
ASME B16.21	Nonmetallic Flat Gaskets for Pipe Flanges
ASME B16.5	Pipe Flanges and Flanged Fittings

BUILDING OFFICIALS AND CODE ADMINISTRATORS INTERNATIONAL (BOCA)

BOCA	National Building Code (1996 or latest version in effect at time of construction).
BOCA	National Plumbing Code (1996 or latest version in effect at time of construction).
BOCA	National Mechanical Code (1996 or latest version in effect at time of construction).

1.4 SUBMITTALS

Submit the following in accordance with section 01330, "Submittal Procedures".

1.4.1 SD-01, Manufacturer's Catalog Data

a. Piping
b. Flexible Piping
c. Valves
d. Pipe Supports and Hangers
e. Pipe Insulation

1.4.2 SD-04, Drawings

a. Submit copies of manufacturer's literature and shop drawings for all piping, valves, and appurtenances not specifically listed in Section 1.4.1, which are not part of or integral to other pieces of equipment.

1.4.3 SD-09, Reports

a. Hydrostatic Testing of Piping

1.4.4 SD-19, Operation and Maintenance Instructions

Provide 6 copies of operation and maintenance instruction listing routine maintenance procedures, possible breakdowns and repairs, and trouble shooting guides for all items addressed in Sections 1.4.1 and 1.4.2.

1.5 EQUIPMENT TAGGING

All piping, valves and components shall be tagged.

1.6 DELIVERY AND STORAGE

Inspect materials delivered to site for damage; unload and store with minimum handling. Store materials on-site in enclosures or under adequate cover to prevent damage, protect materials not suitable for outdoor storage to prevent damage during periods of inclement weather, such as subfreezing temperatures, precipitation, and high winds. Store materials susceptible to deterioration by direct sunlight under cover and avoid damage due to high temperatures. Do not store materials directly on ground. If special precautions are required, prominently and legibly stencil instructions for such precautions on outside of equipment or its crating.

PART 2 PRODUCTS

2.1 PIPING MATERIALS

All piping on this project shall be welded steel pipe as specified below. Piping systems shall be installed as shown in the project drawings.

2.1.1 Steel Pipe

Steel, black carbon pipe. Schedule 80. Steel pipe shall conform to ASTM A53 seamless Grade B or ASTM A106 seamless, Grade B (high temperature applications).
Above ground pipe 2" and smaller shall be furnished with mill attached, extra heavy, tapered couplings. All pipe 2 ½" and larger shall be furnished and installed with beveled ends for welding.

All fittings 2 ½" and larger shall be long radius seamless butt welding fittings of the same wall thickness and of the same material as the pipe to which they are attached conforming to ASTM A-668.

2.1.2 Flexible Pipe

Flexible pipe sections shall be corrugated stainless steel metal hose (316L Stainless Steel) with a single layer stainless steel braid covering (304L Stainless Steel) and with flanged end fittings. The length of the flexible pipe section inside the outer containment shall be 24 inches and outside the outer containment shall be 36 inches. The flexible pipe shall be rated for a minimum working pressure of 150 psi and a nominal burst pressure of 600 psi. Penflex Series 700 Stainless Steel Hose or approved equal shall be used.

2.2 VALVES

Contractor shall furnish and install valves as indicated on drawings except those valves which are supplied and installed by equipment manufacturer. All valves supplied by an equipment manufacturer shall meet the requirements of these specifications. All valves furnished under these specifications shall be product of a manufacturer who has had long experience in design of valves and whose products have proven reliable in service in similar installations over a reasonable period of years. Unless specified otherwise, all valves shall be of the same size as the line in which they are installed.

Piping shall be installed principally as shown on the drawings. Refer to the drawings to ensure all required valves, instruments and gages are provided. In addition, provide whatever piping and fittings are necessary, whether shown on the drawings or not, for a complete and working system. Provide flanged connectors for all process valves, instruments, and gages to facilitate removal (except those items with end connections of 2 inches or less may be threaded or provided with a threaded or socket union).

2.2.1 Pipe System and Tank Valves

All valves shall conform to API 603, Corrosion Resistant Bolted Bonnet Gate Valve standard with Flanged Ends, Class 300.

2.2.2 Manual Operator

The force in a manual operator shall not exceed 39.3 pounds under any operating condition, including initial breakaway. All valve operators shall be of the outside rising screw and yoke type that can be secured with a chain and lock. Traveling nut type operators shall have threaded stainless steel reach rods with an internally threaded bronze or ductile iron nut. Operators shall have galvanized and painted hand wheels.

2.2.3 Flap Valves

Flap valve for main tank overflow shall have flanged end connection. Valve shall be the upper dual pivot type, cast iron (ASTM A126, Class B) , Buna –N resilient seat and open at head no greater than 0.2 feet. The valve shall be Rodney Hunt Flap Valve Model FV-AC or approved equal.

PART 3 EXECUTION

3.1 PIPE AND FITTINGS

3.1.1 No defective pipe or fittings shall be used in piping systems. Any piece discovered to be defective shall be removed and replaced by a sound and satisfactory piece.

3.1.2 Any fitting showing a crack and any fitting or pipe which has received a severe blow that may have caused an incipient fracture, even though no such fracture can be seen, shall be marked as rejected and removed at once from work.

3.1.3 Every pipe and fitting shall be cleaned of all debris and dirt before being used and shall be kept clean until accepted in completed work.

3.1.4 Pipe and fittings shall be accurately installed to required lines and grades. Care shall be taken to preserve a good alignment.

3.1.5 All joints shall be made in clean dry conditions and in strict accordance with manufacturer's recommendations.

3.1.6 The entire installation shall comply with the ANSI code for Pressure Piping, B31.3 or B31.9.

3.2 INSTALLATION

3.2.1 Piping shall be installed principally as shown on the drawings. Refer to the drawings to ensure all required valves, instruments and gages are provided. In addition, provide whatever piping and fittings are necessary, whether shown on the drawings or not, for a complete and working system. Provide also drain valves at all low points, whether shown on the drawings or not.

3.2.2 Gravity drain piping shall be installed at proper elevations with sufficient pitch. Run piping parallel to lines of building. Provision for expansion and contraction shall be made where shown or required.

3.3 SCREWED PIPE JOINTS

3.3.1 Screwed pipe joints shall be made with Teflon pipe thread tape or approved joint compound. Joints shall be made in accordance with industry standards.

3.4 FLANGED CONNECTIONS

3.4.1 Flanged pipe connections shall be made up tight, with suitable fuel resistant gaskets and stainless steel bolts, care being taken to avoid undue strain on flanges and accessories. Any flanged pipe or fitting whose dimensions do not allow the making of proper flanged joint as specified herein shall be replaced by one of proper dimensions.

3.5 PIPE SUPPORTS AND HANGERS

3.5.1 All piping shall be supported in a substantial manner to prevent sagging, vibration and noise due to vibration. Structural members necessary or required to support, brace, or otherwise secure piping shall be furnished by Contractor unless specifically noted otherwise. The installation shall comply with the latest edition of the ANSI code for Pressure Piping, B31.3 or B31.9.

3.5.2 Clevis hangers shall be used for the support of individual hanging pipes with threaded rod and device for attachment to structural member. Piping near floors shall be supported with adjustable saddles. Piping along walls shall be supported by wall brackets with attached pipe roller or saddle or by wall brackets with hanger rods. Hangers and saddles shall be as manufactured by Grinnell or approved equal.

3.5.3 Gang hangers or overhead structural supports shall be constructed of Unistrut or Grinnell Power-Strut type members and clamps to secure piping. Structural attachments shall be of the type that provides even weight distributions on "T" flanges.

3.5.4 All hangers shall be supported from structural steel members or pipe racks. Where member spacing is in excess of allowable hanger spacing, provide intermediate supports.

3.5.5 All pipe saddles shall be carbon steel stanchion saddles that come with u-bolt and nuts. The saddles shall fit the bottom third of the pipe and have a support insert that fits inside a 3 inch diameter steel pipe support. Pipe supports shall be 3 inch diameter galvanized carbon steel pipe, schedule 40, which are embedded into concrete footing as shown on the Contract Drawings.

3.5.6 Pipe saddle, hanger spacing and rod diameters for support of piping shall be as follows:

	Support Spacing		
Nom. Pipe Size	Carbon Steel, Stainless Steel Iron or Steel	PVC or CPVC	Rod Size
3/4"	6 ft.	4 1/2 ft.	3/8"
1"	7 ft.	5 ft.	3/8"
1/2"	9 ft.	5 1/2 ft.	3/8"
2"	10 ft.	6 ft.	3/8"
2 1/2"	10 ft.	6 1/2 ft.	1/2"
3"	10 ft.	7 ft.	1/2"
4" or greater	10 ft.	7 1/2 ft.	1/2"

Use double nuts on all hanger rods

3.5.6 Finish painting of pipe supports shall be primered and painted in accordance with manufacturer's recommendations and as specified in Section 13100 – Field Fabricated Fuel Tank and Containment Tank. Hot dipped galvanized steel hangers may be used in lieu of painted hangers.

3.6 TESTING PROCEDURE

The piping system shall be tested during the progress of the work over completed pipe sections as determined by the Owner's Representative until all pipe has been tested. The Contractor shall first clean and flush all lines and remove all debris. The section of pipe being tested shall be plugged and adequately braced. All air shall be bled from the line and completely filled with water and pressurized to 1 ½ times their operating pressure per ANSI B31.3. The test pressure is then maintained for one hour during which time two pressure gauges, one at each end of the piping system, are monitored for pressure loss. The line must remain at the test pressure (± 2%) for a minimum of one hour to pass the test procedure. Hydrostatic test water shall be properly disposed upon completion of the pressure test.

Leakage in excess of this standard shall be repaired and pipe retested until passing. Any visible leakage shall be repaired regardless of testing results.

END OF SECTION

SECTION 16010

GENERAL REQUIREMENTS FOR ELECTRICAL WORK

PART 1 GENERAL

1.0 REFERENCES

A. Refer to the GENERAL REQUIREMENTS and applicable parts of DIVISION 1 for other general requirements.

1. GENERAL REQUIRMENTS and DIVISION 1 paragraphs may be repeated in this Division for emphasis or for inclusion of more stringent/additional related requirements. Such repetition shall NOT be construed to reduce the requirements of those Divisions NOR to eliminate other requirements under those Divisions.

B. Refer to other Sections of this Division for detailed specifications on the work of this Division.

1.2 INTENT

A. It is the intent of the Contract Documents to require finished work, tested and ready for operation.

B. It is not intended that Contract Documents show every pipe, wire, conduit, fitting and appurtenance; however, such parts as may be necessary to complete the systems in accordance with best trade practice and Code requirements and to the Owner's Representative's satisfaction shall be deemed to be included.

C. Drawings are diagrammatic and indicate the general arrangement of systems and work included in the Contract. Contractor shall confirm all clearances, elevations, equipment layout, equipment sizes, etc., based on actual Contractor proposed components and installation.

1.3 . EXAMINATION OF SITE AND CONTRACT DOCUMENTS

A. Before submitting prices or beginning work, thoroughly examine the site and the Contract Documents.

B. No claim for extra compensation will be recognized if difficulties are encountered which would have been revealed by examination of site conditions and Contract Documents prior to executing Contract.

C. Where discrepancies occur within Contract Documents, notify Owner's Representative, in writing, of discrepancy and request clarification. Until notified of

Owner's Representative's decision, include item or arrangement of better quality, greater quantity or higher cost in Contract price.

1. For material, device and equipment identified on Contract Drawings by manufacturer and model: Check Specification for ancillary requirements such as pilot lights or alarms, and include same with furnished item. If Specifications require different model, notify OWNER'S REPRESENTATIVE of discrepancy and request clarification.

D. Notify OWNER'S REPRESENTATIVE, in writing, of materials and apparatus believed to be omitted, inadequate or unsuitable, or in violation of laws, ordinances, rules or regulations of authorities having jurisdiction. In absence of such written notice, it is mutually agreed that bid price for work under each Section has included the cost of items required for acceptable satisfactory functioning of entire system.

1.4 DEFINITIONS

A. Where more than one material, item, or grade is listed in same paragraph, first one named is preferred choice.

B. The following terms are used in this Division and are defined as follows:

1. "Indicated", "shown", "noted", "scheduled", "specified": These terms are a cross-reference to graphics, notes or schedules on the Drawings, to other paragraphs or schedules in the Specifications, and to similar means of recording requirements in Contract Documents. NO limitation of location is intended except as specifically noted.

2. "Directed", "requested", "authorized", "selected", "required", "permitted": Where not otherwise explained, these terms mean "directed by the OWNER'S REPRESENTATIVE", "requested by the OWNER'S REPRESENTATIVE", etc. However, NO such implied meaning will be interpreted to extend the OWNER'S REPRESENTATIVE's responsibility into Contractor's area of construction supervision.

3. "Provide": To furnish and install, ready for safe and regular operation the item, material or service indicated.

4. "Furnish": To purchase, acquire and deliver to the site, complete with related accessories.

5. "Install": To erect, mount and connect completely, by acceptable methods.

