New York State Department of Environmental Conservation

☑ Approved ☐ Approved As Noted ☐ Resubmit With Revisions ☐ Disapproved

COMMISSIONER OF ENVIRONMENTAL CONSERVATION

Designated Representative

Date 8/24/00

TECHNICAL SPECIFICATIONS FOR THE GROUNDWATER REMEDIATION SYSTEM COLESVILLE LANDFILL BROOME COUNTY, NEW YORK

July 2000

Prepared for

Broome County and GAF Corporation

Prepared by

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Disclosure Statement

The laws of New York State require that the corporations which render engineering services in New York be owned by individuals licensed to practice engineering in the State. ARCADIS Geraghty & Miller, Inc. cannot meet that requirement. Therefore, all engineering services rendered to Broome County and GAF Corporation in New York are being performed by GM Consulting Engineers, P.C., a New York professional corporation qualified to render professional engineering in New York. There is no surcharge or extra expense associated with the rendering of professional services by GM Consulting Engineers, P.C.

ARCADIS Geraghty & Miller, Inc. is performing all those services which do not constitute professional engineering and is providing administrative and personnel support to GM Consulting Engineers, P.C. All matters relating to the administration of the contract with Broome County and GAF Corporation are being performed by ARCADIS Geraghty & Miller, Inc. pursuant to its Amended and Restated Services Agreement with GM Consulting Engineers, P.C. All communications should be referred to the designated project manager at ARCADIS Geraghty & Miller.

TABLE OF CONTENTS

TABLE OF CONTENTS

DIVISION 15 – MECHANICAL

DIVISION 16 – ELECTRICAL

SECTION 01010
SUMMARY OF WORK

PART 1 - GENERAL

1.01 SECTION INCLUDES:

A. Contract Description.

B. Definitions.

C. Scope of Work.

D. Principal Features.

E. Responsibilities.

F. Ownership.

G. CONTRACTOR'S Use of Site and Premises.

H. Offsets.

I. Quality Assurance.

J. Materials and Equipment.

K. Warranties.

L. References.

M. Submittals.

N. Project/Site Conditions.

1.02 CONTRACT DESCRIPTION

A. Broome County and GAF Corporation (collectively referred to as the CLIENT) has retained ARCADIS Geraghty & Miller, Inc. and GM Consulting Engineers, P.C. to prepare these Technical Specifications for the design of a proposed groundwater remediation system being implemented at the Colesville Landfill in Broome County, New York. The CLIENT has also retained ARCADIS Geraghty & Miller, Inc. and GM Consulting Engineers, P.C. to construct this groundwater remediation system by directly entering into contracts with CONTRACTORS and VENDORS.

1.03 DEFINITIONS

A. For the purpose of these Technical Specifications, Construction Drawings, and other contract documents, the following definitions apply:

1. OWNER/CLIENT: Broome County and GAF Corporation.

2. CONSULTANT/ENGINEER: ARCADIS Geraghty & Miller, Inc. and GM Consulting Engineers, P.C.

3. CONTRACTOR: The individual, firm, partnership, or corporation designated as the CONTRACTOR in these contract documents.

4. VENDOR, SUPPLIER or MANUFACTURER: The individual, firm, partnership, or corporation selected to supply specific system equipment components.

5. SITE: The area as indicated on Drawing No. 3.

1.04 SCOPE OF WORK

A. The Construction Drawings and these Technical Specifications shall constitute the design and construction requirements for this project. The CONTRACTOR shall provide the necessary supervision, labor, materials, equipment, tools, and appurtenances as required to affect a complete Work, acceptable to the permitting authorities, the CONSULTANT/ENGINEER, and in compliance with the respective codes. Work under this Contract Document includes the following list of items which is meant as a guide and as a general description of the CONTRACTOR'S scope of work.

1. Obtain all required state, county and local permits.

2. Mobilize materials and equipment.

3. Obtain access to and locate all required utilities necessary for completion of the Work, including, but not limited to the following: electric power and telephone.

4. Supply and construct a prefabricated, one-story treatment building, including, but not limited to the following: excavation; setting reinforcing steel; placing concrete for the footings, and foundations; and the

construction of a treatment building as shown on the Construction Drawings; backfilling; site work and final grading, landscaping and driveway.

5. Supply and install three pneumatic auto pumps, one low profile air stripper, one mixing tank, one holding tank, one compressor, three transfer pumps, and two bag filter assemblies. Including, installing all associated piping and electrical controls in accordance with the Construction Drawings and these Technical Specifications and MANUFACTURER'S recommendations.

6. Provide and install all necessary wiring, electrical devices, control panels, instrumentation, and controls to provide for integrated system operation.

7. Install and connect electrical devices to appropriate electrical service.

8. Perform system start-up.

9. Cleanup and dispose of all waste generated during construction.

1.05 PRINCIPAL FEATURES

This section provides an overview and summary of the different processes associated with the treatment system and the components associated with each portion of the Work to be completed by the CONTRACTOR in accordance with the Construction Drawings and Technical Specifications.

A. Groundwater Recovery System

1. The groundwater recovery system shall be comprised of three (3) existing recovery wells: GM-PW-3, GM-PW-4, and GM-PW-5. Each recovery well shall be equipped with one (1) Clean Environment Equipment AP-4, bottom loading, Autopump, and its' associated interconnecting groundwater recovery and compressed air piping. Each existing recovery wellhead shall be modified in accordance with Construction Drawing 8 and shall be equipped with all necessary piping and appurtenances. Compressed air shall be supplied to the Autopumps by a vertically mounted air compressor.

2. The piping from each groundwater recovery well shall be directed to a common trench which follows the dirt road leading up to the treatment building as shown on Construction Drawing 3.

B. Groundwater Treatment System

1. Groundwater from the recovery wells shall be directed to a low profile air stripper located within the treatment building. Once the groundwater has passed through the low profile air stripper, the treated water will be pumped from the air stripper sump, through two (2) bag filter assemblies, and will then be discharged to either a treated water holding tank, or to the treated water bypass line which discharges into a swale that leads to the North Stream.

C. Molasses Delivery System

1. The molasses and water solution mixing sequence will be initiated when a level switch in the feed solution mixing tank is engaged. Following engagement, treated water from the treated water holding tank will be delivered to the feed solution mixing tank. Next, a predetermined amount of molasses will be delivered to the feed solution mixing tank. Following delivery of the treated water and raw molasses, the molasses feed solution will be mixed for a predetermined time interval to be chosen by the CONSULTANT/ENGINEER.

2. The molasses delivery system shall be comprised of 17 existing injection wells: IW-1 through IW-15, GM-MW-1 and PW-6. Each existing injection wellhead shall be modified in accordance with Construction Drawing 8 and shall be equipped with all necessary piping and appurtenances.

3. The molasses feed solution injection sequence will engage at a predetermined time interval to be chosen by the CONSULTANT/ENGINEER. Following engagement of the injection sequence, the feed solution will be mixed for a predetermined time interval to be chosen by the CONSULTANT/ENGINEER. Following mixing, a predetermined amount of molasses feed solution will be delivered to each of 17 injection wells. Following injection of the feed solution, a predetermined volume of treated water will be delivered to each injection well as a rinse.

4. Pure molasses shall be supplied by Good Food, Inc., located at 4960 Horseshoe Pike, Honey Brook, Pennsylvania 19344; phone number 800-327-4406, or an approved equal. The CONTRACTOR shall coordinate with the molasses VENDOR, a delivery VENDOR (if different then the

molasses VENDOR), and the CONSULTANT/ENGINEER the first delivery of pure molasses (supplied in 275 gallon totes). SITE access allows a maximum 30-foot long box truck. Therefore, all delivery trucks must be less then 30 feet. In addition, the CONTRACTOR shall arrange for a forklift, or other suitable equipment, to be delivered to the SITE to correctly stack the pure molasses totes in a vertical position as shown on the Construction Drawings. Delivery methods utilized for the first delivery shall be by means of an independent VENDOR for both the fork lift and box truck. Following the first delivery, the CONTRACTOR shall supply the CONSULTANT/ENGINEER with all applicable information, including VENDOR names, contacts, and phone numbers, to allow the CONSULTANT/ENGINEER access to the delivery provisions. The CONSULTANT/ENGINEER shall then be responsible for deliveries of pure molasses thereafter, and shall use the provisions set forth by CONTRACTOR. Deliveries thereafter shall be approximately every 3 months.

D. Treatment Building

1. The treatment system shall be housed in a one story, pre-fabricated above-grade structure, as shown on the Construction Drawings. The proposed treatment building will be comprised of one (1) room that will house all influent and effluent piping, mechanical equipment, molasses supply totes, and the electrical controls. The building will contain one (1) man access way for personnel ingress and egress, one (1) garage door (roll up type) for pure molasses deliveries, and two (2)sky panels for natural light entry. The treatment building will also contain a grate covered sump located at the center of the building.

2. The treatment building shall include heating, ventilation, and lighting to maintain a standard operating environment.

E. Piping

1. Piping includes pipe supports (within above-grade structures), and all other associated appurtenances.

F. Electrical System

1. Provide and install all necessary wiring, electrical devices, control panels, instrumentation, and controls to provide for integrated system operation:

3. The electrical system shall include conduit, wiring, transformers, panel boxes, Motor Control Center (MCC), devices, instrumentation, and all other items necessary to make the system functional.

4. The control center for all system operations shall be a Main Control Panel (MCP) equipped with a Programmable Logic Controller (PLC) that can be monitored remotely.

1.06 RESPONSIBILITIES

A. The CONSULTANT/ENGINEER'S responsibilities:

1. Review the CONTRACTOR'S Health and Safety Plan to ensure its consistency with the overall plan for the SITE.

2. Stop work should it not comply with the terms of the Contract.

3. Review shop drawings, product data, and product samples.

4. Render approvals, clarifications, instructions, change orders, etc. (when appropriate).

5. Inspect materials and equipment as required.

6. Observe and verify construction activities.

7. Perform oversight of testing, obtain results of those tests, and evaluate for compliance with specifications.

8. Provide design interpretation and technical support.

9. Approve changes in the Work in writing.

B. The CONTRACTOR'S responsibilities:

1. Adhere to these Technical Specifications and the Construction Drawings.

2. Conduct all work in accordance with applicable local, State, and Federal regulations.

3. Apply for and pay all permit and inspection fees.

4. Supply all utilities required for construction (electricity, telephone, etc.).

5. Provide accurate schedules, adhere to the schedules, and receive approvals from the CONSULTANT/ENGINEER for modifications to the schedules, if necessary.

6. Attend weekly progress meetings with the CONSULTANT/ENGINEER.

7. Prepare, submit, and implement a site-specific Health and Safety Plan.

8. Submit shop drawings, product data, samples and test results for the products, components, and equipment to be used to the CONSULTANT/ENGINEER for approval.

9. Perform testing, submit results, and receive approvals from the CONSULTANT/ENGINEER for all materials prior to delivery to the SITE.

10. Arrange for delivery, receive, unload, and install all materials and equipment at the SITE; inspect for completeness or damage. Replace any items damaged after receipt.

11. Coordinate the first delivery of pure molasses for system startup with the CONSULTANT/ENGINEER. The CONSULTANT/ENGINEER's VENDOR will deliver and install the above mentioned equipment. CONSULTANT/ENGINEER will be responsible for payment of the above mentioned process equipment to the associated VENDOR. CONTRACTOR shall be responsible for any extra costs incurred by the CONSULTANT/ENGINEER in the event that a rush in the delivery and installation schedule is required to make up for delays in schedule caused by the CONTRACTOR.

12. Store and secure all materials and equipment, as required.

13. Take all necessary precautions to ensure that all work under this contract shall be performed in such a manner that any adverse environmental impacts

directly related to performing the Work are reduced to a level that is acceptable to the CONSULTANT/ENGINEER.

14. Provide and install all materials and equipment as specified, and perform testing to document that installation meets contract requirements. Submit test results to CONSULTANT/ENGINEER for review and approval.

15. Submit changes in the Work to the CONSULTANT/ENGINEER for written approval. Obtain written approval from the CONSULTANT/ENGINEER prior to the commencement of such changes in the Work.

16. Accompany the CONSULTANT/ENGINEER for a final inspection upon completion of the Work. The CONSULTANT/ENGINEER will prepare punch list and the CONTRACTOR shall make tradesmen available to make corrections to the system after the inspection.

17. Prepare and submit a complete set of operation and maintenance (O&M) instruction manuals for all equipment furnished by the CONTRACTOR.

18. Maintain a complete set of marked-up contract drawings to reflect all approved field changes and as-built information for the CONSULTANT/ENGINEER to develop record drawings.