6. "Work": Labor, materials, equipment, apparatus, controls and accessories required for proper and complete installation.

7. "Concealed": Embedded in masonry or other construction; or installed in furred spaces, trenches or crawl spaces; or installed within double partitions or hung ceilings; or in enclosures.

8. "Exposed": Visible to building occupants, excluding mechanical room and utility tunnel locations.

9. "Acceptable equivalent" or "Equal": Of weight, size, design, capacity and efficiency to meet requirements specified and shown, and of acceptable manufacture, as determined in the opinion of the OWNER'S REPRESENTATIVE.

10. "Acceptable": Acceptable, as determined in the opinion of the OWNER'S REPRESENTATIVE.

11 "Contractor": General Contractor.

12 "Named" Product: Manufacturer's name for product, as recorded in published documents of latest issue as of date of Contract Documents. Obtain OWNER'S REPRESENTATIVE's permission before using products of later or earlier model.

C. Standards, specifications and tests of following technical societies, organizations and governmental bodies, as referenced in Contract Documents, are hereby made part of Contract Documents.

1. IES: Illuminating Engineering Society.

2. ANSI: American National Standards Institute

3. ASTM: American Society for Testing and Materials

4. EPA: Environmental Protection Agency

5. FSSC: Federal Specification

6. IEEE: Institute of Electrical and Electronics Engineers

7. IRI: Industrial Risk Insurers

8. ISO: Insurance Services Office

9. NBS: National Bureau of Standards

10. NEC: National Electrical Code.

11 NEMA: National Electrical Manufacturers Association

12 NFPA: National Fire Protection Association

13. NSC: National Safety Council

14. OSHA: Occupational Safety and Health Administration

15. UL: Underwriters Laboratories

16. FAA: US Federal Aviation Administration

17. FED. SPECS.: Federal Specifications

18. CODE: Codes and regulations of the Federal, State and local governments and of utility companies having jurisdiction, as appropriate.

D. Use of singular or plural reference form in these Specifications shall not be construed to limit number of units required. Specifications are intended to define quality and performance characteristics; quantity of units supplied shall be as needed to meet requirements as specified and as shown on Contract Documents.

1.5 PERMITS, LAWS, ORDINANCES AND CODES

A. Contractor shall obtain and pay for permits, inspections, licenses and certificates required for work under this Division.

B. Complete Utility connections as indicated or needed, extension to Project, metering as required, and connection to building systems, including:

1. Apply for all services and pay for all fees, assessments and charges of the Utility for each connection, all in a timely manner and according to the Project Schedule.

2. Provide and install all metering equipment and accessories as required by Utility. Install entire service in accordance with the Utility's requirements or other applicable regulation.

3. Coordinate with Utility to determine scope of work provided by Utility and the part provided by Contractor so that a complete Utility connection is made.

4. Schedule all work required by utility companies in order to maintain project schedule.

C. Contractor shall pay utility company charges associated with work of this Division.

D. Contractor shall comply with laws, ordinances, rules and regulations of Local, State and Federal authorities having jurisdiction; and shall comply with rules and regulations of National Board of Fire Underwriters, National Electrical Code and local utility companies.

E. Contract Documents shall govern whenever they are more stringent than Code requirements.

1.6 SHOP DRAWING SUBMITTALS

A. Prepare and submit Shop Drawings through the Contractor to the OWNER'S REPRESENTATIVE for review.

B. The selection and intention to use a product specified by name shall NOT excuse the need for timely submission of shop drawings for that product.

C. Prior to submitting shop drawings, submit for review preliminary list of intended or proposed manufacturers for all items for which shop drawings are required.

D. Submission of shop drawings of an unnamed manufacture or shop drawings at variance with the Contract Documents is NOT a proper request for substitution.

E. Samples that are submitted in lieu of shop drawings shall be clearly identified and shall be submitted in duplicate. Only one sample will be returned and that accepted sample shall be kept available at appropriate job site office. Accepted sample retained by OWNER'S REPRESENTATIVE will be kept available at OWNER'S REPRESENTATIVE's home office.

F. Submittals shall include the following information:

1. Descriptive and product data necessary to verify compliance with Contract Documents.

2. Manufacturer's specifications including materials of construction, metal gauge, thickness and finish.

3. Certified dimensional drawings including clearances required for maintenance or access.

4. Performance data, ratings, operating characteristics, and operating limits.

5. Electrical ratings and characteristics.

6. Wiring and control diagrams, where applicable.

7. Certifications requested, including UL label or listing.

8. List of accessories which are required but are NOT being provided by the product manufacturer or are NOT being furnished under this Section. Identify the Section(s) under which the accessories are being furnished.

G. In addition, submittals shall be clearly marked for the following:

1. Specification Section and Paragraph, or Drawing Schedule/Note /Detail/etc., where equipment is specified.

2. Equipment or fixture identification corresponding to that used in Contract Documents.

3. Accessories and special or non-standard features and materials which are being furnished.

1.7 PRODUCT SELECTION

A. Contractor's options for selecting products are limited by Contract Document requirements and governing regulations and are NOT controlled by industry traditions or procedures experienced by Contractor on previous construction projects. Required procedures include, but are NOT necessarily limited to, following various methods of specifying:

1. Single Product Manufacturer Named: Provide product indicated.

2. Two or More Manufacturers' Products Named: Provide one of the named products, at Contractor's option, but excluding products which do NOT comply with requirements.

3. "Acceptable equivalent" or "Or Equal": Where named products are accompanied by this term or words of similar effect, provide one of named products or proposed substitute products.

4. Standards, Codes and Regulations: Where specification requires only compliance with a standard, code or regulation, Contractor may select any product which complies with requirements of that standard, code or regulation.

5. Performance Requirements: Provide products which comply with specific performances indicated and which are recommended by manufacturer (in published product literature or by individual certification) for application intended. Overall performance of product is implied where product is specified with only certain specific performance requirements.

6. Prescriptive Requirements: Provide products which have been produced in accordance with prescriptive requirements using specified materials and

components, and complying with specified requirements for fabricating, finishing, testing and other manufacturing processes.

7. Visual Matching: Where matching with an established material is required, OWNER'S REPRESENTATIVE's judgement of whether proposed product matches established material shall be final.

8. "Color as Selected by OWNER'S REPRESENTATIVE": Unless otherwise noted, where specified product requirements include "color as selected by OWNER'S REPRESENTATIVE" or words of similar effect, the selection of manufacturer and basic product complying with Contract Documents is Contractor's option and subsequent selection of color is OWNER'S REPRESENTATIVE's option.

B. Inclusion by name, of more than one manufacturer or fabricator, does NOT necessarily imply acceptability of standard products of those named. All manufacturers, named or proposed, shall conform, with modification as necessary, to criteria established by Contract Documents for performance, efficiency, materials and special accessories.

1.8 ADDITIONAL SUBMITTALS REQUIREMENT

A. The following shall be submitted in accordance with Submittal Procedures.

B. SD-02, Manufacturer's Data

1. Submittals for each manufactured item shall be current manufacturer's descriptive literature of cataloged products, equipment drawings, diagrams, performance and characteristic curves, and catalog cuts.

C. SD-13 Certificates

1. Certificates of Compliance

Submit manufacturer's certifications as required on products, materials, finish, and equipment indicated in the technical sections. Certifications shall be documents prepared specifically for this contract. Preprinted certifications and copies of previously submitted documents will not be acceptable. The manufacturer's certifications shall name the appropriate products, equipment, or materials and the publication specified as controlling the quality of that item. Certification shall not contain statements to imply that the item does not meet requirements specified, such as "as good as"; "achieve the same end use and results as materials formulated in accordance with the referenced publications"; or "equal or exceed the service and performance of the specified material." Certifications shall simply state that the item conforms to the requirements specified. Certificates shall be printed on the manufacturer's letterhead and shall

be signed by the manufacturer's official authorized to sign certificates of compliance.

2. Publication Compliance

Where equipment or materials are specified to conform to industry and technical society publications of organizations such as American National Standards Institute (ANSI), American Society for Testing and Materials (ASTM), and Underwriters Laboratories Inc. (UL), submit proof of such compliance. The label or listing by the specified organization will be acceptable evidence of compliance. In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the OWNER'S REPRESENTATIVE. In lieu of the label or listing, submit a certificate from an approved independent testing organization, adequately equipped and competent to perform such services, stating that the item has been tested in accordance with the specified organization's test methods and that the item conforms to the specified organization's publication.

1.9 INSTRUCTION TO OWNER's PERSONNEL

A. Where indicated in the technical sections, furnish the services of competent instructors to give full instruction to the Owner's personnel in the adjustment, operation, and maintenance of systems and equipment, including pertinent safety requirements as required. Each instructor shall be thoroughly familiar with all parts of the installation and shall be trained in operating theory as well as practical operation and maintenance work. Instruction shall be given during the first regular work week after the equipment or system has been accepted and turned over to the Owner for regular operation. The number of man-days (8 hours) of instruction furnished shall be as specified in each individual section.

1.10 RECORD DRAWINGS

A. Furnish and keep on the job at all times, one complete and separate set of Contract Documents of the Electrical work.

B. As work progresses, record changes, revisions and additions to Architectural and Electrical work clearly, neatly, accurately and promptly. Items to be indicated include but are not limited to:

1. Dimensional change
2. Revision to Drawing detail
3. Location and depth of underground utility
4. Revision to conduit routing
5. Revision to electrical circuitry

6. Actual equipment location
7. Ductbank size and routing
8. Location of concealed internal utility
9. Changes made by Change Order
10. Details not on original Contract Drawing
11. Information on concealed elements which would be difficult to identify or measure later

C. Indicate daily progress on these prints by coloring in the various lines, fixtures, apparatus and associated appurtenances as they are erected.

D. Approval of requisition for payment for work installed will NOT be given unless supported by record prints as required above.

E. At the conclusion of work, prepare record CAD drawings with accompanying electronic files. Submit record drawings for review by OWNER'S REPRESENTATIVE. Refer to DIVISION 1, GENERAL REQUIREMENTS for further requirements.

1.11 OPERATING AND MAINTENANCE MANUALS

A. Submit for review operating and maintenance manuals for each system or piece of equipment, at least two weeks prior to request for acceptance of same. Upon acceptance, furnish six copies of each manual (or greater quantity if otherwise specified under DIVISION 1) to Owner's Representative. Operating and maintenance manual shall include:

1. Description of Unit (System) and Component Parts, including function, normal operating characteristics and limiting conditions, performance curves, engineering data and tests, and complete nomenclature and manufacturer's number for replaceable parts.

2. Operating Procedures, including start-up, break-in, routine and normal operating instructions; regulation, control, stopping, shutdown and emergency instructions; summer and winter operating instructions; and any special operating instructions.

3. Maintenance Procedures, including routine operations, guide to trouble-shooting; disassembly, repair and reassembly; alignment, adjusting and checking; servicing and lubrication schedule, and list of lubricants; manufacturer's installation and maintenance bulletins and related information.

4. Sequence of Operation and Control Diagrams, corrected for as-built conditions.

5. Parts List, including illustrations, assembly drawings and diagrams required for maintenance, predicted life of parts subject to wear, and recommendations for stocking spare parts.

6. Copies of accepted shop drawings, charts and diagrams.

7. Names, addresses and telephone numbers of manufacturer's representative and service company.

8. Other data, as required under pertinent Sections of these Specifications.

9. Letters from each manufacturer certifying that his equipment was properly installed and is operating in accordance with manufacturer's intent.

1.12 GUARANTEE

A. Furnish standard manufacturers' guarantees for work under this Division. Such guarantees shall be in addition to, and NOT in lieu of, other liabilities under the law or by other provisions of the Contract Documents.

B. Materials, equipment and workmanship shall carry the standard warranty against defects in material and workmanship. Failure which may develop due to defective or improper material, equipment, workmanship or design shall be made good, forthwith, by and at the expense of the Contractor, including damage done to areas, materials and other systems resulting from this failure.

C. Guarantee that all elements of the systems are of sufficient capacity to meet the specified performance requirements as set forth in Contract Documents.

D. Upon receipt of notice from OWNER'S REPRESENTATIVE of a failure of system(s) or component(s) during the guarantee period, replace affected components within reasonable time period at no additional cost.

E. Guarantee period shall extend for one year from Date of Substantial Completion.

F. Before final request for payment, furnish written guarantee covering above requirements.

PART 2 PRODUCTS

2.1 GENERAL PRODUCT REQUIREMENTS

A. Products shall be undamaged and unused at time of installation and shall be complete with accessories, trim, finish, safety guards and other devices and details needed for complete installation and for intended use.

B. Where available, products shall be standard products of types which have been produced and used previously and successfully on other projects and in similar applications.

C. Labels and stamps which are required for observation after installation shall be located on accessible surfaces which, in occupied spaces, are NOT conspicuous. Other labels and stamps shall be located on concealed surfaces.

PART 3 EXECUTION

3.1 . ARRANGEMENT OF WORK

A. Consult Contract Drawings and Details for exact locations of fixtures and equipment. If exact location is not given, obtain information from OWNER'S REPRESENTATIVE. Verify measurements in field. Base measurements on established benchmarks.