1.07 OWNERSHIP

A. The Construction Drawings and Technical Specifications prepared by the CONSULTANT/ENGINEER are the property of the CONSULTANT/ENGINEER. They are not to be used on other projects or extensions to this Project except by agreement in writing from the CONSULTANT/ENGINEER. Submissions or distribution to meet official regulatory requirements, or other purposes in connection with this Project, is not to be construed as publication in derogation of the CONSULTANT/ENGINEER'S and OWNER'S rights.

1.08 CONTRACTOR'S USE OF SITE AND PREMISES

A. In accordance with Section 01012 (Special Conditions), the CONTRACTOR shall be responsible for making sure the locations of all underground and overhead utilities and structures are known. Before doing any work at the SITE, the CONTRACTOR shall notify the CONSULTANT/ENGINEER of the locations of all utilities and structures in the area where construction activities will be taking place.

B. The CONTRACTOR shall take all steps necessary to prevent disruptions or interference to areas adjacent to the SITE.

C. The CONTRACTOR shall limit construction operations to areas noted on Construction Drawings and designated by the CONSULTANT/ENGINEER.

D. The CONTRACTOR shall restore all areas disturbed by construction activities to existing conditions unless otherwise specified by the CONSULTANT/ENGINEER.

E. All work shall be conducted during hours deemed appropriate by the CONSULTANT/ENGINEER, OWNER, and/or local ordinance.

1.09 OFFSETS

A. The Construction Drawings are diagrammatic in nature. Required size and termination of pipes, and suggested routings are shown to conform to the SITE requirements, avoid creating obstructions, and preserve clearances. However, it is not the intention of these documents to indicate all required offsets. It is the specific responsibility of the CONTRACTOR to provide for offsets, horizontal and vertical control points and other surveying requirements in such a manner as to conform to the SITE features, and make all equipment requiring inspection, maintenance, and repair accessible.

1.10 QUALITY ASSURANCE

The CONTRACTOR shall be responsible for quality assurance of the Work as summarized below and in accordance with Section 01400 (Quality Control). The CONTRACTOR shall:

A. Monitor quality control over SUPPLIER'S, MANUFACTURER'S, products, services, site conditions, and workmanship, to produce Work of specified quality.

B. Comply fully with MANUFACTURER'S instructions, including each step in installation, startup, and operating sequence.

C. Should MANUFACTURER instructions conflict with Contract Documents, request clarification from the CONSULTANT/ENGINEER before proceeding.

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

E. Have the Work performed by persons qualified to produce workmanship of specified quality.

1.11 MATERIALS AND EQUIPMENT

The CONTRACTOR shall be responsible for materials and equipment as summarized below and in accordance with Section 01600 (Materials and Equipment):

A. Products

1. Products: means new material, components, fixtures, and systems comprising the Work. Does not include machinery and equipment used for preparation, fabrication, conveying, and erection of the Work.

B. Storage and Protection

1. Equipment, products, backfill material, and all other construction materials shall be stored in an area designated by the CONSULTANT/ENGINEER.

2. Store and protect products in accordance with MANUFACTURER'S instructions, with seals and labels intact and legible. Store sensitive products in weather-tight, climate controlled enclosures.

3. The CONTRACTOR will be responsible for providing heating and weather protection for equipment and materials that require that level of care.

C. Substitutions

1. Substitutions after project initiation may be considered when a product becomes unavailable through no fault of the CONTRACTOR.

2. Substitution of components is allowed as follows:

a. Where specified as "or equal" shall mean that the CONTRACTOR may use a material of equal quality, function, and value.

b. Where specified as "or approved equal" means that substitution is allowed upon approval by the CONSULTANT/ENGINEER.

c. Where specified as "no substitutions" means substitutions will not be allowed unless compelling reasons exist to require the substitution,

and the CONSULTANT/ENGINEER concurs with the CONTRACTOR and approves substitution

3. A request for substitution constitutes a representation that the CONTRACTOR:

   a. Has investigated the proposed product and determined that it meets or exceeds the quality level of the specified product.

   b. Will provide the same warranty for the substitution as for the specified product.

   c. Will coordinate installation and make changes to other Work, which may be required for the Work to be complete, with no additional cost to the CONSULTANT/ENGINEER.

   d. Waives claims for additional costs or time extension which may subsequently become apparent.

   e. CONSULTANT/ENGINEER'S approval of a request shall place the responsibility under this section on the CONSULTANT/ENGINEER.

1.12 WARRANTIES

The CONTRACTOR shall obtain warranties and bonds in accordance with Section 01012 (Special Conditions) and as summarized below.

A. Warranties and bonds shall be executed in duplicate by responsible SUBCONTRACTORS, SUPPLIERS, and MANUFACTURERS, at least ten (10) days prior to shipment or completion of the applicable item of Work. Except for items put into use with CONSULTANT/ENGINEER permission, leave date of beginning of time of warranty blank until the Date of Substantial Completion is determined.

1.13 REFERENCES

A. In addition to other applicable local, State, and Federal requirements, the CONTRACTOR shall comply with the specific codes and standards cited in each section.

B. Applicable National Fire Protection Association (NFPA) codes shall also be adhered to.

1.14 SUBMITTALS

The CONTRACTOR shall be responsible for providing submittals in accordance with Section 01300 (Submittals) and as summarized below:

A. Submit as follows:

1. Identify Project, CONSULTANT/ENGINEER, CONTRACTOR, SUBCONTRACTOR, or SUPPLIER, pertinent Drawing sheet and detail number(s), and specification Section number, as appropriate.

2. Identify variations from Contract Documents and product or system limitations which may be detrimental to successful performance of the completed Work.

B. Documents Required:

1. Submit the number of copies which the CONSULTANT/ENGINEER requires, three (3) copies of which will be retained by the CONSULTANT/ENGINEER.

2. Mark each copy to identify applicable products, models, options, and other data. Supplement MANUFACTURERS' standard data to provide information unique to this Project.

C. Submit shop drawings and product data grouped to include complete submittals of related systems, products, and accessories in a single submittal.

D. Mark dimensions and values in units to match those specified.

E. Proposed Products List: Submit information on all products and equipment specified for the Project.

F. Proposed SUPPLIER List: Submit a complete list of SUPPLIERS with product, name, and address.

G. Other submittals shall include (but are not limited to): MANUFACTURER'S instructions; product test results; proposed subcontractor list; site-specific Health and Safety Plan (HASP); construction progress schedules and reports; Operations and Maintenance (O&M) manuals; and record drawings.

1.15 PROJECT/SITE CONDITIONS

A. Install Work in locations shown on Construction Drawings, unless prevented by unforeseen conditions.

PART 2 - PRODUCTS

A. Many products are referenced and specified throughout these Specifications by registered trade names. This does not constitute a recommendation of these products to the exclusion of other products. Equivalent products must be approved by the CONSULTANT/ENGINEER before being used (see paragraph 1.11, above). Impact to system layout, cost, and project schedule must be accounted for by the CONTRACTOR in all requested changes in accordance with Section 01600 (Materials and Equipment).

PART 3 - EXECUTION

Not Used.

END OF SECTION

SECTION 01012
SPECIAL CONDITIONS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Utilities.

B. Ordinances, Permits, Licenses.

C. Emergency Responsibility.

D. Environmental Protection.

E. Equipment Adjustment and Calibration.

F. System Start-up and Operation.

G. Operation and Maintenance Instruction Manuals.

H. Warranties.

I. CONSULTANT/ENGINEER'S Authority.

1.02 UTILITIES

A. Repair of damaged utilities caused by the CONTRACTOR'S work is the responsibility of the CONTRACTOR. Utilities such as sewer, water, natural gas, telephone and electric lines encountered in the Work shall be protected from injury and maintained in service until removed, replaced, or abandoned as required for the complete Work.

1.03 ORDINANCES, PERMITS, AND LICENSES

A. The CONTRACTOR shall at all times follow all applicable local, state, and federal laws. Neither the CONSULTANT/ENGINEER, OWNER, nor any other party shall be liable or held responsible if CONTRACTOR violates any of the above laws.

B. The CONTRACTOR must apply and pay for the cost of all local building permits.

C. The required state environmental permits shall be in place before start of construction.

D. The CONSULTANT/ENGINEER shall be responsible for obtaining the following permits:

a. Air permit.

b. State Pollutant Discharge Elimination System (SPDES) permit.

1.04 EMERGENCY RESPONSIBILITY

A. In case of emergency which threatens damage of property and/or safety of life, the CONTRACTOR shall act, without previous instructions from the CONSULTANT/ENGINEER or OWNER, as the situation may warrant. The Health and Safety Plan (HASP) required under Section 01300 (Submittals) shall contain all relevant information regarding emergency response and be completed per Part 3 of this section of the Technical Specifications. The CONTRACTOR shall notify the CONSULTANT/ENGINEER of any emergencies immediately thereafter. Any claim for compensation by the CONTRACTOR, together with substantiating documents regarding expenses, shall be submitted to the CONSULTANT/ENGINEER and the amount of compensation shall be determined by agreement between the CONTRACTOR and CONSULTANT/ENGINEER.

1.05 ENVIRONMENTAL PROTECTION

A. General Requirements - The CONTRACTOR shall provide and maintain environmental protection during the life of the Contract. Environmental protection shall be provided to correct conditions that develop during all phases of construction. The CONTRACTOR'S operations shall comply with all federal, state, and local regulations pertaining to water, air, solid waste, and noise pollution.

B. Protection of Natural Resources - It is intended that the natural resources within the SITE and outside the limits of permanent Work performed under this Contract be preserved in their existing condition or be restored to an equivalent or improved condition upon completion of the Work. Construction activities shall be confined to areas defined by the Contract Documents.

1. The CONTRACTOR shall restore damaged areas of the SITE to "Original Conditions" as applicable after performing required work. An inspection by the CONSULTANT/ENGINEER shall determine completion of Work and shall approve the repair and restoration prior to the acceptance of the Work. All restoration operations shall be performed at the CONTRACTOR'S expense.

2. Signs of temporary construction facilities such as haul roads, work areas, structures, foundations of temporary structures, stockpiles of excess or waste materials, and other vestiges of construction shall be eliminated in an approved way. Upon completion, all areas shall be clean and natural looking to the maximum extent possible.

3. All Work under this contract shall be performed in such a manner that any adverse environmental impacts are reduced to a level that is acceptable to the CONSULTANT/ENGINEER and the New York State Department of Environmental Conservation (NYSDEC).

4. Special measures shall be taken to prevent oily or hazardous substances from entering the ground, drainage areas, or local bodies of water.

C. Erosion and Sediment Control Measures - Earthwork brought to final grade shall immediately be finished as summarized below and as specified in Section 02211. Side slopes and back slopes shall be protected immediately upon completion of rough grading. Earthwork shall be planned and conducted in such a manner as to minimize the duration of exposure of unprotected soils. Erosion and sediment control shall be utilized in accordance with Section 02270 (Temporary Erosion and Sediment Control) to effectively prevent erosion and control sedimentation, including, but not limited to, the following:

1. The rate of runoff from the construction site shall be mechanically retarded and controlled, especially in areas which could potentially impact the North Stream. This includes construction of diversion ditches, benches, and berms, to retard and divert runoff to protected drainage courses.

2. Borrow will not be permitted in areas where suitable environmental controls are not possible.

3. Temporary protection will be provided on all side and back slopes as soon as rough grading is completed or sufficient soil is exposed to require protection to prevent erosion.

4. All soil piles created as part of excavation activities shall be provided with temporary cover and run-off control.

D. Control of Wastes - Wastes shall be picked up and placed in containers which are emptied on a regular schedule. Handling shall be conducted in a way that prevents contamination of the Site and any other areas.

1. All waste shall be transported and disposed of in a manner that complies with federal, state, and local requirements by the CONSULTANT/ENGINEER. The CONSULTANT/ENGINEER shall maintain a copy of any state and/or local permits or licenses that reflect such agency's approval and compliance with applicable solid waste disposal regulations. The permits or licenses and the location of the disposal area shall be provided prior to transporting any waste material.

2. During construction, the CONTRACTOR shall use chemical toilets or comparably effective units with sanitary wastes periodically emptied into municipal sanitary sewage systems. Provisions shall be made for pest control and for elimination of odors.

3. Fueling and lubricating of equipment and motor vehicles shall be conducted in a manner that affords the maximum protection against spills and evaporation. Lubricants and waste oil shall be disposed of by the CONTRACTOR at his expense, in accordance with approved procedures meeting federal, state, and local regulations.

E. Dust Control - Dust shall be suppressed at all times, including non-working hours, weekends, and holidays. Soil at the Site, haul roads, and other areas disturbed by the construction operations shall be sprinkled with water as necessary to control dust. Upon the start of construction activities, a minimum coarse gravel base of 4-inches thick by 20-feet wide by 40-feet long shall be placed on the existing dirt road at the entrance/exit of the construction entrance as shown on Construction Drawing 3. During the construction activities this gravel area shall be re-graded if necessary. No dry power brooming will be permitted. Vacuuming, wet mopping, or wet power brooming shall be used instead. Air blowing will be permitted only for cleaning off nonparticulate debris, such as reinforcing bars. No sandblasting will be permitted unless the dust therefrom is confined. Only wet cutting of concrete blocks, concrete, and asphalt will be permitted. No unnecessary shaking of bags will be permitted where concrete mortar and plaster milling is done.

F. Noise Control - The maximum use of "low-noise emission products" as certified by the Environmental Protection Agency shall be made when available. When not available, screens and/or barriers shall be used for noise control. No blasting or use of explosives will be permitted.

1.06 EQUIPMENT ADJUSTMENT AND CALIBRATION

A. All mechanical equipment and electrical equipment, including related control systems, shall be subjected to preliminary operation and testing before the

individual facilities and systems are put into operation. Tests shall be made to determine whether the equipment has been properly assembled, aligned, adjusted, wired, or connected.

B. The demonstration test of each piece of equipment shall include check-out from each remote control point. All alarm systems and safety lockout systems shall also be demonstrated for proper function along with all process instrumentation and controls.

C. The CONTRACTOR shall coordinate and be present during all such tests. The equipment SUPPLIER shall be responsible for testing and demonstrating the equipment supplied in accordance with Section 01650 (Starting of Systems) and the relevant equipment specification section.

1.07 SYSTEM STARTUP AND OPERATION

A. The CONTRACTOR shall place the various items of equipment into operation, along with the related piping and metering systems. After satisfactory startup of these individual systems, including all of the related equipment, they will remain in continuous or intermittent operation as required. System start-up shall be conducted for a period of one (1) week following installation of all process equipment, piping, and electrical devices as defined in Section 1010 – Summary of Work.

B. All equipment and accessories shall be adjusted and calibrated prior to any startup as specified under these Special Conditions. Any equipment placed into temporary operation prior to final completion of the total project shall be readjusted and/or calibrated.

C. The CONTRACTOR shall supervise, control, and be responsible for the operation and maintenance of the new equipment and/or system after each individual item is placed into operation. An adequate number of competent start-up personnel shall be furnished until the equipment is functional and working properly. The CONTRACTOR shall remain responsible for making any required changes, repairs, or replacements to the new installation during the startup period.

1.08 OPERATION AND MAINTENANCE INSTRUCTION MANUALS

A. In accordance with Section 01300, the CONTRACTOR shall prepare and submit a complete set of operation and maintenance instruction manuals for the overall project, covering all equipment furnished. Manuals shall include complete parts lists for all equipment. Manuals shall be prepared specifically for the particular equipment furnished and shall consider the specific operation of this equipment in

the particular process system involved. Complete lubrication requirements shall be listed, including recommended lubricant and lubricating intervals or schedule.

1.09 WARRANTIES

A. In accordance with Section 01300 (Submittals) and these Special Conditions, the CONTRACTOR shall obtain and submit in writing warranties and bonds, executed in duplicate by responsible SUPPLIERS, and MANUFACTURERS. Except for items put into use with the CONSULTANT/ENGINEER'S permission, the beginning of the time of warranty will be the Date of Substantial Completion.

B. The MANUFACTURER shall guarantee and furnish MANUFACTURER'S warranty against manufacturing and mechanical defects on all equipment provided for a period of two (2) years from date of initial operation.

C. In the event any material, part, or equipment proves defective during this period, the MANUFACTURER shall, at his expense (including labor), furnish and replace the defective item.

D. The MANUFACTURER shall guarantee in writing the structural integrity of all equipment for a period of five (5) years.

E. The MANUFACTURER shall guarantee the performance of the equipment and its components for a period of two (2) years.

F. All warranties shall be provided in writing, signed by an officer of the Manufacturing company.

1.10 CONSULTANT/ENGINEER'S AUTHORITY

A. When performing the work, the CONTRACTOR shall abide by all orders, directions, and requirements of the CONSULTANT/ENGINEER. The work shall be performed to the satisfaction of the CONSULTANT/ENGINEER at the times and places, the methods, and in the manner and sequence the CONSULTANT/ENGINEER may require. The CONSULTANT/ENGINEER shall determine the amount, quality, and acceptability of all phases of the work. The CONSULTANT/ENGINEER shall interpret the plans, specifications, contract documents, and any extra work orders. The CONSULTANT/ENGINEER shall decide all other questions in connection with the work. Upon request, the CONSULTANT/ENGINEER shall confirm in writing any oral orders, directions, requirements, or determinations.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

3.01 FIELD QUALITY CONTROL

A. The CONTRACTOR shall collect samples and conduct tests in accordance with Section 01400 (Quality Control) and all applicable standards related to the item or system being tested.

3.02 HEALTH AND SAFETY

A. The CONTRACTOR shall be responsible for implementing the site-specific HASP prepared in accordance with Section 01300 (Submittals).

B. The CONTRACTOR shall provide adequate health and safety personal protection equipment (PPE) for his/her employees and others who might be affected by excavation and construction activities.

C. Work procedures shall conform to all applicable OSHA, State of New York, county, local government, and other federal regulations.

3.03 PROJECT SCHEDULE

A. Time is of the essence for construction. The CONTRACTOR is responsible for meeting the system start-up deadline.

B. The CONTRACTOR shall be responsible for achieving round-the-clock operation of the treatment system and address all punch list items within 3 months of the notice to proceed.

C. The CONTRACTOR shall develop, implement, and maintain a project schedule that runs 3 months from notice to proceed to completion of all punch list items and fully automatic operation.

D. The CONTRACTOR will be responsible for all fines and extra costs associated with the CONTRACTOR'S failure to meet the deadline specified herein and in the Contract Documents.

END OF SECTION

SECTION 01039
COORDINATION AND MEETINGS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Site Progress Meetings.

B. Coordination.

1.02 RELATED SECTIONS

A. Section 01010 - Summary of Work.

B. Section 01012 - Special Conditions.

C. Section 01300 - Submittals.

D. Section 01400 - Quality Control.

1.03 SITE PROGRESS MEETINGS

A. The CONSULTANT/ENGINEER shall designate, as necessary, progress meetings that will be conducted to review the progress of the Work, and any unexpected conditions or situations that may have arisen. The CONSULTANT/ENGINEER will ensure conformance with the financial plan. The CONTRACTOR shall be fully responsible for any and all of the subcontractors and shall be responsible for subcontractor attendance and/or input into the meetings.

B. The meetings shall be documented by the CONSULTANT/ENGINEER and copies of the minutes of the meetings shall be distributed to the CONTRACTOR and OWNER/CLIENT.

C. Progress meetings shall be held approximately once a week, at which time the weekly progress report will be reviewed.

1.04 COORDINATION

A. All on-site work shall be coordinated by the CONTRACTOR, with the approval of the CONSULTANT/ENGINEER.

B. SITE and utility access shall be coordinated through the CONSULTANT/ENGINEER and/or the appropriate utility authority.

C. Issues related to design and construction of the specified system shall be handled through the CONSULTANT/ENGINEER in accordance with Sections 01010 (Summary of Work), 01012 (Special Conditions), 01300 (Submittals), and 01400 (Quality Control).

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

Not used.

END OF SECTION

SECTION 01090
REFERENCE STANDARDS

PART 1 - GENERAL

1.01 REFERENCE STANDARDS

Where standards of the following organizations or any other standards, codes, or specifications are referred to in the Technical Specifications, the reference is to the particular standard, code, or specification cited, together with all amendments applicable at the date of the opening of Bids; and shall apply except to the extent that said standards and requirements may be in conflict with applicable laws or ordinances.

Acronym	Organization
AASHTO	American Assn. of State Hwy. & Trans. Officials
ACI	American Concrete Institute
AI	The Asphalt Institute
AMCA	Air Moving and Conditioning Association
ANSI	American National Standards Institute
API	American Petroleum Institute
ASME	American Society of Mechanical Engineers
ASTM	American Society of Testing and Materials
AWS	American Welding Society
AWWA	American Water Works Association
BOCA	Building Officials Conference of America
CRSI	Concrete Reinforcing Steel Institute
IEEE	Institute of Electrical and Electronic Engineers
JIC	Joint Industrial Council
NCMA	National Concrete Masonry Association
NEMA	National Electrical Manufacturer's Association
NFPA	National Fire Protection Association
NYDOT	New York Department of Transportation
NYSDEC	New York State Department of Environmental Conservation
OSHA	Occupational Safety and Health Administration
PCA	Portland Cement Association
SSPC	Steel Structures Painting Council
UL	Underwriters Laboratories

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

Not Used.

END OF SECTION

SECTION 01300
SUBMITTALS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. General

B. Submittal Procedures.

C. Shop Drawings.

D. Product Data.

E. MANUFACTURER'S Instructions.

F. Warranties

F. Product Test Results.

G. Proposed SUPPLIER List.

H. Proposed Subcontractor List.

I. Health and Safety Plan (HASP).

J. Construction Progress Schedules.

K. Operation and Maintenance Manuals.

L. Record Drawings.

1.02 GENERAL

A. All submittals shall be complete, neat, and orderly.

B. Submittals shall be provided according to the Contract Schedule.

1.03 SUBMITTAL PROCEDURES

A. Transmit three (3) copies of each submittal to the CONSULTANT/ENGINEER.

B. Sequentially number the transmittal forms. Resubmittals to have original number with an alphabetic suffix.

C. Identify project, CONTRACTOR name, subcontractor or SUPPLIER name, submission date, pertinent drawing sheet and detail number(s), and specification section number(s) as appropriate.

D. Apply CONTRACTOR'S stamp, signature or initials certifying that review, verification of products, field dimensions, adjacent construction work, and coordination of information, is completed as required.

E. All submittals are to be submitted to and approved by the CONSULTANT/ENGINEER in writing prior to commencing work for the item which requires submittal.

F. Distribute copies of reviewed submittals to concerned parties. Instruct parties to promptly report any inability to comply with provisions.

G. Provide space for CONSULTANT/ENGINEER to place review stamp.

H. Revise and resubmit submittals as required by the CONSULTANT/ENGINEER until approved; identify all changes made since previous submittal.

1.04 SHOP DRAWINGS

A. The CONTRACTOR shall furnish Shop Drawings to the CONSULTANT/ENGINEER for review and approval within 21 calendar days after award of contract.

B. Shop Drawings shall show how the CONTRACTOR intends to perform the Work.

C. The Shop Drawings shall include, but are not limited to:

1. The location, elevation, size, and anchoring details of all interior access doorways and service (mechanical and electrical) penetrations.

2. Design tolerances (plumbness, wall thickness, etc.).

3. Concrete mix design.

4. Concrete formwork design.

5. Proposed extents of excavations and sitework.

6. Erosion and sediment control plan in accordance with Sections 01012 (Special Conditions) and 02270 (Temporary Erosion and Sediment Control).

7. Warranties extended by the CONTRACTOR for the Work to be completed.

D. Three (3) copies of the drawings and data submitted by the CONTRACTOR will be returned by the CONSULTANT/ENGINEER to the CONTRACTOR with comments such as, "No Exceptions Noted," "Exceptions Noted," or "Returned for Resubmission." The CONTRACTOR shall make all necessary revisions, corrections, or clarifications, if required, and resubmit three (3) copies of the revised drawings and data within (7) calendar days.

1.05 PRODUCT DATA

A. The CONTRACTOR shall supply to the CONSULTANT/ENGINEER a proposed products list within 7 calendar days after award of contract. This list shall be subject to approval by the CONSULTANT/ENGINEER.

B. The proposed products list shall indicate all products that the CONTRACTOR believes will be incorporated. This list shall be interpreted as agreement by the CONTRACTOR to use the specified products. Omission from this list of any product required by the contract documents shall not relieve the CONTRACTOR of the responsibility for providing that product and completing the associated work as specified.

C. The CONTRACTOR shall submit for the CONSULTANT/ENGINEER'S approval, within 21 calendar days after award of contract, all information and product data related to the products in the proposed products list. The product data shall be submitted with the shop drawings and include data called for under the specifications or requested by the CONSULTANT/ENGINEER, including but not limited to:

1. MANUFACTURER descriptions, technical specifications, shop drawings, and data for each component specified that will not be fabricated on-site (including the pre-fabricated building).

2. MANUFACTURER warranties in accordance with Section 01012 (Special Conditions).

3. Submittals shall indicate that material or product conforms to or exceeds specified requirements. Submit supporting data or certifications as appropriate.