B. Install work as closely as possible to layouts shown on Contract Drawings. Modify work as necessary to:

1. Provide maximum possible headroom and space clearance on each side.

2. Provide adequate clearance and ready access to all parts of the work, for inspection, operation, safe maintenance and repair, and code conformance.

3. Coordinate and arrange work to avoid conflicts with work of other trades, to avoid unnecessary cutting and patching, and as needed for satisfactory space conditions shown on coordination drawing submittals.

4. Where space appears inadequate, consult OWNER'S REPRESENTATIVE before proceeding with installation.

C. Work shall present a neat coordinated appearance.

3.2 COORDINATION

A. Examine Contract Documents and coordinate with Contractor and other trades as necessary to facilitate the progress of the work.

B. Each trade shall keep Contractor and other trades fully informed as to shape, size, and locations of openings, chases, equipment, panels, access doors, sleeves, inserts and anchor bolts required; whether temporary or permanent. Coordinate sizes, depths, fill and bedding requirements with excavation trades. Give sufficient advance notice so that coordination may be completed in advance. If information is not furnished in proper and timely fashion, the trade involved shall do own cutting and patching or have same done by Contractor, without additional cost to the Owner.

C. Particular emphasis is placed on timely installation of major apparatus and furnishing of other trades and Contractor with relevant information.

D. Do NOT install a system until critical components of system and related systems have been coordinated and applicable shop drawings have been accepted.

3.3 WORKMANSHIP

A. Work covered under this Division shall be constructed and finished in every respect in a workmanlike and substantial manner.

B. Equipment and materials shall be new, of first quality, selected and arranged to fit properly into spaces indicated.

C. Obtain detailed information from manufacturer as to proper methods for installation and connections. This includes such tests as equipment manufacturer recommends. Where documentation regarding installation is NOT obtainable, work shall be installed in accordance with best trade practice.

1. Unless specifically indicated otherwise on Contract Documents, equipment and materials shall be installed in accordance with manufacturer's recommendations.

2. Notify Owner's Representative of conflicts between manufacturer's recommendations and Contract Documents requirements, and request clarification before proceeding with installation.

D. Where equipment, piping, ductwork, conduit, etc. is exposed, color of finish or paint shall be as selected by OWNER'S REPRESENTATIVE.

3.4 OPERATION OF SERVICES AND UTILITIES

A. During the construction period and until finally inspected, tested and accepted, maintain new services and utilities.

B. Shutdown of existing services and utilities shall, without exception, be coordinated with the proper utility and with the OWNER'S REPRESENTATIVE as to date, time of day, and duration.

1. Notify OWNER'S REPRESENTATIVE of estimated duration of shutdown period at least ten days in advance of date when shutdown is proposed. Approval of shutdown shall be obtained from proper utility and OWNER'S REPRESENTATIVE, before any service is interrupted.

2. Work during shutdown period shall be arranged for continuous performance, including overtime if required, to ensure that existing operating services will be shut down only for time actually necessary to complete connections.

3.5 PROTECTION

A. Contractor shall be responsible for work and equipment until fully inspected, tested and accepted. Carefully store materials and equipment which are not immediately installed after delivery to site. Close open ends of work with temporary covers or plug during construction to prevent entry of obstructing material or damaging water.

B. Protect work and material of other trades from damage that might be caused by electrical work and make good damage thus caused.

3.6 IDENTIFICATION

A. Basic materials such as piping, tubing, sheet metal, insulation, etc., shall have following information clearly printed on the material: manufacturer's name, material grade, gauge, thickness, type, and data to identify required methods of attachment; as applicable. Unmarked material shall NOT be used.

B. Permanent nameplates shall be provided on each piece of service-connected or power-operated equipment, on easily accessible surface. Nameplate shall include product name, model number, serial number, capacity, speed, ratings, and similar essential operating data.

1. Manufacturer's nameplate, name, trademark and address shall be attached permanently to equipment and material furnished. Nameplate showing distributor or Contractor will NOT be permitted.

2. Unless otherwise specified or requested, letters and numbers shall be ½" high.

3. Attach nameplates with screws or rivets. Wherever covers of adjacent units are interchangeable, attach nameplates to wall or backboard rather than covers.

C. Identification labels shall be provided to number equipment according to designations used in Contract Documents. Label shall be plastic nameplate with letters and numbers 1-1/2" high. Furnish directory indicating number, location and use of each item. After finish painting is completed, apply identification label where it will be readily visible from normal operating position on floor.

3.7 LUBRICATION

A. Equipment shall be furnished and installed so that lubrication points are conveniently and readily accessible for maintenance. Make these provisions by whatever means is appropriate: extended fittings, access doors, equipment location, etc.

B. No equipment shall be operated for temporary service or for testing purposes without proper lubrication. Items requiring lubrication shall be left freshly and fully lubricated at time of substantial completion.

C. Prior to substantial completion, deliver to OWNER'S REPRESENTATIVE, along with itemized list: one complete new set of special lubrication devices required for servicing, such as grease guns, fittings and adapters.

3.8 ATTACHMENT OF SUPPORTS TO BUILDING STRUCTURE

A. Equipment shall be securely attached to building structure in acceptable manner. Attachments shall be of strong and durable nature.

B. Attachment of supports to roof decking is NOT permitted. Pipes, ducts, boxes, etc. must be supported from bar joists or steel construction or additional members spanning roof steel as determined by structural engineer.

3.9 TESTS

A. Make final adjustments to equipment before testing. Manufacturer's authorized representative shall verify proper installation and adjustment prior to startup of major equipment; refer to paragraph 1.11.A.9.

B. Furnish labor, materials, instruments, supplies and services necessary for testing required under this Division. Correct defects appearing during tests, and repeat tests until no defects are disclosed. Final tests shall be made in OWNER'S REPRESENTATIVE's presence.

C. Use true RMS ammeter to measure current, for equipment which may have harmonic (non-linear) load component.

D. Notify OWNER'S REPRESENTATIVE of testing schedule at least 48 hours in advance of tests.

E. Perform specified tests and tests required by legal authorities and by agencies having jurisdiction over this Work. Tests shall be performed to the satisfaction of legal authorities, agencies having jurisdiction, and OWNER'S REPRESENTATIVE.

F. Each piece of equipment, including motors and controls, shall be operated continuously for minimum test period of one hour.

G. If manufacturer's startup services are specified under other Sections in this Division, furnish services of factory-trained service engineering representative to provide following. If manufacturer's startup services are not required, Contractor shall furnish following services.

1. Inspection of equipment/system installation.

2. Assistance in initial startup and adjustment of equipment; including necessary time to achieve proper installation and adjustments.

3. Instruction of OWNER's staff; see paragraph 3.10, INSTRUCTIONS.

H. Upon completion of tests, demonstrate the following:

1. Equipment and systems are installed and operating in accordance with manufacturer's specifications and instructions and with Contract Documents.

2. Proper adjustment of equipment and systems.

3. Systems are properly cleaned and free of contaminants.

4. Systems are properly phase balanced.

5. Circuits and motorized equipment are equipped with proper overload protection and are not operating under overload.

6. Instruments are recording properly.

3.10 INSTRUCTIONS

A. Arrange for each installer of work requiring continuing maintenance or operation, to meet with OWNER's personnel at project site and instruct them in the operation and maintenance. Include instruction by manufacturer's representatives where installers are not expert in the required procedures. Instruction periods for all trades shall be minimum of 8 hours total; refer to individual SECTIONS for further requirements.

B. Instruction shall include review of maintenance manuals, record documentation, tools, spare parts and materials, lubricants, fuels, identification system, control sequences, hazards, cleaning and similar procedures and facilities.

C. Start-up, shut down, emergency operations, noise and vibration adjustment, safety, economy/efficiency adjustments, and similar operations shall be demonstrated.

D. Applicable warranties shall be reviewed.

E. Procedures for routine maintenance shall be demonstrated at the equipment involved, to ensure accessibility to components involved.

3.11 QUIET OPERATION

A. Equipment and material provided as part of the Work shall NOT produce sound level greater than 55 decibels (or level required by Code, if more stringent) in adjacent occupied areas. Sound level shall be as measured on A-weighting scale of sound level meter or sound survey meter.

B. Methods described in ASHRAE guide and data books may be used to determine sound level of equipment when total of background sound and equipment sound exceeds the required minimum.

C. Contractor shall ensure that equipment and materials provided as part of the Work do NOT produce excessive noise/vibration and do NOT transmit excessive noise/vibration to occupied spaces. If objectionable noise/vibration occurs, Contractor shall provide systems, devices, and equipment necessary to eliminate objectionable noise/vibration at no additional cost to OWNER.

3.12 FINAL CLEANING

A. Clean each surface of each unit of work, to normal "clean" condition expected for a first-class building cleaning and maintenance program. Comply with manufacturer's instructions for cleaning operations. The following are examples, but not limitations, of cleaning required:

1. Remove labels which are not required as permanent labels.

2. Clean transparent materials, removing substances which are noticeable as vision-obscuring.

3. Clean exposed hard-surfaced finishes, until free of dust, stains, films and similar noticeable substances.

4. Wipe surfaces of mechanical and electrical equipment clean, remove excess lubrication and other substances.

5. Remove debris and surface dust from limited-access spaces such as plenums, shafts, and ceiling spaces.

6. Clean lighting fixtures and lamps; removing dust, smudge marks and protective wraps; so as to function with full efficiency.

END OF SECTION

SECTION 16050

BASIC MATERIALS & METHODS - ELECTRICAL

PART 1 GENERAL

This Section covers the specification of basic materials and methods for electrical work.

1.1 SCOPE

A. Provide labor, materials, services, equipment and transportation necessary for complete and operational electrical systems as indicated on Contract Drawings and specified herein, including but not limited to following:

1. Complete secondary service and distribution system, including:

   a. Panelboards
   b. Conduits, wires and cables
   c. Feeders and branch circuits
   d. Distribution transformers
   e. Switches and boxes
   f. Power and control wiring
   g. Wiring devices

2. Disconnects, and controls not integral with or specialized for equipment.

3. Installation of, and power wiring to and from: disconnects, controls and lighting.

4. Removal and relocation of existing feeder conduit, wire, distribution equipment, light fixtures, switches, receptacles, branch wiring, alarm systems, etc., as shown and required to accommodate alteration work.

5. Hangers and supports

6. System identification

7. Record drawings

8. Operating and maintenance manuals

1.2. STANDARDS

A. All work of this Division shall conform to following standards:

1. IES: Lighting Handbook.

2. NEMA Standards.

3. ANSI Standard CI: National Electrical Code (NFPA 70).

4. ANSI Standard C50: Rotating Electrical Machinery.

5. ANSI Standard C501-1: Construction and guide for selection, installation and use of electric motors.

6. ANSI Standard C52.1: Motors and generators (NEMA MG1).

7. ADA: Americans With Disabilities Act

8. IEEE: Standards 81, C62.41, C57.105 and C37.13.

9. GSA: US General Services Administration Standards

1.3 UNDERWRITERS LABORATORIES LABELS

A. Equipment, materials and components, for which there are listings in UL Product Directories, shall bear UL labels.

1.4 GENERAL

A. The installation shall conform to the requirements of NFPA 70 and NFPA 101, unless more stringent requirements are indicated herein or shown.

B. The drawings indicate the extent and the general location and arrangement of equipment, conduit, and wiring. The Contractor shall become familiar with all details of the work and verify all dimensions in the field so that the outlets and equipment shall be properly located and readily accessible. Lighting fixtures, outlets, and other equipment and materials shall be located to avoid interference with mechanical or structural features; otherwise, lighting fixtures shall be symmetrically located according to the plan arrangement when uniform illumination is required, or asymmetrically located to suit conditions fixed by design as shown. If any conflicts occur necessitating departures from the drawings, details of and reasons for departures shall be submitted and approved prior to implementing any change. The Electrical Contractor shall coordinate the electrical work with electrical drawings and provide all power related wiring even if they are not shown on electrical drawings.

PART 2 PRODUCTS

2.1 CONDUIT, CABLE AND FITTINGS

A. Rigid conduit (RMC) shall be UL listed, hot dipped galvanized steel with full cut hot dipped galvanized NPT threads. RMC shall be chromated on all surfaces for corrosion and abrasion protection. Connectors and couplings shall be galvanized steel threaded type listed for RMC use. RMC shall be used for all exterior exposed conduit.

B. Intermediate metal conduit (IMC) shall be UL listed, hot galvanized steel with full cut hot galvanized NPT threads and factory-applied interior coating or lining for ease in pulling wires. Connectors and couplings shall be galvanized steel threaded type listed for IMC use.

C. Flexible metal conduit (FMC) shall be UL listed, single strip, spirally wound, corrosion-resistant, galvanized steel acceptable equivalent to Liquatite "Type BR". Use galvanized steel fittings and clamps listed for FMC use.

D. Type HFC cable shall be listed, 600 V, 90°C rated, flexible metal encased multi-conductor assembly; with cable sheath of interlocked galvanized steel strip, copper conductors with Code gauge THHN insulation and internal green insulated ground: acceptable equivalent to AFC "Type HFC-90". Connectors and fittings shall be galvanized steel, listed for HFC cable use.