1.06 MANUFACTURER'S INSTRUCTIONS

A. CONTRACTOR shall submit printed instructions for delivery, storage, assembly, installation, and maintenance of specified components that will not be fabricated on-site to the CONSULTANT/ENGINEER. Instructions shall be provided a minimum of seven (7) calendar days prior to delivery.

1.07 PRODUCT TEST RESULTS

A. Test results shall be submitted to the CONSULTANT/ENGINEER for review within 5 calendar days of receipt of results, but no later than 30 calendar days after sample is collected for testing.

1.08 PROPOSED SUPPLIER LIST

A. A complete list of SUPPLIERS with product, name, and address shall be submitted to the CONSULTANT/ENGINEER for review within 7 calendar days after award of contract.

1.09 PROPOSED SUBCONTRACTOR LIST

A. A final list of subcontractors with name, address, and experience shall be submitted to the CONSULTANT/ENGINEER for review within 7 calendar days after award of contract.

B. No work on the contract shall commence until all the proposed subcontractors have been approved by the CONSULTANT/ENGINEER in writing.

1.10 HEALTH AND SAFETY PLAN

A. The CONTRACTOR shall prepare a construction health and safety plan (HASP) in accordance with the HASP presently in place at the site. The HASP shall be submitted to the CONSULTANT/ENGINEER for review within 7 calendar days after award of contract.

B. CONTRACTOR shall be responsible for implementing the HASP in accordance with Section 01012 (Special Conditions).

C. No work shall commence at the SITE until a HASP is in place.

1.11 CONSTRUCTION PROGRESS SCHEDULES

The CONTRACTOR shall:

A. Submit initial project schedule within 7 calendar days after award of contract.

B. Submit revised schedules as substantial variations are identified or as required by the CONSULTANT/ENGINEER.

C. Show complete sequence of construction by activity, identifying Work in separate stages and in logically grouped activities. Indicate the start and finish dates and duration. Presentation shall be neat and accurate utilizing MS Project© or comparable project tracking software package.

1.12 OPERATION AND MAINTENANCE MANUALS

A. The CONTRACTOR shall provide operation and maintenance instruction manuals and warranty and service information from equipment MANUFACTURERS to the CONSULTANT/ENGINEER within fifteen (15) days of (prior to) system startup. The CONTRACTOR shall prepare an operation and maintenance manual that addresses the following items:

1. Operating Procedures: startup, break-in, and routine normal operating instructions and sequences; regulation, control, stopping, shut-down, and emergency instructions; summer, winter, and any special operating instructions.

2. Maintenance Requirements: routine procedures and guide for trouble-shooting, disassembly, repair, and reassembly instructions, and alignment, adjusting, balancing, and checking instructions.

3. MANUFACTURER's parts list, illustrations, assembly drawings, and diagrams required for maintenance.

4. MANUFACTURER'S record drawings and any additional submittal information.

1.13 RECORD DRAWINGS

A. The CONTRACTOR shall furnish drawings with all technical information (including product data, MANUFACTURER'S instructions and certificates) and all field modifications clearly indicated to the CONSULTANT/ENGINEER. All

information necessary for the generation of record drawings shall be provided by the CONTRACTOR within 14 calendar days of substantial completion of construction.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

Not used.

END OF SECTION

SECTION 01400
QUALITY CONTROL

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Contractor Quality Control and Assurance of Installation.

B. Workmanship.

C. References.

D. Field Inspection of Contractor's Work.

E. On-Site and Laboratory Testing.

F. MANUFACTURER'S Field Services and Reports.

1.02 RELATED SECTIONS

A. Section 01039 - Coordination and Meetings.

B. Section 01090 - Reference Standards.

C. Section 01300 - Submittals.

1.03 CONTRACTOR QUALITY CONTROL AND ASSURANCE OF INSTALLATION

The CONTRACTOR shall:

A. Monitor quality control over SUPPLIERS, MANUFACTURERS, products, services, site conditions, and workmanship, to produce Work of specified quality.

B. Comply fully with MANUFACTURER'S instructions, including each step in installation and startup sequence.

C. If MANUFACTURER'S instructions conflict with Contract Documents, CONTRACTOR shall request clarification from the CONSULTANT/ENGINEER before proceeding.

D. Comply with specified standards as a minimum quality for the Work except when 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.

F. Secure products and equipment in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, or disfigurement.

G. During freezing or inclement weather, or other adverse conditions, no work shall be performed except that which can be performed in a manner that will ensure first-class construction throughout.

1.04 WORKMANSHIP

A. The intent of these Technical Specifications is to describe definitively and fully the character of materials and workmanship required with regard to all ordinary features, and to require first-class work and material in all particulars.

B. For any unexpected features arising during the progress of the Work and not fully covered herein, the specifications shall be interpreted by the CONSULTANT/ENGINEER to require first-class work and materials; and such interpretation shall be accepted by the CONTRACTOR.

C. All labor shall be performed in the best and most workmanlike manner by mechanics skilled in their respective trades. The standards of the Work required throughout shall be of such grade as will bring only first-class results.

D. Materials and methods used in the assemblage of the equipment shall comply with relevant standards, codes, or specifications related to the manufacture and operation of the specified equipment.

1.05 REFERENCES

A. Conform to current reference standards, including those listed in Section 01090 (Reference Standards), by contract documents' date of issue.

B. Obtain copies of standards when required by contract documents.

C. Should specified reference standards conflict with Contract Documents, request clarification from CONSULTANT/ENGINEER before proceeding.

D. The contractual relationship of the parties to the Contract shall not be altered from the contract documents by mention or inference otherwise in any reference document.

E. Where a field sample is specified to be removed in individual sections, clear area after field sample has been accepted by CONSULTANT/ENGINEER.

1.06 SUBMITTALS

A. Three (3) certified copies of each test report shall be mailed directly to the CONSULTANT/ENGINEER within 24 hours after the sample is taken, except in those instances when tests cannot be immediately performed because of required curing or incubation periods, or lengthy testing procedures. The CONTRACTOR shall make arrangements with the laboratory to secure copies.

B. Each report shall be in writing and shall include the testing method used, the test results, the specified results, the exact location of where the test specimens were taken, the date taken, Project identification, CONTRACTOR'S name and other pertinent information required for a complete and meaningful test report.

C. Each report shall be signed and certified by a responsible officer of the testing laboratory.

D. The laboratory shall verbally communicate test results when requested by the CONSULTANT/ENGINEER. This does not eliminate nor replace the requirements for a written report.

1.07 FIELD INSPECTION OF CONTRACTOR'S WORK

A. The CONSULTANT/ENGINEER will provide periodic inspection of the CONTRACTOR'S Work which will ensure that the Work is being performed in accordance with the Construction Drawings and these Technical Specifications such that the end product will be in conformance with the Construction Drawings and Technical Specifications.

B. The CONTRACTOR is responsible for complete conformance to the Construction Drawings and Technical Specifications for all Work performed on the project, including all subcontractors.

C. The CONTRACTOR will provide ample opportunity for safe and easy access to the inspectors for proper inspection of the Work.

D. Inform the CONSULTANT/ENGINEER in advance of periods when the CONTRACTOR does not intend to work due to, but not limited to, inability to obtain materials or equipment or expected inclement weather.

E. Upon completion of the Work, the CONTRACTOR shall notify the CONSULTANT/ENGINEER for the final inspection of the system. The CONTRACTOR, or his representative, must accompany the CONSULTANT/ENGINEER on the final inspection. The CONTRACTOR shall have tradesmen available or on call to make changes or corrections to the system after or during the inspection, as determined by the CONSULTANT/ENGINEER.

1.08 ON-SITE AND LABORATORY TESTING

A. The CONTRACTOR shall be responsible for collecting samples and conducting tests related to the work performed under this contract. Testing shall include, but not be limited to: concrete tests, compaction tests, pipeline and interconnecting piping pressure tests, metering, electrical and control device testing.

B. Unless listed otherwise, all performance tests and field and laboratory analyses will be conducted by the CONTRACTOR as detailed in the relevant sections of the Technical Specifications.

C. Except where otherwise specified, the CONSULTANT/ENGINEER will determine the number of samples to be taken, the date and time samples will be taken and tests made, the number and type of tests to be performed, who will collect the samples, how they will be handled and stored and when laboratory personnel are required on site.

D. The CONSULTANT/ENGINEER will notify the CONTRACTOR of his/her decision to take samples and/or have tests made and provide him/her with the pertinent information. The CONTRACTOR is responsible for notifying the testing laboratory and for having the testing performed, on schedule.

E. In addition to the above, the CONTRACTOR shall make his/her own arrangements for the sampling and testing of materials he proposes to incorporate into the Work.

F. Notify CONSULTANT/ENGINEER at least 72 hours in advance of the times at which scheduled samples or tests will be conducted.

G. If samples and/or tests cannot be collected or performed when required, delay the work until such time that they can be accomplished. Where possible, any work that has been installed but has not been sampled or tested as required, shall be tested by other means. Upon CONSULTANT/ENGINEER'S request, uncover any work that has been buried or covered and perform special tests designated by CONSULTANT/ENGINEER. If the work cannot be tested by other means, the CONSULTANT/ENGINEER may declare the work unacceptable. All costs associated with noncompliance and for special testing shall be borne by the CONTRACTOR.

H. Should the testing laboratory be scheduled to take or collect samples or to perform tests, and finds that it is unable to do so as a result of delays in construction, inclement weather, or any other reason, reschedule the tasks for a date acceptable to the CONSULTANT/ENGINEER. Costs associated with times testing laboratory is unable to perform scheduled services shall be borne by the CONTRACTOR.

I. Plan all work and operations to allow for the taking and collection of samples and allow adequate time for the performance of tests. Delay the progress of questionable work until the receipt of the certified test reports.

1.09 SOIL TESTING REQUIREMENTS

A. Compaction Testing – Soil:

1. Perform compaction testing in accordance with ASTM D2922, Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth) or ASTM D1556 Density and Unit Weight of Soil In Place by the Sand Cone Method.

2. Perform tests and analysis of fill material in accordance with ANSI/ASTM D698 – Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures, using 55-lb. Rammer and 12-inch Drop.

1.10 SOIL TESTING SCHEDULE

A. Compaction Testing of Soil:

1. Recovery Well Pipe Installation: Perform compaction tests at 50 foot intervals after each two vertical feet above crown of pipe and at finished subgrade elevation, for all backfilling of trenches in areas under pavement. Perform compaction test at 100 foot intervals at finished subgrade elevation for areas not under pavement.

2. Concrete Flatwork: One test per 400 square feet of flatwork.

3. Pavement Subgrade: One test per 500 square feet of subgrade immediately prior to placing subbase.

1.11 MANUFACTURERS' FIELD SERVICES AND REPORTS

A. When specified in individual specification sections, the CONTRACTOR is responsible for coordinating required material or product SUPPLIERS or MANUFACTURERS to provide qualified staff personnel to observe SITE conditions, conditions of surfaces, conditions of installation, quality of workmanship, testing, as applicable, and to initiate instructions when necessary.

B. CONTRACTOR must report to the CONSULTANT/ENGINEER observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to MANUFACTURER'S written instructions.

C. Submit report under provisions of Section 01300 (Submittals) within 30 calendar days of observation, or as specified in relevant sections of the Technical Specifications, whichever is shorter, to CONSULTANT/ENGINEER for review.

D. The CONTRACTOR shall furnish to the CONSULTANT/ENGINEER copies of certificates from SUPPLIERS/MANUFACTURERS showing that all units conform to the requirements of these specifications, in accordance with Section 01300 (Submittals).

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that existing SITE conditions and substrate surfaces are acceptable for subsequent Work. Beginning new Work means acceptance of existing conditions.

B. Examine and verify specific conditions described in individual specification sections.

C. Verify that utility services are available, of the correct characteristics, and in the correct locations.

3.02 FIELD QUALITY CONTROL

A. Allow representatives of the testing laboratory access to the Work at all times.

B. Provide all equipment, labor, materials and facilities required by the laboratory to properly perform its functions.

C. Cooperate with and assist laboratory personnel during the performance of their work.

D. Test specimens and samples shall be taken by the person(s) designated in other Sections, or as directed by the CONSULTANT/ENGINEER. Conduct field sampling and testing in the presence of the CONSULTANT/ENGINEER.

3.03 PREPARATION

A. Clean substrate surfaces prior to applying next material or substrate.

B. Seal cracks or openings of substrate prior to applying next material or substance.

C. Apply MANUFACTURERS required or recommended substrate primer, sealer or conditioner prior to applying any new material or substance in contact or bond.

END OF SECTION

SECTION 01450
PIPE TESTING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Testing of piping.

B. Pipe leakage testing shall comply with the limitations established in the attached Schedule.

1.02 RELATED SECTIONS

A. Section 1400 – Quality Control

1.03 DEFINITIONS

A. Leakage– The quantity of water to be supplied into the newly laid pipe, any valved section thereof, or other appurtenance, necessary to maintain the specified leakage test pressure after the pipe has been filled with water and the air expelled.

1.04 QUALITY ASSURANCE

The CONTRACTOR shall:

A. Prior to Substantial Completion, pressure pipes shall meet specific leakage requirements. These leakage requirements shall be satisfied by the basic materials alone. Where joint filters and the like have been specified, primarily to protect jointing materials, and secondarily to provide a factor of safety, they shall not be applied until after leakage tests have been completed and have been accepted by CONSULTANT/ENGINEER.

B. Tests will be witnessed by the CONSULTANT/ENGINEER. Tests not witnessed will be considered as not having been performed.

C. Work shall not be closed or covered up until it has been observed for proper and satisfactory construction and installation in compliance with the Contract

Documents. Should incomplete or unacceptable work be covered, the CONTRACTOR shall, at his/her own expense, uncover all work so that it may be properly observed. After such observations, repair and replace the work that was found defective, unsatisfactory, and not in accord with the Contract Documents. After such repair and replacement, bring all work to completeness and status as it was before it was closed and covered, all at the CONTRACTOR'S own expense. The CONTRACTOR shall submit for review and approval means and methods for correcting failed systems.

D. Successful completion of required tests shall be in no way interpreted as relieving the CONTRACTOR of responsibility for defects that become apparent subsequent to the time of testing. It shall be the sole right of the CONSULTANT/ENGINEER to determine whether defects exist. Retest all portions of the Work deemed necessary by the CONSULTANT/ENGINEER prior to Substantial Completion.

1.05 SUBMITTALS

A. Submit under provisions of Section 01300.

B. Complete details and specifications on testing apparatus.

C. At CONSULTANT/ENGINEER'S discretion, additional sections of pipelines may be required to be tested as soon as pipe is laid and prior to backfilling when working conditions or the standard of workmanship have been altered.

PART 2 - PRODUCTS

2.01 TESTING APPARATUS

A. Provide labor, plugs, measuring equipment, and other apparatus, complete, to perform testing.

B. Provide clean water, air, nitrogen, and other materials as required to accomplish testing.

C. Provide plugs and caps capable of withstanding test pressures.

D. Provide temporary flanges, plugs, bulkheads, thrust blocks, weighing, bracing and other items necessary to prevent joints from separating, and to prevent injuries or damage.

PART 3 - EXECUTION

3.01 PREPARATION

A. Plug open ends, adequately block bends, tees, ends, and other fittings, and do whatever is necessary to brace piping system so that it will safely withstand the pressures developed under the tests and so that no damage or injury occur to the pipeline, people or property.

B. Before tests are conducted, isolate, or remove any regulator, gauge, trap, or other apparatus or equipment which may be damaged by test pressures.

3.02 GENERAL

A. Trapped Air: Trapped air may cause a false indication of the rate of leakage. Points of concern include ends of lines, stubs, house connections and high points in pipelines. No credit will be made for this condition and no adjustment will be made to the allowable leakage. When trapped air is suspected of causing a test failure, do whatever is necessary to evacuate the air and repeat tests until the actual leakage is equal to or less than allowable rate of leakage. All air shall be removed from the test section of the pipe prior to beginning leak testing.

B. Water Absorption: No credit will be given for absorption of water in pipe. If necessary, fill pipes and manholes with water well in advance of testing and allow them to soak in order to eliminate or minimize the effects of absorption.

3.03 TESTS FOR PRESSURE PIPES

A. General

1. Leakage shall include the main exiting pipe, service connections, and other appurtenances on the section of pipeline being tested.

2. Test pipes prior to applying insulation and before they are concealed or furred-in.

3. Provide all necessary gauges. Gauges shall be standard pressure type with a minimum 6 inch diameter dial and a pressure range not in excess of 50% of the maximum required test pressure.

4. Provide and maintain at the SITE a gauge stand with an approved laboratory calibrated test gauge. Periodically check test gauge used for testing against the test gauge, and whenever requested by CONSULTANT/ENGINEER.

5. Where it is necessary for testing, tap pipes and insert approved plugs after testing is completed.

6. Provide a hand or motor driven compressor to maintain the required test pressure constant throughout the duration of the test. If a water pump is used, pump water from a container with a known volume of water. If an air or inert gas pump is used, leakage shall be determined and calculated by the cycling of the pump.

7. Provide test gauges at each end of the line being tested.

8. Conduct leakage test in accordance with the requirements contained in paragraph 3.06 herein.

B. Hydrostatic Testing

1. All sections of newly installed pipe shall be subject to hydrostatic pressure and leakage tests at 125 psi. The CONTRACTOR shall follow the pipe MANUFACTURER's recommendations for pressure testing procedures.

2. The hydrostatic test will consist of an initial pressure of 125 psi which will be allowed to stand without make-up pressure for at least two (2) hours to allow for pipe expansion or stretching to stabilize.

3. Following this equilibrium period, the hydrostatic pressure test will be conducted for at least one (1) hour.

C. Pneumatic Testing

1. All sections of newly installed compressed air piping shall be subjected to pneumatic testing and leakage tests at 150 psi. The CONTRACTOR shall

follow the pipe MANUFACTURER's recommendations for pressure testing procudures.

2. The pneumatic test will consist of a preliminary check of pressure at 25 psi. The pressure will be increased gradually in steps of approximately 15 minutes to all the piping to equalize strains during testing, and to check for leaks.

3. The pneumatic test will be at least 2 hours duration.

3.04 ALLOWABLE LEAKAGE

A. The maximum allowable leakage for the various piping systems is presented in the schedule.

B. It is the intent of this contract to secure piping systems without leakage. Each section of pipe shall not exceed the allowable leakage. It is also the intent to secure a piping system free from visible drips, streams and leaks. Therefore, even if a portion of the system meets the requirements for allowable leakage, visible leaks are not permitted and shall be repaired.

C. Leakage tests will be considered satisfactorily passed when the rate of leakage is equal to or less than the stipulated allowances, there is no evidence of visible leaks, and there is no evidence of other system defects.

3.05 RETESTING

A. Pipes not passing the tests shall have all defects corrected with methods approved by the CONSULTANT/ENGINEER to the inspection and satisfaction of CONSULTANT/ENGINEER, and shall be retested and recorrected as often as is necessary until the test requirements have been met.

B. It is the intent of this Contract to obtain work meeting test requirements on their own and solely through the use of the normal integral sealing components. Joint leaks shall not be stopped using concrete, caulking, mortar, or other patching materials. Leaking pipe joints shall be rejointed or replaced if necessary.

C. Methods other than rejoining, resetting or replacing joint seals shall require the written approval of CONSULTANT/ENGINEER.

3.06 SCHEDULE

LEAKAGE TESTING REQUIREMENTS

SERVICE	FLUID	PRESSURE	DURATION (Hrs).	ALLOWABLE LEAKAGE (a)	
				Pressure Piping	Compressed Air Piping
Pressure Piping	Water	125	1	.1	NA
Compressed Air Piping	Air	150	2	NA	5

(a) Leakage units for water are gallons/100 feet of pipe. Leakage units for air are pounds per square inch (psi).

NA Not Applicable.

END OF SECTION

SECTION 01500
CONSTRUCTION FACILITIES

PART 1 - GENERAL

1.01 SECTION INCLUDES:

A. Field Conditions and Measurements.

B. Access and Drainage.

C. Temporary Sanitary Facilities.

D. Contractor Storage Area.

E. Erosion and Siltation Control Measures.

F. Staging Areas, Storage and Field Offices.

G. Security.

H. Project Identification and Signs.

1.02 RELATED SECTIONS

A. Section 02270 - Temporary Erosion and Sediment Control

1.03 FIELD CONDITIONS AND MEASUREMENTS

A. The CONTRACTOR shall base all measurements, both horizontal and vertical, from established benchmarks and monuments. The CONTRACTOR shall be responsible for field verification of all dimensions and conditions at the job site.

B. Should the CONTRACTOR discover any discrepancy between actual conditions and those indicated, which prevent following good practice or the intent of the Construction Drawings and these Technical Specifications, he shall notify the CONSULTANT/ENGINEER; request clarification and instructions; and, shall not proceed with his Work until he has received the same from the CONSULTANT/ENGINEER, provided that such wait does not unduly delay the progress of the Work.

C. No claims shall be made for extra payment or extensions of Contract completion time if the CONTRACTOR fails to notify the CONSULTANT/ENGINEER of any discrepancy before proceeding with the aspect of the Work.

1.04 ACCESS AND DRAINAGE

A. The CONTRACTOR shall keep all natural drainage and water courses unobstructed or provide equal courses effectively placed, and prevent accumulations of surface water. The CONTRACTOR shall construct grade and stabilize access roads, and provide temporary mobilization, parking and storage areas for his use during construction within areas approved by the CONSULTANT/ENGINEER.

B. Access roads and mobilization, parking, and storage areas shall be maintained in a stable and smooth condition throughout the life of the Contract.

1.05 TEMPORARY SANITARY FACILITIES

A. The CONTRACTOR shall furnish and maintain the necessary temporary self-contained sanitary facilities in accordance with all applicable regulations. The use of these facilities shall be available for the CONTRACTOR'S employees as well as the CONSULTANT/ENGINEER.

1.06 PROJECT OFFICES

A. The CONTRACTOR shall provide an office trailer (in clean condition) for use by the CONSULTANT/ENGINEER and the CONTRACTOR throughout the duration of the project. The office trailer shall be adequately sized to accommodate a minimum of two (2) personnel on-site throughout the duration of the project.

The office trailer shall include, but not be limited to, the following:

1. A minimum of 200 square feet of floor space.
2. Two (2) office desks with multiple chairs.
3. One (1) four-drawer, lockable file cabinets.
4. One (1) telephone with hands-free capabilities and dedicated telephone lines.
5. One (1) telephone answering machine.
6. One (1) telefax machine.
7. One (1) photocopy machine.
8. Air conditioning and/or heat, as appropriate.
9. Water cooler.
10. Coffee Maker (with supplies).
11. Refrigerator.

The CONTRACTOR shall be responsible for all utility connection fees to the office trailer and the cost of all utility services throughout the duration of the project. The CONSULTANT/ENGINEER will reimburse the CONTRACTOR for all documented long distance telephone calls made by the CONSULTANT/ENGINEER.

1.07 UTILITIES

A. The CONTRACTOR shall be responsible for providing the following utilities for use at the project site throughout the duration of the project.

1. Electrical Power
   Electrical power, as appropriate and necessary of the anticipated equipment requirements, shall be provided for the CONTRACTOR work force and the office trailer.

2. Telephone
   Telephone line(s) shall be supplied to the office trailer. The telephone lines provided shall also accommodate a telefax machine.

3. Water Supply
   The CONTRACTOR shall make arrangements for obtaining water for personnel consumption, or other purposes in connection with the Work under this Contract. The CONTRACTOR shall also make arrangements for the routine delivery of bottled water to the office trailer.

4. Sanitary Facilities
   A sufficient number of chemical-type sanitary structures shall be provided for personnel on the project. They shall be located near the points of the Work, and shall be cleaned and adequately serviced daily.

1.08 CONTRACTOR STORAGE AREA

A. A storage area will be designated by the CONSULTANT/ENGINEER on the project site for use by the CONTRACTOR for storage of his materials, tools, equipment, office, and other items necessary for construction. The exact limits of the storage area will be designated in the field by the CONSULTANT/ENGINEER. The CONTRACTOR shall be fully responsible for the preparation of this area, its maintenance, and its security, including fencing, watchmen, and other means of security. Under no circumstances will the OWNER be responsible for the security of any property belonging to the CONTRACTOR, his subcontractors, or any of his work forces.

B. The CONTRACTOR shall be fully responsible for the payment of all utilities at no additional cost to the CONSULTANT/ENGINEER throughout the Work; these utilities include but are not limited to power, telephone, water and, sanitary facilities.

1.09 EROSION AND SILTATION CONTROL MEASURES

A. Adequate control of erosion and siltation of both a temporary and permanent nature on areas disturbed by the Work shall be provided under this Contract subject to the approval of the CONSULTANT/ENGINEER. As stipulated in Section 02270 (Temporary Erosion and Sediment Control) there will be a joint on-site inspection prior to commencing the Work, with CONTRACTOR, and the CONSULTANT/ENGINEER to determine specific siltation control requirements.