E. Non-metallic conduit (NMC) shall be rigid PVC, heavy-wall Schedule 40, UL rated, acceptable equivalent to Carlon "Type 40".

F. Minimum Sizes shall be as follows:

1. Conduit: ¾" unless otherwise noted.
2. Flexible metal conduit: ½".

G. Special Fittings

1. Where conduit penetrates walls or in hazardous (classified) locations: provide sealing fittings acceptable equivalent to Crouse-Hinds "EYS Series".

2. Where conduit penetrates waterproof foundation, floor or roof: provide through-wall seals acceptable equivalent to O.Z./Gedney "Type CSMI" on each side of existing walls and O.Z./Gedney "Type FSK" on new walls.

3. Where conduit from underground distribution system enters building, provide cable terminators acceptable equivalent to O.Z./Gedney "Type CR". Fill the compound chamber with insulating compound acceptable equivalent to O.Z./Gedney "Dozseal #220".

4. Where conduit is exposed at building expansion joint: provide expansion fittings acceptable equivalent to O.Z./Gedney "Type EX" or "Type EXE".

5. Where conduit is in concrete at building expansion or seismic joint and where conduit is exposed at seismic joint: provide expansion/deflection fittings acceptable equivalent to O.Z./Gedney "Type DX".

H. Applications shall be as follows:

1. RMC: exterior exposed, underground or below grade, buried in or below floor slabs, in concrete walls, concealed in exterior masonry walls, wiring in fire pump rooms.

2 IMC: interior as specified for rigid conduit, except not in hazardous locations, fire pump rooms or applications over 600 V.

3. FMC: final connections to motors and equipment-mounted controls from minimum of 18" to maximum of 6 feet lengths.

4. NMC: underground duct bank concrete encased, sleeves and elsewhere where designated.

9. In any case not specifically covered, rigid conduit shall be used unless otherwise approved by the Owner's Representative.

10 EMT is NOT permitted as a substitute for rigid conduit; MC is NOT permitted as a substitute for flexible metal conduit.

11 AC (BX) cable shall NOT be used.

2.2 PULL BOXES AND JUNCTION BOXES

A. Boxes shall be heavy, stamped steel with covers attached by screws. Provide locknuts for conduit size to which boxes are connected. In finished areas, boxes shall have neatly mitered frame and flush steel cover screwed to the frame.

B. Boxes shall be sized according to NEC.

C. Boxes shall be flush mounted where installed with concealed conduit, and surface mounted elsewhere.

2.3 OUTLET BOXES

A. Where conduit is exposed: switch outlet boxes, plug outlet boxes and fixture outlet boxes shall be acceptable equivalent to Crouse-Hinds "Type FD", with covers to fit devices use.

2.4 BACKBOARDS & EQUIPMENT CABINETS

A. Backboards shall be ¾" plywood painted on all sides before installation. Paint shall be one coat primer and two coats latex fire-retardant gray paint acceptable equivalent to Benjamin-Moore "Retardo 220". Backboards shall be used for mounting grouped switches, starters and other equipment where shown on Contract Drawings.

B. Telephone and equipment cabinets shall be UL listed, sheet steel cabinet with hinged door with catch and lock; mounted on backboard. Cabinets shall be flush or surface-mounted, sized as shown on Contract Drawings.

2.5 CONDUIT HANGERS AND SUPPORTS

A. Hangers, clips and accessories supporting conduit shall be UL listed and hot dipped galvanized.

B. Individual large conduits shall be supported by means of adjustable, malleable hangers of acceptable design placed on maximum 8'-0" centers. Individual small conduits may be held in place by one hole malleable clips.

2.6 WIRES AND CABLES

A. Secondary conductors shall be new copper with 600 V code gauge insulation, conforming to NEC requirements, and shall be Type THWN or THHN, except as follows:

1. Type XF or SFF 150 deg C shall be used for fixture wiring.

2. Ground wires shall be in accordance with NEC.

3. Type XHHW shall be used for conductors #3 AWG and larger.

4. Type TFE shall be used for high temperature applications.

B. When wire sizes are not shown on Contract Drawings, sizes shall be in accordance with NEC but no smaller than following:

1. Light and power wiring: #12 AWG.

2. Control wiring: #14 AWG.

3. Wiring and cable for alarm and signal systems: as recommended by equipment manufacturer.

C. All multi-purpose feeders and circuits shall include a full size neutral and separate insulated ground conductor.

1. All 277/120 VAC circuits shall include separate full sized neutral and insulated ground conductors. Shared neutrals or ground conductors are not permitted.

2.7 SPLICES

A. Splices for #10 or smaller wires shall be made with UL approved solderless connectors: spring type acceptable equivalent to Minnesota Mining and Manufacturing Company "Scotchlock"; or crimp-type acceptable equivalent to Thomas & Betts "Sta-Kon".

B. Splices, cable taps and terminals for #8 and larger shall be made with UL approved compression connectors: compression taps acceptable equivalent to Thomas & Betts "Colored Keyed" "C" taps applied with special tools according to manufacturer's recommendations; or bolted pressure connectors, bronze or copper construction, by Thomas & Betts, Burndy or acceptable equivalent.

C. Splices for M.I. cable shall comply with the manufacturer's recommendations.

2.8 LIGHT SWITCHES

A. Switches shall be ivory, unless noted otherwise, 20 A, UL labeled and rated for 120/277 V operation; with ground screw or self-grounding clip.

B. Light switches shall be acceptable equivalent to manufacturer's industrial-institutional heavy-duty specification grade switches listed below. Acceptable manufacturers are Arrow-Hart, Bryant, Hubbell, Leviton, P&S, or acceptable equivalent.

1. Single pole switches: Hubbell #1221-I.

2. Three-way switches: Hubbell #1223-I.

3. Four-way switches: Hubbell #1224-I.

4. Switches with pilot lights: as specified above, with Arrow-Hart #1720 (120 V).

5. Weatherproof switches: As specified above; with Crouse-Hinds "Type DS-185" cover plate on FS box or FD box, OR with Hubbell #7420 cover plate, fiber shield on FS box or FD box.

2.9 RECEPTACLES

A. Receptacles shall be ivory unless noted otherwise. Receptacles wired to emergency circuits shall be red.

B. Receptacles shall be acceptable equivalent to manufacturer's specification grade listed below and shall include grounding screw terminal. Acceptable manufacturers are Arrow-Hart, Bryant, Hubbell, Leviton, P&S, or acceptable equivalent.

1. Receptacles for general use (120 V): 20 A, duplex-grounding type, Hubbell #CR5362-I.

2. Safety type, tamper-proof receptacles: 20 A, hospital grade, tamper-resistant, duplex-grounding type, Hubbell HBL8300SGI.

3. Receptacles for exterior or wet locations: weatherproof Crouse-Hinds FS box with Hubbell "Rayntite" (raintight while in use) aluminum padlockable enclosure and with duplex receptacles as specified for general use.

C. Ground Fault Circuit Interrupter branch breakers shall be 20 A single-pole molded case circuit breakers with neutral pigtail; shall sense current unbalance between branch circuit and its neutral and shall trip upon unbalance; shall be Class "A", 5 mA sensitivity; and shall be by same manufacturer as panelboards.

D. Ground Fault Circuit Interrupter (GFI) receptacles shall be NEMA 5-20R, Class "A", 5 mA sensitivity; Arrow-Hart #GF5342-I, Hubbell #GF5342-I, or acceptable equivalent.

2.12 SOLID STATE, DIGITAL TIME SWITCHES

A. Provide automatic solid-state digital 24-hour time switch capable of providing single channel, pre-programmed automatic startup and shutdown control of two loads: Tork #DG180 or acceptable equivalent by Paragon or Intermatic; with following features:

1. LCD display indicating time-of-day (AM/PM or 24-hour format), day-of-week, and on-off status.

2. User-selectable daylight savings time or standard time

3. Automatic leap year compensation.

4. Manual on-off override

5. Clock input power voltage, as noted on Drawings

6. Indoor/outdoor NEMA 3R enclosure.

7. Automatic battery backup, minimum 175 hours, from 9 V lithium or alkaline battery. Battery shall be accessible from front of switch.

PART 3 EXECUTION

3.1 SUPERVISION

A. Furnish services of experienced electrical Superintendent who shall be constantly in charge of electrical work, together with skilled laborers required to unload, transfer, erect, connect, adjust, start, operate and test each system.

B. Particular emphasis is placed on timely installation of major apparatus and furnishing of other trades and Contractor with relevant information.

3.2 CONTROL CIRCUIT WIRING

A. Provide wiring required for electrical equipment furnished under other Divisions of this Specification. Provide disconnects ahead of each piece of equipment, unless specified otherwise.

B. Check all protective and control equipment furnished or installed under this Division. Ensure that such equipment is properly sized for electrical equipment that it serves. Replace any material or equipment damaged due to improperly-sized protective control mechanisms.

3.3 IDENTIFICATION

A. Distribution Equipment

1. All distribution equipment and associated electrical elements of mechanical equipment shall be identified according to the designations used in the Contract Documents or established in cooperation with the Owner's Representative as part of the as-built record drawings. Furnish directory indicating number, location and use of each item. Equipment requiring such numbering includes, but is not limited to the following:

    a. Overcurrent protection device enclosures
    b. Disconnect switches
    c. Panelboards
    d. Transformers
    e. Equipment control panels and enclosures
    f. Special systems, alarm and communication terminal cabinets and enclosures.

2. Nameplates/Labeling: Center on device, coverplate or enclosure. Place on non-removable surface.

    a. Use abbreviations defined in the contract documents whenever possible. Use plan designations for labeling, unless indicated otherwise. Indicate loads served using designating from electrical schedules and designations from the trade furnishing the equipment served.

    b. Label the following with engraved lamicoid nameplates:

c. Install nameplates inside covers in finished areas and outside covers in unfinished areas including mechanical, electrical and building maintenance areas.

3. Manufacturer's nameplate, name, trademark and address shall be attached permanently to equipment and material furnished under this division. Nameplate showing distributor or contractor will not be permitted.

4. Equipment designation nameplates shall be engraved lamicoid, sized as follows:

   a. Nameplates on panelboards, distribution panels and service switches: minimum of 1-1/2" by 2-1/2" size with name letters not less than 1/2" high and voltage, phase and number of wires not less than 1/4" high.

   b. Nameplates on starters and other equipment switches and devices: minimum of 3/4" by 2-1/2" size with letters not less than 3/8" high.

5. Attach nameplates with rivets. Wherever covers of adjacent units are interchangeable, attach additional nameplates to wall or backboard adjacent to covers.

6. Panelboard circuit identification: engraved plastic nameplates for units without panel cover doors, or plastic covered circuit directory cards, type written, mounted on the inside of the panel cover doors.

7. Acceptable manufacturers for nameplates are Lamicoid, Seton or Brady.

B. Distribution Raceway Systems

1. Distribution raceway systems shall require system identification and shall include, but is not limited to the following:

   a. Conduit systems

   b. Pull boxes and junction boxes

2. Marker pen labeling shall be utilized on conduit and cable system junction boxes. Marker pen labeling methods shall be submitted for review prior to execution. Spray painting shall not be permitted. Systems requiring such identification include and shall be limited to the following:

   a. Junction boxes or portions of junction boxes containing 277/480 volt or 120/208 volt wiring.

   b. Communication and special system pull and junction boxes

   c. Pull boxes and junction boxes installed for future use.

3. Marker pen labeling shall be on outside of junction and pull box coverplates and on the box itself in unfinished areas including mechanical, electrical and building maintenance areas and inside covers in finished areas.

4. Marking pen where used shall be permanent, waterproof and quick drying.

5. Conduits contain essential power system feeders and branch circuits shall be identified by attaching red vinyl adhesive backed decal with 1/2' high black letters on 1" high labels identifying essential power within 1'-0" of each termination or pull box and a minimum of every 25 feet of conduit run. Referenced labels shall be by Seton.

6. Acceptable manufactures for underground warning tape, identification decals and vinyl adhesive backed labels are Seton or Brady.

7. Alarm system, junction boxes and recovery couplings shall be painted red. Provide vinyl label indicating fire alarm every 25 feet and at terminations.

C. Conductor and Cabling Systems

1. Label tapes: Use for feeder, branch circuit control and special system conductors throughout. Indicate feeder and branch circuit number son both feeders and branch circuit conductors and terminal block termination numbers for control and special system conductors. Label conductors at origin and destination points and at all junction boxes, pull boxes and cable branch off points where installed in cable trough, wireway, monotray, cable ladder, etc.

D. Conductors size #6 and smaller shall have solid color insulation for identification.

E. Conductors size #4 and larger shall have color identification, six inches minimum length near termination and in splice boxes, junction boxes, panels and manholes. Identification shall be by solid color insulation, tape or paint.

I. Devices

1. Device plates for light switches, receptacles and miscellaneous other devices connected to essential branches of the distribution system shall be stainless steel unless otherwise noted. The required red color coding shall be integral within the device itself.

2. Device plates for medical and housekeeping receptacles, light switches and miscellaneous other devices connected to the "normal branches" of the distribution system shall be stainless steel unless otherwise noted.

3. Wall plates provided for flush-mounted control switches in finished areas, excluding light switches, shall be engraved, stainless steel with black-filled letters. Device switches shall be color coded according to essential or normal power systems, as identified in other sections of this specification.

4. Label all electrical outlets including electrical outlets furnished as an integral part of furniture and fittings with supply panel and circuit breaker designation, both on cover and tag wiring inside box. In general identification label shall be affixed to outside of cover plate. Label shall be engraved lamicoid

5. Engrave nameplates of receptacles wired to GFI breakers to read "GFI" adjacent to or above receptacle opening.

6. Engraved letter characters for device outlet labels shall be a minimum of 3/16" high.

7. Attached device nameplates with rivets only, adhesive backed labels are not permitted.

8. Acceptable Manufacturers: Nameplates, wall plates and conductor tape within device back box: Seton, Brady.

9. Low Voltage Cabling Systems Color Code

   a. Cable jacket colors and labeling for the following systems shall be the following standards:

      (1) Level Sensing - Brown
      (2) Alarm - Red

3.4 ACCESSIBILITY, ACCESS PANELS AND ACCESS DOORS

A. Locate equipment which must be serviced, including switches, panels and junction boxes, in accessible locations if at all possible. For other locations, furnish access panels as described under DIVISION 1.

B. During project closeout, Contractor shall perform walk-through identifying and demonstrating access to equipment for service and/or replacement. Walk-through shall be arranged at times convenient for the Owner's Representative to attend.

   1. Equipment with insufficient access shall be relocated or provided with additional access panels at no additional cost to the Owner

   2. Trade responsible for access problem shall be responsible for costs of access modifications. In general, this shall be understood to be the trade installing the equipment. If access problem was caused by architectural layout changes which

occurred subsequent to equipment installation, cost of access modifications shall be borne by trade responsible for architectural changes.

3.5 WATERPROOFING

A. Provide necessary sleeves, caulking and flashing required to make openings waterproof.

3.6 INSTALLATION OF CONDUIT, BOXES AND FITTINGS

A. Ends of conduits shall be reamed before assembly, and bushings and locknuts shall be provided where conduits connect to boxes.

B. Boxes shall be set plumb and square with the tank. Exposed conduit shall run parallel to tank lines, unless noted otherwise.

C. Conduit shall run to avoid low pockets which might collect water, and, during installation, open ends shall be capped.

F. RMC buried in grade or in ductbanks shall have couplings made up tight. Thread to coupling joint shall be coated heavily with bitumastic paint, ensuring watertightness.

G. Parallel groups of conduit shall be supported from below, either by horizontal angle irons or channel systems such as "Unistrut", with vertical hanger rods at appropriate intervals.

H. Supports for conduit on concrete walls shall be attached to wall either with all metal expansion shields or explosive-type inserts, as permitted.

I. Conduits in slabs or in grade shall be swabbed internally prior to pulling wire or cable.

J. Final connections to control devices mounted on equipment, vibrating equipment and vibration isolated equipment shall be made through liquid-tight flexible metal conduit.

K. Use standard radius bends on concealed conduit; on exposed work, use either standard bends or "L" type fittings acceptable equivalent to Crouse-Hinds.

Q. Field cut IMC and RMC conduits shall be field threaded. Field threads to be cold galvanized by brush or spray. Cold galvanize to be minimum 95% zinc and shall cure before attaching to threaded fitting. Set screw and compression fittings shall not be acceptable.

3.7 INSTALLATION OF CABLES

A. Installation of M.I. cable shall follow the manufacturer's recommendations and as follows:

1. Examination

   a. Verify that cable and factory temporary seals have remained intact, that the insulation has not been exposed to air, and that no moisture has entered cable insulation.
   b. Verify that work of other trades likely to damage cable has been completed.

2. Storage

   a. Cable shall be shipped from the manufacturer with ends temporarily sealed against moisture ingress.
   b. When cables are cut in the field, the end shall be sealed using standard sealing compound and PVC tape.
   c. Cable shall be stored in a clean dry location.

3. Handling

   a. Cable shall be uncoiled by rolling and rotating supply reel. Do not pull from coil periphery or center.
   b. Take precautions necessary to prevent damage to cable from contact with sharp objects, including pulling over foreign material or sheaves.

4. Bending:

   a. Not less that five (5) times the cable diameter for cable not more than 3/4 inch (250 kcmil).
   b. Not less than ten (10) times the cable diameter for cable more than 3/4 inch (350 and 500 kcmil).

5. Pulling:

   a. For all cables up to and including #1 AWG use ten inch (250mm) or larger sheaves.
   b. For #1.0 through 250 kcmil inclusive, use 18 inch (460mm) or larger sheaves.
   c. For 350 kcmil and larger cables, use 24 inch (590mm) or larger sheaves.
   d. On pulls of over 360 degrees, contact manufacturer for assistance.
   e. 350 and 500 kcmil cables shall not be pulled more than 360 degrees in total.

6. Splicing:

   a. All fire rated spices shall be made in the factory.
   b. In the event a field splice is necessary, it must be approved by the Resident Engineer (RE) and:

      (1) made in the field by manufacturer's field technician, or
      (2) made in the field by personnel trained by the cable manufacturer using

manufacturer's components.

7. Terminations:

   a. Field made terminations shall be made with cable manufacturer's termination kits only. Stripping tools, crimping and compression tools available from the manufacturer shall be used for proper cable termination.

   b. Terminations must be completed immediately once started to avoid moisture ingress from surrounding air. Prior to completing each termination, test insulation resistance and follow manufacturer's drying procedures until insulation resistance reaches an acceptance level.

   c. Connections to ferrous cabinets for single conductor cables shall incorporate brass plates 1/4 inch (6mm) thick by 4 inch (100mm) wide by length as required with 2 inch (12mm), 3/4 inch (19mm), 1 inch (25mm) per 1-1/4" inch (32mm) drilled and tapped holes. Install per manufacturers' drawing.

8. Sheath induction reduction:

   a. When multi-phase circuits have paralleled single conductors, cables shall be run in groups having one of each phase and neutral in each group.
   b. Each set of paralleled conductors shall be separated by at least two single cable diameters.
   c. Each group of cables shall be fastened tightly together, at least once between each support on horizontal runs and twice on vertical runs, using 2 inch (13mm) wide by 0,030 inch (0.75mm) thick stainless steel straps.

9. Exposed or Surface installations:

   1. Cable may be secured directly to fire rated building structure using an approved method such as one, or any combination, of the following:

      (1) Straps: 2 inch (13mm) wide x 3-1/2 inch (38mm) long by 0.030 (0.75mm) thick stainless steel or copper straps. Each strap shall contain two 1/4 inch (6mm) holes for securing with 3/16 inch (5mm) by minimum 1-3/4 inch (44mm) long steel anchors.
      (2) Steel struts and cable tray: Use only the steel strut framing system and support recommended by Pyrotenax. Aluminum or other materials are not acceptable.
      (3) Other approved method.

   b. Cable supports shall not exceed three (3) feet on center horizontally, or six (6) feet vertically.
   c. Cables shall be installed parallel to building lines.

10 Wall or floor penetrations:

a. Provide sleeve to protect cable and penetration opening during pulling.
b. Provide approved sealing of all penetrations.

11. Neatly train and lace cable inside boxes, equipment, and switchboard.

12 Field Quality Control

a. Inspect cable for physical damage and proper connection.
b. Measure tightness of bolted connections and compare torque measurements with manufacturer's recommended values.
c. Verify continuity of each conductor.
d. Prior to energizing cables, measure insulation resistance of each cable. Tabulate and submit for approval.
e. Provide certification from cable manufacturer that installation is in accordance with their requirements.

3.8 SLEEVES, INSERTS AND ANCHOR BOLTS

A. Furnish, set in place, coordinate and be responsible for location of sleeves, inserts and anchor bolts required for work of this Division. If work is not completed in coordination with work of other trades, trade involved shall do cutting and patching required or have same done, at no additional cost to FAA.

B. Conduits passing through floors, walls or partitions shall be provided with sleeves which have internal diameter one inch larger than outside diameter of conduit and insulation, if any.

C. Sleeves through outside walls shall be cast iron, with intermediate integral flange. Sleeves shall be set with ends flush with each face of wall. Provide oakum packing between sleeve and conduit, to within two inches of each face of wall; pack remaining space with waterproof compound.

D. Sleeves through fire-rated concrete floors or interior masonry walls shall be Schedule 40 steel pipe; sleeves through concrete floors or interior masonry walls which are not fire-rated shall be Schedule 40 PVC. Sleeves shall be flush with finished wall, flush with finished ceiling, and extended two inches above finished floor.

E. Sleeves through interior partitions shall be Schedule 40 PVC, set flush with finished surfaces of partitions.

F. Inserts shall be of pressed steel construction, with accommodation for removable nuts and threaded rods up to ¾" diameter, permitting lateral adjustment. Inserts shall be by Carpenter and Patterson, Grinnell or acceptable equivalent.

1. Individual inserts shall open at top, permitting reinforcing rods up to ½" diameter to pass through insert body.

2. Strip inserts shall have attached rods with hooked ends.

3.9 BASES AND SUPPORTS

A. Unless noted otherwise, provide necessary supports, rails, framing, bases and piers required for equipment furnished or installed under this Division.

B. Where mounted on the floor: Foundations, supports, pads, bases and piers shall be of the same finish quality as the adjacent flooring material.

C. Equipment supports shall be designed and constructed so that equipment will be capable of resisting both vertical and horizontal movement. Refer to SECTION 16160, SEISMIC RESTRAINT FOR ELECTRICAL SYSTEMS.

3.10 PAINTING

A. Unless otherwise specified, materials furnished under this Division shall have prime coat and standard manufacturer's finish.

B. Finish painting of exposed work and equipment is covered under Section 13100 – Field Fabricated Steel Tank and Containment

C. Paint electrical equipment and appurtenances in concealed and unfinished areas with one coat of rust-inhibiting paint or with an appropriate bitumastic protective product designed for the intended application. Asphalt paint is NOT acceptable. Items to be painted shall include, but not be limited to: non-insulated hangers, supports, piping, conduit, tanks and other ferrous metal work, which are concealed or inaccessible but not galvanized.

D. Special care shall be taken to avoid painting or spattering equipment nameplates.

E. Cooperate in identifying systems for painters. Refer to paragraph 3.3, IDENTIFICATION.

3.11 GENERAL WIRING TESTS

A. Prior to final inspection and tests: Wiring and connections shall be completed, devices and equipment shall be properly operating, power and lighting circuit and control wiring shall be clearly identified with acceptable tags, and lighting fixtures shall be installed, ready for acceptance.

B. Before devices are installed, test each wiring system for following:

1. System shall be free from short circuits.

2. System shall be free from grounds.

3. Systems at or below 600 V shall have minimum insulation resistance of 5 megohms when tested with 1000 VDC potential between conductors and between conductors and ground, for minimum of one minute, at 70 deg. F ambient temperature and reasonably dry atmosphere.

3.12 OPERATIONAL TESTS

A. Each piece of electrical equipment, including lighting fixtures, motors and controls shall be operated continuously for minimum test period of one hour.

B. Demonstrate by operating equipment that circuits and devices are in good operating condition. Each item of control equipment shall be operated minimum of five times. Demonstration shall be performed after wiring tests.

3.13 DEMOLITION: IMPACT ON EXISTING SYSTEMS

A. Changes to existing tank electrical lighting and control systems have been shown on Contract Drawings. Contractor shall anticipate that there will be changes including:

1. Relocation of small conduits.

2. Removal of existing conduit, cable, etc.

B. Disconnect and relocate small lighting and receptacle branches and other circuits, in and along walls and ceilings where new openings are being provided and where renovation work is making devices inaccessible.

C. Disconnect electrical connections to existing equipment which is to be removed or relocated, including motors light fixtures and tank level sensing equipment.

D. Remove, store and relocate electrical equipment designated to be relocated and reused.

F. Existing wiring, exposed conduit, lighting fixtures and electrical system equipment which are located in areas designated for demolition and which are not designated to remain shall be removed by the Contractor. Material which is removed and is not designated for reuse shall, at the Owner's option, either:

1. Be delivered to Owner's storage location, OR

2. Become Contractor's property and be removed from the site.

G. Existing conduit which is embedded in floors or walls not being demolished and which is no longer used shall be cut off at floor or wall surface. Finish of floor or wall shall be adjusted by appropriate trade to form a smooth and aesthetically pleasing surface.

H. Existing flush wall boxes which are to be abandoned shall be provided with blank covers closely matching finished wall surface.

I. Existing conduit, wire, equipment or components which are to remain and which are disturbed or damaged during construction shall be replaced with appropriate new materials, equipment or components at no extra cost to the Owner.

J. Circuits to equipment which is to remain shall be rerouted or replaced, as required.

K. If equipment or conduit and wiring are neither designated to be removed or to remain, do NOT disturb same until written instructions have been obtained from the Owner's Representative.