B. Erosion control shall comply with all applicable State and County Regulations.

C. Specific erosion control measures to be taken for this Work include:

1. Compliance with Broome County rules and regulations.

2. Compliance with all rules and regulations as issued by the State of New York.

1.10 STAGING AREAS, STORAGE AND FIELD OFFICES

A. The CONTRACTOR may, during the course of this project, start construction, store materials, or erect temporary field office only within areas approved by the CONSULTANT/ENGINEER. The CONTRACTOR shall not interfere with the operation of the adjacent OWNER facilities.

1.11 SECURITY

A. Security for the purpose of this project will be defined as fencing and lighting.

B. Protect Work premises and operations from theft, vandalism, and unauthorized entry by fencing, gates, locks, and appropriate security measures.

C. The right of access to this Work whether it is in preparation or progress shall be extended to the OWNER'S representatives as well as the NYSDEC, USEPA, and local authorities.

D. Allow entrance only to authorized persons with proper identification.

1.11 PROJECT IDENTIFICATION AND SIGNS

A. The project shall consistently be referred to as:

Groundwater Remediation System
Colesville Landfill
Broome County, New York

B. Signage shall be prepared by the CONTRACTOR and posted prominently at one key location to be designated by the CONSULTANT/ENGINEER. The sign shall be 3 feet by 5 feet and constructed of sheet metal or approved equal. The sign shall contain the information provided in Section A and the print shall be of 3 inch black lettering on a white background.

C. Signage shall be specified and approved by the CONSULTANT/ENGINEER prior to installation.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

Not used.

END OF SECTION

SECTION 01600
MATERIALS AND EQUIPMENT

PART 1 - GENERAL

1.01 SECTION INCLUDES:

A. Equipment and Products Specified.

B. Storage and Maintenance of Materials.

C. Equipment and Material Installation.

D. Cutting, Patching, and Painting.

1.02 RELATED SECTIONS

A. Section 01300 - Submittals

B. Section 01400 - Quality Assurance

1.03 EQUIPMENT AND PRODUCTS SPECIFIED

A. In the various detailed sections of the Specifications where any item of equipment or product is specified by proprietary name or trade name, with the addition of such expressions as "or approved equal", it is to be understood that equal-quality equipment or products of either a MANUFACTURER named or of a MANUFACTURER not named which meet the detailed requirements of the Specifications, are intended, subject to the approval of the CONSULTANT/ENGINEER as to the equality thereof. The CONTRACTOR must also demonstrate that there will be no adverse impact to the project schedule and no additional cost to the CONSULTANT/ENGINEER.

B. Substitutions after project initiation may also be considered when a product becomes unavailable through no fault of the CONTRACTOR.

C. The CONSULTANT/ENGINEER shall review the technical data for substitutions and shall accept or reject the offered substitution.

D. The CONTRACTOR is responsible for all delays in the project schedule associated with the review of offered substitutions. Such delays shall be

incorporated into the CONTRACTOR's projected construction schedule and shall be compensated for such that the overall project schedule is not affected.

E. Substitution of components is allowed as follows:

1. Where specified as "or equal" shall mean that the CONTRACTOR may use material of equal quality, function, and value.

2. Where specified as "or approved equal" means that substitution is allowed upon approval by the CONSULTANT/ENGINEER.

3. "No substitution," or unspecified, means substitutions will not be allowed unless compelling reasons exist to require the substitution, and the CONSULTANT/ENGINEER concurs with the CONTRACTOR and approves the substitution.

F. A request for substitution 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, at a minimum, the same warranty for the Submission as for the specified Product.

3. Will coordinate installation and make changes to other Work, which may be required for the Work to be complete, with no additional cost to CONSULTANT/ENGINEER or delay to the project schedule.

4. Waives claims for additional costs or time extension that may subsequently become apparent.

5. Understands that the CONSULTANT/ENGINEER'S approval of a requested change does not place the responsibility under this section on the CONSULTANT/ENGINEER.

1.04 STORAGE AND MAINTENANCE OF MATERIALS

A. All materials provided and Work performed under this Contract shall be protected from damage before and after installation. The CONTRACTOR shall be

responsible for Work, equipment, and materials until inspected, tested, and finally accepted in accordance with this Section and these Technical Specifications.

B. All arrangements for delivery, storage, and handling of equipment specified herein shall be the CONTRACTOR'S responsibility. The CONTRACTOR shall store equipment and materials so as to ensure the preservation of their quality and fitness for work. When considered necessary, they shall be placed on wooden platforms, or other hard, clean surfaces and shall be placed under cover when directed. Stored materials shall be located so as to facilitate prompt inspection.

C. Where materials or products called for under this Contract are installed before the erection of adequate protective structures, the CONTRACTOR without additional compensation therefore, shall provide approved, effective and durable covers for fully protecting such materials or products against damage from the elements or from any other causes.

D. All machinery, equipment, piping, and accessories and appurtenances shall be adequately supported and safeguarded against all damage or injury during performance of Work under this Contract. The CONTRACTOR shall be responsible for all damage or injury resulting from his operations and shall repair such damage immediately and to the satisfaction of the CONSULTANT/ENGINEER.

E. The CONTRACTOR shall store and protect products in accordance with the MANUFACTURER'S recommendations and the requirements specified in these Contract Documents and shall submit the MANUFACTURER'S storage and maintenance instructions prior to delivery.

F. The CONTRACTOR shall make all arrangements and provisions necessary for the storage of materials and equipment. All excavated material, construction equipment, and materials and equipment to be incorporated into the Work shall be placed so as not to injure any part of the Work or existing facilities, and so that free access can be achieved at all times to all parts of the Work, to all unrelated portions of the OWNER'S facility, and to all public utility installations in the vicinity of the Work. Materials and equipment shall be kept neatly and compactly stored in locations that will cause a minimum of inconvenience to other contractors, public travel, adjoining owners, tenants, occupants and the OWNER.

G. Areas available on the SITE for storage of materials and equipment shall be as shown, specified or designated and approved by the CONSULTANT/ENGINEER. All materials and equipment must be consigned to the CONTRACTOR directly. No delivery of materials and equipment will be accepted by the

CONSULTANT/ENGINEER, and all expenses incurred by the CONSULTANT/ENGINEER in handling materials or equipment which have been consigned or directed to the CONSULTANT/ENGINEER will be charged to the CONTRACTOR.

H. Materials and equipment which are to become the property of the OWNER shall be stored to facilitate their inspection and ensure preservation of the quality and fitness of the Work, including proper protection against damage by freezing and moisture. They shall be placed inside storage areas, unless otherwise shown, specified or acceptable to the CONSULTANT/ENGINEER.

I. CONTRACTOR shall be fully responsible for loss or damage to stored materials.

J. Any material or equipment which, in the opinion of the CONSULTANT/ENGINEER, has been damaged due to improper storage and/or handling and is unfit for its specified or intended use shall be properly removed from the SITE or Work. The CONTRACTOR shall receive no compensation for the damaged material or its removal or replacement. The CONTRACTOR shall be responsible for replacing any such materials with undamaged material as specified and shall be liable for any damages associated with removal and replacement of damaged materials, as well as damages - direct or consequential - resulting from delays in the project schedule that occur due to the damaged materials.

1.05 EQUIPMENT AND MATERIAL INSTALLATION

A. Install per MANUFACTURER'S instructions and specifications.

B. Maintain plumbness and be within specified tolerances.

C. Locate and install in accordance with plans and specifications.

D. Install in accordance with accepted quality construction practice to assure proper operation and full design life of the system and components.

1.06 CUTTING, PATCHING AND PAINTING

A. The CONTRACTOR shall perform all cutting and patching required for the proper installation of the equipment. If cutting will harm the structural integrity or mar the appearance, consult the CONSULTANT/ENGINEER for approval before proceeding. Patching shall meet the approval of the CONSULTANT/ENGINEER.

B. Equipment furnished by the CONTRACTOR in a painted condition shall be free from scratches, blemishes, or rust spots. Equipment with painted surfaces cracked, chipped, rusted, or peeled shall be repaired as approved by the CONSULTANT/ENGINEER and as per Section 09900 - Painting, before final acceptance.

C. CONTRACTOR shall request CONSULTANT/ENGINEER'S approval before cutting or altering items specified in Contract Documents.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

Not used.

END OF SECTION

SECTION 01650
STARTING OF SYSTEMS

PART 1- GENERAL

1.01 SECTION INCLUDES

A. Scope.

B. Division of Responsibilities.

C. Process Testing.

1.02 RELATED SECTIONS

A. Section 01010 - Summary of Work.

B. Section 01012 - Special Conditions.

C. Section 01039 - Coordination and Meetings.

D. Section 01300 - Submittals.

E. Section 01400 - Quality Assurance.

F. Section 01600 - Materials and Equipment.

1.03 SCOPE

A. This Job Instruction delineates the division of responsibilities between the CONSULTANT/ENGINEER and CONTRACTOR for activities which occur during the startup/shakedown and turnover period after substantial construction has been accomplished.

1.04 DIVISION OF RESPONSIBILITIES

A. Certain specific activities are to be completed before the final Turnover Notice will be issued to the CONTRACTOR to signify Substantial Completion of a portion (or all) of the Work. Following issue of a Turnover Notice, the CONTRACTOR shall continue to complete all unfinished work covered by a "Punch-List" resulting from known deficiencies.

B. There will undoubtedly be a certain amount of "make-good" work required after issuance of a Turnover Notice; for example, insulation, paint, fireproofing, or paving may require repair through no fault of the OWNER/CLIENT and/or the CONSULTANT/ENGINEER. In such instances, the CONTRACTOR will be expected to make such repair promptly.

C. CONTRACTOR shall be responsible for having tradesmen, including but not limited to the SUBCONTRACTOR, VENDOR representatives/technicians, and mechanics, available on the SITE during the first run-in of equipment and for arranging for MANUFACTURERS to check out equipment as required at the appropriate time. The CONTRACTOR shall provide SUBCONTRACTOR and VENDOR services at no charge to the CONSULTANT/ENGINEER for all SUBCONTRACTORS and VENDORS contracted through the CONTRACTOR.

1.05 PROCESS TESTING

A. MANUFACTURER'S representative shall perform functional testing during start-up. MANUFACTURER'S representative shall be available (on-site) during start-up, in accordance with the relevant section(s) of the Technical Specifications.

B. Instrumentation, controls, and complete system integration shall be tested by the CONTRACTOR under the observation of the CONSULTANT/ENGINEER and MANUFACTURER.

C. CONSULTANT/ENGINEER shall collect samples for evaluation and/or laboratory analyses to verify the performance of the process equipment.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

Not used.

END OF SECTION

SECTION 01700
CONTRACT CLOSEOUT

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Procedures

B. Clean-up.

C. Substantial Completion.

D. Final Inspection.

E. Project Record Documents.

F. Contractor's Closeout Submittals.

1.02 RELATED SECTIONS

A. Section 01300 - Submittals.

1.03 PROCEDURES

A. Comply with requirements stated in Conditions of the Contract and in Specifications for administrative procedures in closing out the Work.

1.04 CLEAN-UP

A. Remove all waste, debris, rubbish, tools, equipment, machinery and surplus materials to the satisfaction of the CONSULTANT/ENGINEER.

B. Dispose all wastes, debris, and rubbish in accordance with applicable federal, state, and local regulations.

C. Clean all sight-exposed surfaces. Leave work clean and ready for possession by the OWNER.

1.05 SUBSTANTIAL COMPLETION

A. When the CONTRACTOR considers that the work is substantially complete, he/she shall submit to the CONSULTANT/ENGINEER the following:

1. A written notice that the Work, or designated portion thereof, is substantially complete.

2. A list of items to be completed or corrected.

B. Within a reasonable time after receipt of such notice, the CONSULTANT/ENGINEER will make an inspection to determine the status of completion.

C. Should the CONSULTANT/ENGINEER determine that the work is not substantially complete, the following shall occur:

1. The CONSULTANT/ENGINEER will promptly notify the CONTRACTOR, in writing, giving the reasons thereof.

2. The CONTRACTOR shall remedy the deficiencies in the work and send a second written notice of substantial completion to the CONSULTANT/ENGINEER.

3. The CONSULTANT/ENGINEER will re-inspect the work.

D. When the CONSULTANT/ENGINEER finds that the work is substantially completed, the CONSULTANT/ENGINEER will:

1. Prepare and deliver to the OWNER a tentative Certificate of Substantial Completion with a tentative list of items to be completed or corrected before final payment.

2. After consideration of any comments made by the OWNER as provided in Conditions of the Contract, the CONSULTANT/ENGINEER will execute and deliver to the CONTRACTOR a definite Certificate of Substantial Completion with a revised tentative list of items to be completed or corrected.