L. Wire which is removed from existing conduit shall NOT be reused. Reuse of existing wire may be permitted if wire is NOT disturbed by renovation work and serves same function as existing.

END OF SECTION

SECTION 16301

UNDERGROUND ELECTRICAL WORK

PART 1 GENERAL

1.1 APPLICABLE PUBLICATIONS

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C2	(1997) National Electrical Safety Code

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM B 1	(1995) Hard-Drawn Copper Wire
ASTM B 8	(1999) Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
ASTM D 1556	(2000) Density and Unit Weight of Soil in Place by the Sand Cone Method
ASTM D 2466	(1999) Poly Vinyl Chloride (PVC) Plastic Pipe, Schedule 40
ASTM F 412	Definition of Terms Relating to Plastic Piping System

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 48	(1996) High-Voltage Alternating-Current Cable Terminations
IEEE Std 48	(1998) Standard Test Procedures and Requirements for Alternating-Current Cable Terminations 2.5 KV through 765 KV
IEEE Std 386	(1995) Separable Insulated Connector Systems for Power Distribution Systems Above 600 V
IEEE Std 404	(1993) Cable Joints for Use with Extruded Dielectric Cable Rated 5000 V through 138,000 V and Cable Joints for Use with Laminated Dielectric Cable Rated 2500 V Through 500 000 V

IEEE Std 592	(1990; R 1996) Exposed Semiconducting Shields on Premolded High Voltage Cable Joints and Separable Insulated Connectors

NATIONAL ELECTRICAL MANUFACTURER'S ASSOCIATION (NEMA)

NEMA RN 1	(1998) Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit
NEMA TC 2	(1998) Electrical Polyvinyl Chloride (PVC) Tubing (EPT) and Conduit (EPC-40 and EPC-80)
NEMA TC 3	(1990) PVC Fittings for Use With Rigid PVC Conduit and Tubing
NEMA TC 6	(1990) PVC and ABS Plastic Utilities Duct for Underground Installation
NEMA TC 9	(1990) Fittings for ABS and PVC Plastic Utilities Duct for Underground Installation
NEMA WC 7	(1988; Rev 3 1996) Cross-Linked-Thermosetting Poly-ethylene-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy
NEMA WC 8	(1988; Rev 1996) Ethylene-Propylene-Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2002) National Electrical Code (NEC)

UNDERWRITERS LABORATORIES INC. (UL)

UL 6	(1997) Rigid Metal Conduit
UL 467	(1993; Rev thru Apr 1999) Grounding and Bonding Equipment
UL 510	(1994; Rev thru Apr 1998) Insulating Tape
UL 514A	(1996; Rev Dec 1999) Metallic Outlet Boxes
UL 514B	(1997; Rev Oct 1998) Fittings for Conduit and Outlet Boxes

UL 651A	(1995; Rev thru Apr 1998) Type EB and A Rigid PVC Conduit and HDPE Conduit
UL 854	(1996; Rev thru Oct 1999) Service-Entrance Cables
UL 1242	(1996; Rev Mar 1998) Intermediate Metal Conduit

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

A-A-60005	Frames, Covers, Gratings, Steps, Sump and Catch Basin, Manhole

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittal Procedures".

1.2.1 SD-02, Manufacturer's Data; GA

a. Conduit
b. Splice box
c. Insulating tape
d. Terminator
e. Cable lubricants
f. Telephone cable and splices
g. Safety plug in terminators
h. Handholes

1.3.2 SD-04, Drawings; GA

a. Conduit
b. Splice box
c. Insulating tape
d. Terminator
e. Cable lubricants
f. Telephone cable and splices
g. Safety plug in terminators
h. Handholes

1.3.3 SD-06, Manufacturer's Instructions; GA

a. Manufacturer's directions for use of ground megger with proposed method indicated
b. Terminator manufacturer's installation instructions

1.3.4 SD-13, Certificates; GA

a. Certificates of Compliance

PART 2 PRODUCTS

2.1 GENERAL

Provide materials and equipment listed by UL or approved by Factory Mutual (FM) System when such equipment is listed or approved.

2.2 CONDUIT

2.2.1 PVC-Coated Sch 40 Gal. Steel

Rigid galvanized steel conduit and fittings shall conform to the requirements of UL 6 and UL 1242, for threaded type, respectively, and shall be coated with a polyvinyl chloride (PVC) sheath bonded to the galvanized exterior surface, nominal 40 mils thick, conforming to NEMA RN 1, Type A40, except that hardness shall be nominal 85 Shore A durometer, dielectric strength shall be minimum 400 volts per mil at 60 Hz, tensile strength shall be minimum 3500 psi, and aging shall be minimum 1000 hours in an Atlas Weatherometer.

2.2.2 Rigid Metallic Conduit – RMC

Rigid Metallic Conduit (RMC) shall be UL listed, hot dipped galvanized steel with full cut hot dipped galvanized NPT threads. RMC shall be chromated on all surface for corrosion and abrasion protection. Connector and couplings shall be galvanized steel threaded type for RMC use.

2.2.3 Rigid Nonmetallic Conduit - PVC

Rigid nonmetallic PVC conduit shall conform to UL listed Schedule 40 meeting UL 651A and NEMA TC-2.

2.2.4 Outlet boxes for use with rigid steel conduit shall be cast-metal cadmium or zinc-coated if of ferrous metal with gasketed closures and shall conform to UL 514A. Fittings for steel conduit and outlet boxes shall conform to UL 514B.

2.3 PLASTIC INSULATING TAPE

Provide UL 510.

2.4 WIRE AND CABLE

2.4.1 Pull Wire

Shall be plastic, having a minimum tensile strength of 200 pounds.

2.4.2 Connectors and Terminals

Shall be designed and approved for use with the associated conductor material, and shall provide a uniform compression over the entire contact surface. Solderless terminal lugs shall be used on stranded conductors. For connecting aluminum to copper, connectors shall be the circumferentially compressed, metallurgically bonded type.

2.5 CABLE JOINTS, TERMINATIONS, AND CONNECTORS

2.5.1 High-Voltage Cable Joints

High-voltage cable joints shall comply with IEEE Std 404 and IEEE Std 592. High-voltage cable terminations shall comply with IEEE Std 48. Joints shall be the standard products of a manufacturer and shall be either of the factory preformed type or of the kit type containing tapes and other required parts. Joints shall have ratings not less than the ratings of the cables on which they are installed. Splice kits may be of the heat-shrinkable type for voltages up to 15 kV, of the premolded splice and connector type, the conventional taped type, or the resin pressure-filled overcast taped type for voltages up to 35 kV; except that for voltages of 7.5 kV or less a resin pressure-filled type utilizing a plastic-tape mold is acceptable. Joints used in manholes, handholes, vaults and pull boxes shall be certified by the manufacturer for waterproof, submersible applications.

2.5.2 High-Voltage Separable Insulated Connectors

Separable insulated connectors shall comply with IEEE Std 386 and IEEE Std 592 and shall be of suitable construction or standard splice kits shall be used. Separable insulated connectors are acceptable for voltages up to 35 kV. Connectors shall be of the loadbreak type as indicated, of suitable construction for the application and the type of cable connected, and shall include cable shield adaptors. Separable insulated connectors shall not be used as substitutes for conventional permanent splices. External clamping points and test points shall be provided.

2.6. GROUNDING AND BONDING EQUIPMENT

UL 467. Ground rods shall be copperweld type copper clad steel with diameter adequate to permit driving to full length of the rod, but not less than 3/4 inch in diameter and 10 feet long unless otherwise indicated.

2.7 POLE MOUNTED 15 KV FUSE CUTOUTS

Provide approved 15 KV cutouts, pole mounted, where shown on drawings. Fuse sizes shall be as shown on the drawings. The cutouts shall be suitable for use on the overhead

distribution system, 15 KV, 100 amps. The cutout shall be equal to ABB's Model Number "ICX".

2.7.1 The cutouts shall be mounted on a new cross-arm on the pole. Provide cross arms to match existing and as directed by FAA Engineer

2.7.2 The cutout shall have silver-to-silver contacts (top and bottom), all contacts shall be silver plated, mounted on a solid porcelain insulator.

2.7.3 The fuse tubes shall be painted glass filament wound type with copper alloy castings on fuse tubes top and bottom support, complete with eye bolt. Moisture absorption in fuse tube liner shall be less than 1% ASTMD 619.

2.7.4 The rating of the cutouts shall be:

Nominal voltage	15 KV
BIL rating	110 KV
Continuous rating	100 Amps.
Interrupting rating	16,000 Amps. Asymmetric

2.7.5 Provide a portable load-break tool for operating the fuse tube.

2.7.6 The short-circuit rating of the fuses shall be minimum of 50,000A

2.7.7 Provide 3 spare fuses of each size.

2.8 SAFETY PLUG IN TERMINATOR

2.8.1 Safety Plug-In Terminators: Terminators shall be provided for terminating single conductor, or the single conductors of multi-conductor solid-insulated cables of 15 KV. The terminator shall be the product of one manufacturer who shall furnish all components in the form of a kit, including complete instructions, which shall be followed for assembly and installation, and suitable for the type and material of the cable terminated.

2.8.2 Safety-plug-in terminators 25 KV shall provide dead front termination and plug-in load break switching. Molded of EPDM rubber, the entire terminator shall be enclosed in a molded semi-conductive jacket that is grounded during operation. Jacket shall be virtually immune to ozone attack, having outstanding heat resistance and retain flexibility at extreme temperatures. A stainless steel reinforced pulling eye shall be provided for convenient line tool operation.

2.8.3 The 200 amp. termination shall include the following:

Designed in accordance with ANSI C1191.1 stds.
Line to ground voltage - 15.2 rms
Continuous current - 200 amp. rms

Short time current - 10,000 amp. sysm.
Basic insulation level - 125 KV impulse

2.9 PRE-CAST CONCRETE - ELECTRICAL MANHOLES

2.9.1 Pre-cast units shall be as indicated on the drawings, and shall be the product of a manufacturer regularly engaged in the manufacturer of pre-cast concrete products.

2.9.2 Concrete for pre-cast work shall have 28-day compression strength of not less than 4000 psi. Structures shall be pre-cast monolithically and placed as a unit, or, they may be of assembled sections, designed and produced by the manufacturer in accordance with the requirements specified. All structures shall be identified with the manufacturer's name embedded in, or permanently attached to an interior wall face.

2.9.3 Pre-cast structures shall be designed in accordance with AASHTO "Specification for Highway Bridges", concrete and reinforcing shall be designed in accordance with ACI Code 318. Tops, walls, gratings, and manhole covers of structures shall be designed for AASHTO highway loading, with 30 percent loading added for impact, and with design load being that which produces maximum shear and moment. Walls shall be designed to withstand all soil pressures, taking into consideration the soil to be encountered and ground water level present at the site, and assuming that the H20 design vehicle will operate on surfaces adjacent to the structure. Design shall also take into consideration stresses induced in handling units. Lifting devices shall be provided for properly handling units. Calculations and shop drawings shall be submitted covering the design and manufacturer of pre-cast units, and shall bear the seal of a registered professional engineer.

2.9.4 Mating edges of pre-cast units shall be provided with tongue and grooved joints to firmly interlock adjoining components and to provide waterproof junctions. Joints shall be sealed watertight using pre-formed plastic strip. Sealing material shall be installed in strict accordance with sealant manufacturer's printed instructions. Provisions shall be made for waterproofing cable, tank, pipe entrances into structures, at floor drains, and at manhole openings.

2.9.5 Provide gratings, manhole covers as indicated on the drawings. Gratings shall be steel, hot-dip galvanized after fabrication; manhole covers shall be cast iron.

2.9.6 Cable racks, including hooks and insulators, shall be sufficient to accommodate the cables and shall be spaced not more than 18 inches apart horizontally. The wall bracket shall be channel or T-section steel. The hooks shall be of steel or malleable iron and shall be of the removable type. Insulators shall be dry-process glazed porcelain. The metal portion of racks shall be zinc-coated after fabrication.

2.9.7 Assembly and installation of pre-cast components shall follow the printed instructing of the manufacturer of the units. The structures shall be installed on a level bed of well-

compacted gravel or rushed stone, well graded from the one-inch sieve to the No. 4 sieve. Drain sumps shall be provided for pre-cast structures as required.

2.10 CAST-IN-PLACE CONCRETE

2.10.1 Cast-in-Place concrete shall conform to American Concrete Institute (ACI), and American Society for Testing and Material (ASTM).

2.10.2 Concrete shall be ready-mixed conforming to ASTM C-94, and shall be normal weight, 5 to 7% air entrained concrete having a minimum ultimate compressive strength of 3,000 psi at 28 days. Cement content shall be not less than 6 ½ bags per cubic yard of concrete. Cement shall conform to ASTM C150, Type I.

2.10.3 Water for mixing and curing, including free moisture and water in the aggregates, shall be fresh, clean and potable.

2.10.4 Aggregates: ASTM C33, except as modified herein. Aggregates shall be free from any substance which may be deleteriously reactive with the alkalies in the cement in the amount sufficient to cause excessive expansion of the concrete. Aggregates shall be washed before use. Maximum size of coarse aggregate shall be ½ inch.

2.10.5 Reinforcement details, splices and lengths to the laps shall be in accordance with details.

PART 3 EXECUTION

3.1 INSTALLATION

Underground installation shall conform to ANSI C2 and NFPA 70 except as otherwise specified or indicated.

3.1.1 Contractor Damage

The Contractor shall promptly repair any utility lines or systems damaged by Contractor operations. Damage to lines or systems previously located or "marked out", which are caused by Contractor operations, shall be repaired at no expense to the government. If the Contractor is advised in writing of the location of a line or system, such notice shall provide that portion of the line or system with "previously located" status in determining liability for damages. In any event, the Contractor shall immediately notify the Resident Engineer (RE) of any such damage. Underground utility line sensor shall be utilized prior to digging any trenches.

3.1.2 Cables crossing other cables or metal piping shall be separated from the other cables or pipe by not less than 6 inches of well-tamped earth.

3.1.2.1 Cables shall be in one piece without splices between connections except where the distance exceeds the lengths in which the cable is furnished.

3.1.2.2 Bends in cables shall be not less than those specified in NFPA 70 for the type of cable specified.

3.1.2.3 Horizontal slack of approximately 3 feet shall be left in the ground on each end of cable runs, on each side of connection boxes, and at all points where connections are brought above ground. Where cable is brought above ground, leave additional slack to make necessary connections. Splices in lead-sheathed or armored cables shall be enclosed in split-type cast-iron splice boxes; after completion of the connection, tightly clamp the box and fill with insulating filler compound.

3.1.2.4 Identification Slabs Markers

Provide a slab at each change of direction of the cable, over the ends of ducts or conduits which are installed under paved areas and roadways, and over each splice. Identification slabs shall be concrete, approximately 20 inches square by 6 inches thick, and shall be set flat in the ground so that the top surface projects not less than 3/4 inch, nor more than 1-1/4 inches above ground. The concrete shall have a minimum compressive strength of 3000 psi and shall have a smooth, troweled finish on exposed surface. Inscribe an identifying legend such as "cable", "duct", "splice", or other applicable designation on the top surface of slab before the concrete hardens. Inscribe circuit identification symbols on slabs as directed. The letters or figures shall be approximately 2 inches high and the grooves shall be approximately 1/4 inch in width and depth. Install the slabs so that the side nearest the inscription on the top shall include an arrow indicating the side nearest the cable.

3.1.3 Conduit Installation

3.1.3.1 Underground Duct Without Concrete Encasement

Conduits shall be PVC-coated galvanized steel or Schedule 40 PVC, unless shown otherwise.

3.1.3.2 Conduits above ground

All conduits installed above grade (including stub-up) shall be rigid threaded heavy wall galvanized steel conduit.

3.1.3.3 Conduit below ground

Electrical primary, manhole to manhole and manhole to pad mounted transformer: 4" PVC Concrete encased (as shown on the Contract Drawings).

3.1.3.4 Electrical secondary

Pad mounted Transformer to Building and Building to Building: 4 inch PVC, Schedule 40, concrete encased (as shown on the Contract Drawings).

3.1.3.5 The top of the conduit shall be not less than 24 inches below grade, shall slope away from buildings and toward manholes and other necessary drainage points, and shall run in straight lines except where a change of direction is necessary. As each conduit run is completed, a testing mandrel not less than 12 inches long with a diameter 1/4 inch less than the inside diameter of the conduit shall be drawn through each conduit, after which a stiff-bristled brush shall be drawn through until the conduit is clear of earth, sand, or gravel particles. Conduit plugs shall then immediately be installed. Ensure a minimum 6-inch clearance from the conduit to each side of the trench. Grade the bottom of the trenches smooth; where rock, soft spots, or sharp-edged materials are encountered, excavate the bottom for an additional 6 inches; fill with sand or earth, free from particles that would be retained on a 1/4-inch sieve; and tamp level with the original bottom.

3.1.3.6 Under roads, paved areas, and railroad tracks, install conduits in concrete encasement of rectangular cross-section providing a minimum of 3-inch concrete cover around ducts. The concrete encasement shall extend at least 5 feet beyond the edges of paved areas and roads.

3.1.3.7 Separate multiple conduits with a minimum concrete thickness of 2 inches, except that light and power conduits shall be separated from control, signal, and telephone conduits by a minimum distance of 3 inches. Stagger the joints of the conduits by rows and layers to strengthen the conduit assembly. Provide plastic duct spacers that interlock vertically and horizontally. Spacer assembly shall consist of base spacers, intermediate spacers, and top spacers to provide a completely enclosed and locked-in conduit assembly. Install spacers per manufacturer's instructions, but provide a minimum of two spacer assemblies per 10 feet of conduit assembly.

3.1.4 Buried Utility Warning and Identification Tape Provide detectable aluminum foil plastic-backed tape or detectable magnetic plastic tape manufactured specifically for warning and identification of buried cable and conduit. Tape shall be detectable by an electronic detection instrument. Provide tape in rolls, 2 inches minimum width, color coded for the utility involved with warning and identification imprinted in bold black letters continuously and repeatedly over entire tape length. Warning and identification shall be CAUTION BURIED ELECTRIC CABLE BELOW or similar. Use permanent code and letter coloring unaffected by moisture and other substances contained in trench backfill material. Bury tape with the printed side up at a depth of 12 inches below the top surface of earth or the top surface of the subgrade under pavements.

3.1.5 Cable Pulling

Test existing ducts with a mandrel and thoroughly swab out to remove foreign material before the pulling of cables. Cables shall be pulled down grade with the feed-in point at the manhole or buildings of the highest elevation. Flexible cable feeds shall be used to convey cables through the manhole opening and into the ducts. Cable lubricants shall be used and shall be lubricants specifically recommended by the cable manufacturer. Cable-pulling tensions shall not exceed the maximum pulling tension recommended by the cable manufacturer. Do not exceed the specified cable bending radii when installing cable under any conditions, including turnups into switches, transformers, switchgear, switchboards, and other enclosures. Cable with tape shield shall have a bending radius not less than 12 times the overall diameter of the completed cable. Cable with wire shield shall have a bending radius not less than eight times the overall diameter of the completed cable. If basket-grip type cable-pulling devices are used to pull cable in place, cut off the section of cable under the grip before splicing and terminating.

3.1.5.1 Secondary cable runs, 600 volts and less, shall include an insulated copper equipment grounding conductor sized as required by the rating of the overcurrent device supplying the phase conductors.

3.1.5.2 Installation of Cables in Manholes and Handholes

Route cables along walls providing the longest route and the maximum spare cable lengths. Form cables to closely parallel walls without interference to duct entrances. Support cables on brackets and cable insulators at a maximum of 4 feet. Identify each cable by corrosion-resistant embossed metal tags attached in each underground structure in accordance with the cable schedule and as approved by the Contracting Officer. Example: 11.5 kV cable, Circuit 4-Sub. NB - to SP. Identify each phase of the 34.5 kV cable.

3.1.6 Handholes

3.1.6.1 Workmanship

Underground structures shall be poured in place or may be of precast construction as specified herein. Horizontal concrete surfaces of floors shall have a smooth trowel finish. Cure concrete by applying two coats of white pigmented membrane forming-curing compound in strict accordance with the manufacturer's printed instructions, except that precast concrete may be steam cured. Curing compound shall conform to ASTM C 309. Cast-in-place handholes shall be standard type. Locate duct entrances and windows in the center of end walls (shorter) and near the corners of sidewalls (longer) to facilitate cable racking and splicing. Covers for underground structures shall fit the frames without undue play. Steel and iron shall be formed to shape and size with sharp lines and angles. Castings shall be free from warp and blow holes that may impair strength or appearance. Exposed metal shall have a smooth finish and sharp lines and arises. Provide necessary lugs, rabbits, and brackets. Set pulling-in irons and other built-in items in place before depositing concrete. The words "electric" and "telephone" shall be cast in the top face of power and telephone manhole covers, respectively.

3.1.6.2 Optional Precast Concrete Construction

In lieu of poured-in-place concrete handholes, the Contractor may, at his option, provide precast concrete structures, subject to the requirements specified below. Precast units shall be the product of a manufacturer regularly engaged in the manufacture of precast concrete products, including precast handholes.

a. General: Precast concrete structures shall have the same accessories and facilities as required for poured-in-place structures. Likewise, precast structures shall have plan area and clear heights not less than those of poured-in-place structures. Concrete materials and methods of construction shall be the same as for poured-in-place concrete construction, as modified herein. Slope in floor may be omitted provided precast sections are poured in reinforced steel forms. Concrete for precast work shall have an ultimate 28-day compressive strength of not less than 4000 psi. Structures may be precast to the design and details indicated for poured-in-place construction, precast monolithically and placed as a unit, or structures may be assembled sections, designed and produced by the manufacturer in accordance with the requirements specified. Structures shall be identified with the manufacturer's name embedded in, or otherwise permanently attached to, an interior wall face.

b. Design for Precast Structures: ACI 318. In the absence of detailed on-site soil information, design for the following soil parameters/site conditions:

Angle of Internal Friction (θ) = 30 degrees
Unit Weight of Soil (w) = 110 pcf
Coefficient of Lateral Earth Pressure (Ko) = 0.50
Ground Water Level = 6 feet below ground elevation

Vertical design loads shall include full dead, superimposed dead, and live loads including a 30 percent magnification factor for impact. Live loads shall consider all types and magnitudes of vehicular (automotive, industrial, or aircraft) traffic to be encountered. The minimum design vertical load shall be for H20 highway loading per AASHTO HB-12.

Horizontal design loads shall include full geostatic and hydrostatic pressures for the soil parameters, water table, and depth of installation to be encountered. Also, horizontal loads imposed by adjacent structure foundations, and horizontal load components of vertical design loads, including impact, shall be considered, along with a pulling-in iron design load of 6000 pounds.

Each structural component shall be designed for the load combination and positioning resulting in the maximum shear and moment for that particular component.

Design shall also consider the live loads induced in the handling, installation, and backfilling of the manholes. Provide lifting devices to ensure structural integrity during handling and installation.

c. Construction: Structure top, bottom, and walls shall be of a uniform thickness of not less than 6 inches. Thin-walled knock-out panels for designed or future duct bank entrances shall not be permitted. Quantity, size, and location of duct bank entrance windows shall be as directed, and cast completely open by the precaster. The size of the windows shall exceed the nominal duct bank envelope dimensions by at least 12 inches in each direction to preclude in-field window modifications made necessary by duct bank misalignment. However, the sides of precast windows shall be a minimum of 6 inches from the inside surface of adjacent walls, floors, or ceilings. Form the perimeter of precast window openings to have a keyed or inward flared surface to provide a positive interlock with the mating duct bank envelope. Provide welded wire fabric reinforcing through window openings for in-field cutting and flaring into duct bank envelopes. Provide additional reinforcing steel comprised of at least two No. 4 bars around window openings. The minimum concrete cover for reinforcing steel shall be 2 inches. Provide drain sumps for precast structures a minimum of 12 inches in diameter and 4 inches deep.

d. Joints: Provide tongue-and-groove joints on mating edges of precast components. Shiplap joints shall not be allowed. Design joints to firmly interlock adjoining components and to provide waterproof junctions and adequate shear transfer. Seal joints watertight using preformed plastic strip conforming to AASHTO M 198, Type.

e. Install sealing material in strict accordance with the sealant manufacturer's printed instructions. Provide waterproofing at conduit/duct entrances into structures and, where access frame meets the top slab, provide continuous grout seal.

3.1.6.3 Metal Frames and Covers

Frames and covers of steel shall be welded by qualified welders in accordance with standard commercial practice. Steel covers shall be rolled-steel floor plate having an approved antislip surface. Hinges shall be of galvanized steel with bronze hinge pin, 5 by 5 inches by approximately 3/16-inch thick, without screw holes, and shall be for full surface application by fillet welding. Hinges shall have non-removable pins and five knuckles. The surfaces of plates under hinges shall be true after the removal, by grinding or other approved method, of raised lugs.

3.1.6.4 Pulling-in irons shall be steel bars bent as indicated and cast in the walls and floors. Alternatively, pipe sleeves may be precast into the walls and floors where required to accept U-bolts or other types of pulling-in devices possessing the strengths and clearances stated herein. The final installation of pulling-in devices shall be made permanent. Cover and seal exterior projections of thru-wall type pulling-in devices with an appropriate protective coating. In the floor the irons shall be centered under the cover, and in the walls the irons shall be located within 6 inches of the projected center of the duct bank pattern or precast window in the opposite wall. However, the pulling-in iron shall not be located within 6 inches of an adjacent interior surface, or duct or precast window located within the same wall as the iron. If a pulling-in iron cannot be located directly opposite the corresponding duct bank or precast window due to this clearance limitation, locate the iron directly above or below the projected center of the duct bank pattern or precast window the minimum distance required to preserve the 6-inch clearance previously stated. In the case of directly opposing precast windows, pulling-in irons consisting of a 3-foot length of No. 5 reinforcing bar, formed into a hairpin, may be cast-in-place within the precast windows simultaneously with the end of the corresponding duct bank envelope. Irons installed in this manner shall be positioned directly in line with, or when not possible, directly above or below the projected center of the duct bank pattern entering the opposite wall, while maintaining a minimum clear distance of 3 inches from any edge of the cast-in-place duct bank envelope or any individual duct. Pulling-in irons shall have a clear projection into the structure of approximately 4 inches and shall be designed to withstand a minimum pulling-in load of 6000 pounds. Irons shall be zinc-coated after fabrication.