1.06 FINAL INSPECTION

A. When the CONTRACTOR considers the work to be complete, the CONTRACTOR shall submit written certification that:

1. The contract documents have been reviewed.
2. Work has been inspected for compliance with Contract Documents.
3. Work has been constructed in accordance with Contract Documents.
4. Equipment and systems have been tested and are operational.
5. Work is completed and ready for final inspection.
6. Certificate of Completion.

B. The CONSULTANT/ENGINEER will make an inspection to verify the status of completion with reasonable promptness after receipt of such certification.

C. Should the CONSULTANT/ENGINEER consider that the work is incomplete or defective, the following shall apply:

1. The CONSULTANT/ENGINEER will promptly notify the CONTRACTOR in writing, listing the incomplete or defective work.
2. The CONTRACTOR shall take immediate steps to remedy the stated deficiencies and send a second written certification to the CONSULTANT/ENGINEER.
3. The CONSULTANT/ENGINEER will re-inspect the work.

D. When the CONSULTANT/ENGINEER finds that the work is acceptable under the contract documents, the CONSULTANT/ENGINEER shall request that the CONTRACTOR make closeout submittals.

1.07 PROJECT RECORD DOCUMENTS

A. The CONTRACTOR shall legibly mark on the Construction Drawings actual construction showing horizontal and vertical location of underground utilities, field changes of dimension and detail, and changes made by change orders and details not included on the original Construction Drawings.

B. The CONTRACTOR shall deliver record documents (as-builts), consisting of annotated Construction Drawings as indicated to the CONSULTANT/ENGINEER at the completion of the project to be used in preparation of the as-built drawings.

1.08 CONTRACTOR'S CLOSEOUT SUBMITTALS

A. Evidence of payment and release of liens shall be done according to the requirements of the submittal procedures and Special Conditions.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

Not used.

END OF SECTION

SECTION 02211
ROUGH/FINAL GRADING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Clearing.

B. Topsoil.

C. Field Engineering.

D. Grading.

1.02 RELATED SECTIONS

A. Section 02222 - Excavation.

B. Section 02223 - Backfilling.

C. Section 02270 - Temporary Erosion and Sediment Control.

1.03 CLEARING

A. All vegetation, shrubs, and brush within the construction area shall be removed. Stumps shall be removed entirely. Roots shall be grubbed out to at least 18 inches below the finished grade. Brush, refuse, roots, etc. shall be transported and deposited off the premises.

1.04 TOPSOIL

A. Material from the excavation, suitable for topsoil, shall be deposited in piles separate from other excavated material. Piles of topsoil shall be located so that the material can be used readily for the finished surface grading in areas that were stripped of topsoil during construction. When used for finished surface grading, topsoil shall be spread uniformly (minimum four inches thick, if sufficient material is available) over the areas to receive it.

B. Broome County compost will be available at no cost to the CONTRACTOR.

1.05 FIELD ENGINEERING

Prior to start of construction, CONTRACTOR shall (1) locate and protect survey control and reference points, (2) verify setbacks and easements, confirm drawing dimensions and elevations, and (3) confirm existing grading elevations.

1.06 GRADING

A. The CONTRACTOR shall restore all areas disturbed by construction activities to existing conditions unless otherwise specified by the CONSULTANT/ENGINEER.

B. The CONTRACTOR shall grade disturbed areas, to smooth uniformity between datum points. Form subgrade to proper shapes and contours, work out swales and other earth features, and complete the earthwork to receive fine grading, base coarse or topsoil.

C. Final grades shall be carried to the lines, grades, and slopes established by Construction Drawing 4 and the baseline survey, within a tolerance of 0.1 foot.

D. All material encountered, of whatever nature, within the limits indicated, shall be used as backfill or removed and disposed in accordance with Sections 02222 and 02223.

E. During the process of grading, the subgrade shall be maintained in such condition that it will be well drained at all times. The graded area shall be protected from surface water run-on and temporary erosion and sediment control shall be installed as required by local authorities and in accordance with Section 02270.

F. The right is reserved by the CONSULTANT/ENGINEER to make minor adjustments or revisions in lines or grades, if found necessary as the Work progresses in order to obtain satisfactory construction.

G. CONTRACTOR is responsible for protection and relocation, if necessary, of all above and below grade pipelines, utilities, adjacent existing structures, and, relocation, if necessary.

H. New areas designated to be grassed and grassed areas disturbed by construction shall be graded with topsoil, as specified above, fertilized and seeded.

PART 2 – PRODUCTS

A. Fertilizer shall be a suitable commercial 10-6-4 mixture (50% organic) spread evenly at the rate of 10 lbs. Per 1,000 square feet.

B. Seed shall be one of the following mixtures spread at the rate of 8 lbs. per 1,000 square feet.

Primary	-	45% Baron Kentucky Bluegrass 25% Ram I Kentucky Bluegrass 15% Glade Kentucky Bluegrass 15% Citation Perennial Ryegrass
Secondary	-	40% Citation Perennial Ryegrass 40% Adelphi Kentucky Bluegrass 20% Creeping Red Fescue
Shade	-	36% Penlawn Red Fescue 32% Yorktown Perennial Ryegrass 32% Jamestown Red Fescue

C. Dolomite Limestone (granular type) shall be added to all newly seeded areas at the rate of 50 lbs. per 1,000 square feet.

PART 3 - EXECUTION

A. The CONTRACTOR shall adhere to the following:

1. All utilities that pass through the Work Area or structures in or adjacent to the Work area shall be maintained and protected.

2. The CONTRACTOR shall take steps to control dust wherever the CONTRACTOR performs work.

3. Where seed is placed on sloped surfaces, stabilizing must be employed to prevent erosion, in accordance with Section 02270.

END OF SECTION

SECTION 02222
EXCAVATION

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Excavation.

B. Protection.

C. Submittals.

1.02 RELATED SECTIONS

A. Section 01300 - Submittals

B. Section 02211 - Rough/Final Grading.

C. Section 02223 - Backfilling.

D. Section 02270 - Temporary Erosion and Sediment Control.

1.03 EXCAVATION

A. This section covers excavation for all foundations, slabs, recovery and injection well boxes, and underground piping.

B. Excavations shall be kept free from water while construction therein is in progress. Any clay pockets, soft spots, vegetable and other foreign material shall be removed and replaced with sound material as directed by the CONSULTANT/ENGINEER (see paragraph 3.01). Excavations shall be refilled to the proper grade with suitable material and compacted as specified in Section 02223.

C. Unless directed otherwise by the CONSULTANT/ENGINEER, all footings must rest on undisturbed soil.

D. Excavations shall be along straight lines.

E. Excavations shall be shored and sheeted as required, with material of sufficient size and arrangement to prevent injury to persons, damage to structures, injurious caving, or erosion. Shoring, sheeting, and bracing shall be removed as the excavations are backfilled; care shall be exercised to prevent injurious caving during the removal of the shoring and/or sheeting.

F. Excavation shall be performed in such a manner that excavated areas and the area immediately surrounding the excavation for a distance of approximately 25 feet, including slopes and ditches, shall be continually and effectively drained. Water shall not be allowed to pond at the extremities of the drainage area and temporary erosion and sediment control shall be installed as required by local authorities and in accordance with Section 02270.

1.04 PROTECTION

The CONTRACTOR shall:

A. Comply with all federal, state and local codes, ordinances and laws governing excavation.

B. Protect existing structures and paving from damage caused by execution of the Work and equipment.

C. Protect above and below grade utilities that exist in the vicinity of the excavation.

D. Protect excavation by the use of bracing and/or shoring, if required, to prevent side wall caving or excessive groundwater in-flow.

E. Notify the CONSULTANT/ENGINEER of unexpected subsurface conditions interfering with normal construction methods and discontinue Work in the area until given written notice to resume Work.

F. Repair any damages.

1.05 SUBMITTALS

A. The CONTRACTOR shall submit drawings to the CONSULTANT/ENGINEER showing the locations and dimensions of proposed excavations with details of the proposed construction techniques and sheeting/shoring equipment, etc. in accordance with applicable rules and regulations.

B. Submittals will be made in accordance with Section 01300.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

3.01 PREPARATION

A. Survey Controls - The CONTRACTOR shall identify the required benchmarks for horizontal and vertical control. Closures for vertical and horizontal control shall be ± 0.01 feet.

B. Clearing – In accordance with Section 02211, all portions of the Work area shall be cleared of vegetation, roots, topsoil peat, trash, or other deleterious materials.

C. Excavation of Unsuitable Material - The CONTRACTOR shall remove and replace with compacted fill any subgrade material that is designated as "unsuitable" by the CONSULTANT/ENGINEER. Compaction of the fill placed in such areas will conform to the requirements for fill placement and compaction herein specified.

D. Water Supply - The CONTRACTOR shall provide water on the site as required to maintain proper moisture content of fill and to suppress fugitive dust emissions.

E. Before the start of any Work, the CONTRACTOR shall do the following:

1. Identify all underground utilities. Identify and mark the location and depth of any existing underground pipelines and other utilities.

2. Identify and mark the location of surface and overhead utilities.

3. Identify and mark the areas that will be excavated.

4. Identify and assess the impact of excavation on nearby utilities, pipelines, equipment, electrical poles and other surface features.

5. Maintain and protect the utilities and pipelines that pass through the Work area and are to remain in use.

3.02 EXCAVATION

A. The CONTRACTOR shall identify and mark on the existing surface, the location of the proposed excavation Work.

B. Excavated materials shall be used, whenever possible, to grade the area around the proposed treatment building.

C. Should saturated materials containing free water be encountered, the CONTRACTOR shall notify the CONSULTANT/ENGINEER.

D. The CONTRACTOR shall adhere to the following guidelines:

1. Excavation shall not be done in excess of that authorized by the CONSULTANT/ENGINEER. Unnecessary and excessive excavation shall be backfilled with suitable structural fill at no expense to the CONSULTANT/ENGINEER.

2. The CONTRACTOR shall take steps to control dust wherever the CONTRACTOR performs work. This includes using a water spray to moisten any areas where it is thought dust may be a problem.

3. Temporary erosion and sediment control shall be installed as required by local authorities and in accordance with Section 02270.

4. Excavated materials may be used for backfill if judged appropriate by the CONSULTANT/ENGINEER.

5. Excavated material, not reused, shall be stockpiled as directed by the CONSULTANT/ENGINEER and shall be disposed of in a suitable manner in accordance with federal and state regulations by the CONSULTANT/ENGINEER.

6. The CONTRACTOR shall adhere to the general guidelines as defined in paragraph 1.03.

3.03 FIELD QUALITY CONTROL

A. The CONTRACTOR shall conduct routine visual inspections of the excavation activities for compliance with these Specifications.

B. The CONTRACTOR shall conduct routine visual inspections of excavated soils to determine the presence of contamination during the excavation. Any such contamination is to be reported to the CONSULTANT/ENGINEER immediately.

END OF SECTION

SECTION 02223
BACKFILLING

PART 1 - GENERAL

1.01 SECTION INCLUDES:

A. References

B. Filling

1.02 RELATED SECTIONS

A. Section 02211 - Rough/Final Grading.

B. Section 02222 - Excavation.

C. Section 03300 - Cast-in-Place Concrete

1.03 REFERENCES

A. ASTM D-1557 - Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10-lb Rammer and 18-in. Drop.

B. ASTM D-2922 - Density of Soil in Place by Nuclear Methods.

C. ASTM D-422 - Standard Method for Particle Size Analysis of Soils.

D. ASTM D-1556 - Density of Soil in Place by the Sand-Cone Method.

1.04 FILLING

A. The CONTRACTOR shall be responsible for (1) backfilling and compacting the base for footings and structural slab, (2) backfilling and compacting around footings to grade, (3) backfilling and compacting areas associated with pipeline and utility trenches, (4) backfilling and compacting areas associated with injection and recovery wellhead modifications, (5) backfilling and compacting in other areas disturbed by construction activities as directed by the CONSULTANT/ENGINEER, and (6) grading of transported material from the excavations.

B. With the exception of those stockpiles of materials or other sources of materials made available to the CONTRACTOR by the CONSULTANT/ENGINEER, the

CONTRACTOR shall be responsible for procuring suitable materials for the performance of the Work and providing documentation of their suitability.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Suitable fill material shall include on-site excavated material or borrow material which is capable of being compacted to the required density at the proper moisture content, containing a maximum of 30 percent by dry weight of particles passing a No. 200 sieve, and of such type and characteristics approved by the CONSULTANT/ENGINEER. No rock, broken concrete, demolition material, frozen material, top soil, nor any material designated as unsuitable in Paragraph B shall be used for fill material.