3.1.6.5 Cable rack arms shall be steel or malleable iron and shall be of the removable type. Insulators shall be dry-process glazed porcelain. The metal portion of racks shall be zinc-coated after fabrication. Cable racks, including rack arms and insulators, shall be sufficient to accommodate the cables. Racks in power manholes shall be spaced not more than 3 feet apart, and each manhole wall shall be provided with a minimum of two racks. Racks in signal manholes shall be spaced not more than 16-1/2 inches apart with the end rack being no further than 12 inches from the adjacent wall. The wall bracket shall be 4 inches by approximately 1-1/2 inch by 3/16 inch by 48 inches long (minimum) channel steel. Slots for mounting cable rack arms shall be spaced at 8-inch intervals. Methods of anchoring cable racks shall be as follows:

a. Provide a 5/8-inch diameter by 5-inch-long anchor bolt with 3-inch foot cast in structure wall with 2-inch protrusion of threaded portion of bolt into structure. Provide 5/8-inch steel square head nut on each anchor bolt. Coat threads of anchor bolts with white lead immediately prior to installing nuts.

b. Provide concrete channel insert with a minimum load rating of 800 pounds per foot. Insert channel shall be steel of the same length as "vertical rack channel"; channel insert shall be cast flush in structure wall. Provide 5/8-inch steel nuts in channel insert to receive 5/8-inch diameter by 3-inch-long steel, square head anchor bolts.

c. Provide concrete "spot insert" at each anchor bolt location, cast flush in structure wall. Each insert shall have minimum 800-pound load rating. Provide 5/8-inch diameter by 3-inch-long steel, square head anchor bolt at each anchor point. Coat threads of anchor bolts with white lead immediately prior to installing bolts.

3.1.6.6 Precast Handholes Installation

Installation shall conform to the manufacturer's instructions.

3.1.6.7 Field Painting

Cast-iron frames, covers, and gratings not buried in masonry shall be cleaned of mortar, rust, grease, dirt, and other deleterious materials, and coated with bituminous paint. Steel frames not buried in masonry and steel covers shall be cleaned of mortar, dirt, and grease by an approved blasting process. Surfaces that cannot be cleaned satisfactorily by blasting shall be cleaned to bare metal by wire brushing or other mechanical means. Surfaces contaminated with rust, dirt, oil, grease, or other contaminants shall be washed with solvents until thoroughly cleaned. Immediately after cleaning, surfaces shall be coated with a pretreatment coating or a crystalline phosphate coating. As soon as practicable after the pretreatment coating has dried, treated surfaces shall be coated with zinc chromate primer and synthetic exterior gloss enamel. Pretreatment primer and paint shall be as specified for shop painting in Section 16010, "Electrical General Requirements."

3.1.6.8 Removal of Ducts

Where duct banks are removed from existing underground structures, close the openings to waterproof the structure. Chip out the wall opening to provide a key for the new section of wall.

3.1.7 Cable Terminating

Protect terminations of insulated power and lighting cables from accidental contact, deterioration of coverings, and moisture by the use of terminating devices and materials. Make terminations by using materials and methods indicated or specified herein or as designated by the written instruction of the cable manufacturer and termination kit manufacturer. Termination for high-voltage cables shall be rated, and be capable of withstanding test voltages, in accordance with IEEE 48. Terminations of single and

multiconductor cables shall include the securing and sealing of the sheath and insulation of the cable conductors, stress relief and grounding of cable shields of shielded cable, and grounding of neutral conductors, metallic sheaths, and armor. Adequately support cables and cable terminations to avoid any excessive strain on the termination and the conductor connection.

3.1.8 Splices for 600-Volt Class Cables

Splices in underground systems shall be made only in accessible locations such as manholes and handholes, using a compression connector on the conductor and by insulating and waterproofing by one of the following methods suitable for continuous submersion in water.

3.1.8.1 Cast-type splice insulation shall be provided by means of a molded casting process employing a thermosetting epoxy resin insulating material which shall be applied by a gravity-poured method or by a pressure-injected method. The component materials of the resin insulation shall be in a packaged form ready for convenient mixing without removing from the package. Do not allow the cables to be moved until after the splicing material has completely set.

3.1.8.2 Gravity-poured method shall employ materials and equipment contained in an approved commercial splicing kit which includes a mold suitable for the cables to be spliced. When the mold is in place around the joined conductors, prepare and pour the resin mix into the mold. Do not allow cables to be moved until after the splicing materials have completely set.

3.1.9 Grounding

Noncurrent-carrying metallic parts associated with electrical equipment shall have a maximum resistance to solid earth ground not exceeding the following values:

500 kVA or less	5 ohms
Grounded secondary distribution system neutral and noncurrent-carrying metal parts associated with distribution systems and grounds not otherwise covered	5 ohms

3.1.9.1 Grounding electrodes shall be cone-pointed ground rods, driven full depth plus 6 inches, installed when indicated to provide an earth ground of the appropriate value for the equipment being grounded.

3.1.9.2 Grounding connections which are buried or otherwise normally inaccessible, and excepting specifically those connections for which access for periodic testing is required, shall be made by exothermic weld or compression connector. Exothermic welds shall be made strictly in accordance with the weld manufacturer's written recommendations. Welds which are "puffed up" or which show convex surfaces, indicating improper

cleaning, are not acceptable. Mechanical connectors are not required at exothermic weldments. Compression connector shall be the type which uses a hydraulic compression tool to provide the correct circumferential pressure. Tools and dies shall be as recommended by the manufacturer. An embossing die code or other standard method shall provide visible indication that a connector has been adequately compressed on the ground wire.

3.1.9.3 Grounding conductors shall be stranded-bare copper conforming to ASTM B 8, Class B, for sizes No. 6 AWG and larger, and shall be solid-bare copper conforming to ASTM B 1 for sizes No. 8 and smaller. Cable sheaths, cable shields, conduit, and equipment shall be grounded with No. 6 AWG. Surge arresters shall be grounded to ground rods with No. 4 AWG.

3.1.9.4 Ground Cable Crossing Expansion Joints

Protect ground cables crossing expansion joints or similar separations in structures and pavements by use of approved devices or methods of installation which provide the necessary slack in the cable across the joint to permit movement. Use stranded or other approved flexible copper cable run or jumper across such separations.

3.1.10 Special Conditions

During the construction of duct banks and underground structures located in streets, the streets shall remain open to traffic. Plan and execute the work to meet this condition. At locations where duct banks cross railroad tracks and the work requires closing of the tracks, secure permission from the Contracting Officer for each track closure.

3.2 FIELD TESTS

As an exception to requirements that may be stated elsewhere in the contract, notify the Contracting Officer in writing at least 5 working days prior to each test. Furnish labor, equipment, and incidentals required for testing, except that the Government will provide electric power required for the tests. Correct defects in the work provided by the Contractor and repeat tests until the work is in compliance with contract requirements. Show by demonstration in service that circuits and devices are in good operating condition. Tests shall be such that each item of control equipment will function not less than five times.

3.2.1 Ground Rods

Test ground rods for ground resistance value before any wire is connected. Perform ground resistance measurements in normally dry weather, not less than 48 hours after rainfall. Ground resistance shall also be measured for each piece of equipment to the ground electrode. Use a portable ground testing megger to test each ground or group of grounds. The instrument shall be equipped with a meter reading directly in ohms or fractions thereof to indicate the ground value of the ground electrode under test.

Provide one copy of the ground megger manufacturer's directions, indicating the method to be used.

3.2.2 Compaction

Backfill shall be tested in accordance with ASTM D 1556, one test per lift per 2000 square feet.

3.2.3 Test Report

a. 600-Volt Cables: Identify each cable and test result.

b. Grounding Electrodes and Systems: Identify electrodes and systems for each test, as well as the resistance and soil conditions at the time the measurements were made.

c. High Voltage Cable

END OF SECTION

SECTION 16510

LUMINAIRES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Exterior luminaries and accessories.

1.2 REFERENCES

A. ANSI 62.41

B. ANSI C78.379 - American National Standard for Electric Lamps -- Reflector Lamps - Classification of Beam Patterns; 1997.

C. ANSI C82.1 - American National Standard Specifications for Fluorescent Lamp Ballasts; 1985 (R1997).

D. ANSI C82.4 - American National Standard for Ballasts for High-Intensity-Discharge and Low Pressure Sodium Lamps (Multiple-Supply Type); 1992.

E. NFPA 70 - National Electrical Code; National Fire Protection Association; 2000.

F. IES LHBK - (1993) Lighting Handbook, Reference & Applicative

G. NFPA 101 - (2000) Life Safety Code

1.3 SUBMITTALS

1.3.1 SD-02, Manufacturer's Catalog Data; GA

1. Submit all necessary information to demonstrate conformance with the specifications for:

    a. exterior luminaries (all types to be installed)
    b. ballasts and control units
    c. lamps (all types to be installed)
    d. photocell

2. Information on each fixture which indicates lamp(s), ballast(s), and performance data.

1.3.2 SD-09, Reports; GA

1. Submit certified test report by recognized independent testing laboratory, on electronic ballasts.

1.4 QUALITY ASSURANCE

A. Performance: Fluorescent ballasts and HID ballasts shall have protective circuiting that will sense the end-of-lamp-life characteristic and will prevent the lamp from overheating.

B. Products: Listed and classified by Underwriters Laboratories, Inc. as suitable for the purpose specified and indicated.

PART 2 PRODUCTS

2.1 LUMINAIRES

A. Furnish products as indicated in on Contract Drawings and as specified herein.

1. "Type" letter designation is shown on Contract Drawings to indicate what fixture is to be provided in each location; it does not indicate quantity.

2. Fixtures named are indicative of type, performance, appearance, and quality desired. Appearance, features and accessories inherent in the named fixture are mandatory.

B. Special Protection for Luminaires with Exposed Reflector Assemblies: Factory-supplied protective wrap which prevents contact, staining and damage.

2.2 LAMPS – TANK AREA LIGHTS AND FLOODLIGHTS

A. High Pressure Sodium Lamps for Stairway & Platform Area Lights: Unless otherwise noted: Diffuse coated, "color corrected", minimum 60 CRI, universal burn type. Units shall be 150 watt as manufactured by Day-Brite Lighting – Model Nite Brite, Fixture WLM – 150-S-12-PC-MT- LP, with Twist Lock Photo Control and Die-Cast Back Box.

B. High Pressure Sodium Lamps for Tank Floodlights: Unless otherwise noted: Diffuse coated, "color corrected", minimum 60 CRI, universal burn type. Units shall be 250 watt as manufactured by Day-Brite Lighting – Model Nite Brite, Fixture FLI-254-S-MT-BLANK-LP-PCR, with Twist Lock Photo Control.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine tank layout and construction defined on Contract Drawings, and coordinate locations and mounting heights of fixtures. Provide mounting accessories for particular construction in which fixtures will be installed.

3.2 INSTALLATION

A. Fixtures shall be securely attached to the structure by mechanical means and by safety wire. Provide additional structural supports as required. Provide two safety wires per fixture. Each safety wire shall be capable of supporting four times the weight of the fixture. Safety wire shall be adjusted to be in slack tension.

B. Pendant Fixtures: Install suspended luminaries and exit signs using pendants supported from swivel hangers. Provide pendant length required to suspend luminaire at indicated height.

D. Pendant-mounted fixtures shall be boxes which are securely attached to the structure. Run safety wire inside of each fixture pendant. Fixtures over 50 lbs (22.7 kg) shall be mounted direct from the structure independent of the box.

E. Install surface mounted luminaries plumb and adjust to align with tank lines and with each other. Secure to prevent movement.

F. Install tank mounted luminaries at height as indicated on Drawings.

G. Install accessories furnished with each luminaire.

H. Bond products and metal accessories to branch circuit equipment grounding conductor.

I. Install specified lamps in each luminaire.

3.3 FIELD QUALITY CONTROL

A. Operate each luminaire after installation and connection. Inspect for proper connection and operation.

3.5 ADJUSTING

A. Aim and adjust luminaries as directed.

CLEANING

A. Clean electrical parts to remove conductive and deleterious materials.

B. Remove dirt and debris from enclosures.

C. Clean photometric control surfaces as recommended by manufacturer.

D. Clean finishes and touch up damage.

E. Remove factory protective wrap from fixture reflector assemblies only after Contract area surface finishes are applied and after cleaning is complete. Replace damaged reflector assemblies as directed.

3.7 PROTECTION

A. Relamp luminaries that have failed lamps at Substantial Completion.

3.8 SCHEDULE- SEE DRAWINGS

END OF SECTION