B. Unsuitable material shall include, but not be limited to, all grass, weeds, vegetation of any type, roots, trash, rocks, boulders, debris, demolition materials, or any layer, strata, formation, or deposit of soil determined by the CONSULTANT/ENGINEER to be unsuitable for support of footings, slabs, or any other intended purpose. No material will be classified as unsuitable solely on the basis of excessive moisture content.

C. Granular material shall be the same as defined for "Suitable Material" above, except that it shall contain a maximum of 12 percent by dry weight of particles passing the No. 200 sieve, and a maximum of 40 percent passing the No. 40 sieve.

D. Borrow material shall be the same as defined for "Suitable Material" above, except that it shall be obtained from approved sources off the SITE. The CONTRACTOR shall provide verification and documentation to the CONSULTANT/ENGINEER that proposed borrow material is certified clean fill acceptable to the CONSULTANT/ENGINEER and the New York State Department of Environmental Conservation.

2.02 COMPACTED STRUCTURAL FILL

A. Material furnished shall be suitable and conform to the following requirements:

1. Gradation - the material shall have the following gradation:

Sieve Size	% Passing by Weight
4-inch	100
No. 40	0 - 70
No. 200	0 - 15

2. Soundness - the material shall be substantially free of shale or other soft, poor durability particles.

B. The material shall be used for bedding under slabs and footings.

PART 3 - EXECUTION

3.01 INSPECTION

Prior to actual placement of backfill materials, the following will be field verified:

A. Verify that all materials have been approved for use by the CONSULTANT/ENGINEER.

B. Verify that areas to be backfilled are free of miscellaneous debris, or standing water.

3.02 PLACING FILL

The CONTRACTOR shall:

A. Place all fill, unless otherwise specified, in horizontal lifts not exceeding 12 inches in loose thickness. So far as practical, each layer of materials shall extend the entire length and width of the area being filled.

1. Before compaction is started, the material shall be leveled by means of bulldozers, blade graders, or other equipment as approved by the CONSULTANT/ENGINEER.

2. The use of dragline excavators or similar equipment that excavate and deposit material in large unit masses will not be permitted unless all

materials excavated are spread in the manner and to the thickness specified herein.

3. Material shall not be placed on surfaces that are muddy, frozen, or which contain frost. No frozen fill shall be placed.

4. Backfill around structures shall be placed to the extent practicable, as the work progresses. Backfilling against concrete shall be done only when directed by the CONSULTANT/ENGINEER.

B. Reduce the moisture content of the fill by aeration or increase the moisture content by uniform sprinkling of water as necessary, to achieve optimum moisture content to facilitate compaction. The moisture content of the fill shall be within ± 3 percentage points of optimum. Fill shall not be placed in water.

C. Slope the fill surface to facilitate the removal of run-off from the SITE and to prevent ponding of surface water. During periods of anticipated inclement weather, the surface of the fill shall be graded and sealed as directed by the CONSULTANT/ENGINEER to preclude percolation of surface water.

D. Place the backfill or bedding material in 12-inch lifts that conform to the dimensions as shown on the Construction Drawings.

E. Compact the backfill using suitable compaction equipment such as rammers or plate compactors.

F. Remove and properly dispose of all surplus backfill materials.

G. Grade backfill to existing elevations as specified in Section 02211.

H. Replace any paving that is damaged from the excavation activities, and match the repaved area with the existing elevations.

3.03 COMPACTION

The CONTRACTOR shall:

A. Use steel wheel vibratory rollers for compaction of predominantly granular soils. The use of sheepsfoot or tamping rollers shall be limited to the compaction of fine grained, plastic soils.

B. Compact each layer of material to a minimum of at least 85 percent of maximum dry density determined in accordance with ASTM D1557 (Modified Proctor) unless otherwise specified.

C. Make sufficient passes in order to obtain the specified densities.

D. As compaction of fill in each Work area has been completed, leave the area undisturbed for a reasonable period of time for testing. Do not place fill over a layer that has not been tested and accepted by the CONSULTANT/ENGINEER.

E. Maintain moisture content of the exposed lift; desiccation cracking shall result in removal and reinstallation of affected area by the CONTRACTOR at his own expense.

F. Be directed by the CONSULTANT/ENGINEER to correct, at the CONTRACTOR'S expense, any unsatisfactory compacted materials by removal and replacement or by scarifying, aerating, or sprinkling (as needed), and recompaction and retesting, in-place prior to placement of a new lift.

END OF SECTION

SECTION 02270
TEMPORARY EROSION AND SEDIMENT CONTROL

PART 1 - GENERAL

1.01 DESCRIPTION

A. The Work covered by this Section consists of furnishing all materials, equipment, tools and labor to construct temporary erosion and sediment control systems as shown on Construction Drawing 4.

B. The Work to be performed includes, but is not limited to, silt fences, straw bales, conveyance channels, and site surface drainage.

1.02 RELATED SECTIONS

A. Section 01300-Submittals.

B. Section 02211-Rough/Final Grading.

C. Section 02222-Excavation.

1.03 SUBMITTALS

A. Product data shall be submitted as indicated in Section 01300.

PART 2 - PRODUCTS

2.01 SURFACE-WATER CONTROL MATERIALS

A. Silt Fence: The CONTRACTOR shall supply silt fence in sufficient quantities to control surface-water runoff and sediment. Acceptable silt fence material shall be as follows:

1. Propex-Silt Stop
2. Mirafi 100X
3. Beltech 755, or
4. An approved equal.

The CONTRACTOR shall submit MANUFACTURERS product data to the CONSULTANT/ENGINEER for approval a minimum of one week prior to installation. Silt fence shall be replaced at a frequency consistent with the MANUFACTURERS directions, or as directed by the CONSULTANT/ENGINEER.

B. Straw Bales: The CONTRACTOR shall supply straw bales in sufficient quantities to be used for sedimentation control as needed. Straw bales shall be replaced at a minimum of every two months, or as directed by the CONSULTANT/ENGINEER.

PART 3 - EXECUTION

3.01 HANDLING

A. Materials shall be handled in such a manner as to prevent damage to the material. Materials shall not be dropped or dragged over the ground. Any materials damaged shall be replaced at no expense to the CONSULTANT/ENGINEER.

3.02 SURFACE-WATER CONTROL STRUCTURES

A. Silt Fence: The CONTRACTOR shall install silt fence in accordance with these Specifications and installation instructions provided by the MANUFACTURER, or as directed by the CONSULTANT/ENGINEER. Presiding authority shall be as follows, in descending order: CONSULTANT/ENGINEER'S direction, Specifications, MANUFACTURER's installation instructions.

B. Straw Bales: The CONTRACTOR shall install straw bales in the locations indicated on the Construction Drawings, or as directed by the CONSULTANT/ENGINEER.

END OF SECTION

SECTION 02510
ASPHALT CONCRETE PAVING

PART 1 - GENERAL

1.01 WORK INCLUDED

A. The Work covered by this Section consists of furnishing all equipment, tools, and labor necessary for the installation of asphalt concrete paving including a base course, tack coat, and surface course at the locations shown on the Construction Drawings.

1.02 RELATED SECTIONS

A. Section 01010 - Summary of Work.

B. Section 01300 - Submittals.

C. Section 01400 – Quality Controls.

D. Section 02211 - Rough/Final Grading.

1.03 REFERENCES

A. The Asphalt Institute - Manual MS-4 - The Asphalt Handbook.

B. The Asphalt Institute - Manual MS-13 - Asphalt Surface Treatments and Asphalt Penetration Macadam.

C. ASTM D-1557 - Laboratory Compaction Characteristics of Soil Using Modified Effort.

D. ASTM D-946 - Asphalt Cement for Use in Pavement Construction.

E. New York State Department of Transportation (DOT) Specifications - Section 400: Bituminous Pavements, and Section 407 - Tack Coat.

1.04 SYSTEM PERFORMANCE

A. Paving shall withstand the anticipated short-term daily use by construction equipment, and shall withstand heavy-duty heavy vehicular traffic after the completion of construction activities at the SITE.

1.05 QUALITY ASSURANCE

The CONTRACTOR shall:

A. Perform work in accordance with The Asphalt Institute specifications and the New York State DOT Standard Specifications for Road and Bridge Construction.

B. Obtain materials from the same local, reputable SUPPLIER throughout the project.

1.06 REGULATORY REQUIREMENTS

A. The CONTRACTOR shall conform to applicable local regulations for paving on private property.

1.07 TESTS

A. Testing and analysis of the asphalt concrete paving mix will not be required. However, the CONTRACTOR shall also provide a performance guarantee for a minimum two-year period and repair any damage at no cost to the CONSULTANT/ENGINEER during the guarantee period.

B. The CONTRACTOR shall submit proposed mix designs to the CONSULTANT/ENGINEER for review and approval a minimum of three weeks prior to the commencement of the Work.

C. Asphalt used shall have a minimum field density of 95 percent of the required laboratory density (Marshall Method) for the mix used.

1.08 SUBMITTALS

The CONTRACTOR shall submit:

A. All data in accordance with Section 01300.

B. Technical product data to the CONSULTANT/ENGINEER a minimum of three weeks prior to commencement of the Work.

C. Documentation for the asphalt pavement, which includes mix type, sealer, and other technical data to the CONSULTANT/ENGINEER for review and informational purposes a minimum of three weeks prior to the commencement of the Work.

D. MANUFACTURER'S instructions for asphalt repair prior to commencement of the Work.

1.09 ENVIRONMENTAL REQUIREMENTS

A. The CONTRACTOR shall not place asphalt when the base surface temperature is less than 50 °F, unless prior approval is given by the CONSULTANT/ENGINEER.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Base Course: Granular material or crushed stone, which is dry and free of deleterious materials. The base course shall conform to the State of New York DOT Specifications for Base Course "Type 2". The asphalt cement shall be AC-20.

B. Surface Course: Sand type or approved substitute as per Asphalt Institute Manual MS-4. The surface course shall conform to the State of New York DOT Specification for Top Course "Type 7." The surface course asphalt cement shall be 85-100 penetration asphalt cement.

C. The tack coat shall conform to the State of New York DOT Specification Material Designation 702-3401.

D. The CONTRACTOR shall use primer, tackcoat, asphalt cement and aggregates conforming to ASTM D-946 and to those normally used in the geographical locality of the SITE.

E. The asphalt concrete shall consist of a combination of coarse aggregate, fine aggregate and mineral filler uniformly coated and mixed with asphalt cement.

F. Aggregate and filler shall conform to the appropriate State DOT Specification and meet the requirements and gradations of the specified mix.

2.02 ASPHALT PAVING MIX

The CONTRACTOR shall use:

A. Dry materials to avoid foaming and for uniform mixing.

B. A base course that has between 4.5 to 6 percent of asphalt cement by weight in mixture.

C. A surface course that has between 5 to 7 percent of asphalt cement by weight in mixture.

2.03 EQUIPMENT

A. Compacting: A minimum of one steel wheel roller and a pneumatic-tired roller or (3) steel wheel rollers will be required in large areas.

B. Steel Wheel Rollers: The steel wheel rollers shall be conventional 12-ton minimum weight, three wheel or tandem two-wheel types (approximately 400 lbs. per linear inch).

C. Pneumatic-Tired Rollers: The pneumatic-tired roller shall be conventional self-propelled types (approximately 90 psi tire pressures) and shall consist of two axles on which are mounted multiple pneumatic-tired wheels having a minimum operating weight of 2,000 pounds per tire.

D. Finishing: The finishing equipment shall consist of an approved self-propelled mechanical spreader to place the mix to grades required by the CONSULTANT/ENGINEER.

PART 3 - EXECUTION

3.01 INSPECTION

The CONTRACTOR shall:

A. Stabilize any subbase to be paved a minimum of 12 inches below the bottom of the base material by compacting and tamping with heavy smooth-wheeled rollers.

B. Verify that the compacted granular material or crushed stone base has been properly prepared and is dry and ready to support paving and imposed loads. The base shall be compacted in 6-inch lifts to 90 percent of the maximum dry density using Modified Proctor compaction effort (ASTM D-1557).

C. Verify gradients and elevations of the base are correct prior to placing the asphalt concrete mix.

D. Accept the granular material or crushed stone base as suitable prior to the installation of asphalt.

3.02 BASE COURSE INSTALLATION

A. After the subbase has been compacted, and approved by the CONSULTANT/ENGINEER, an asphalt concrete base course shall be constructed as herein specified to a compacted thickness as indicated on the Construction Drawings.

B. Base Course Mixing, Transporting and Placing: The mixing, including the plant used in the preparation of the mix; transporting and placing of the mix, shall be in accordance with the New York State DOT Specification for Base Course Type 2 and in accordance with standard practices for quality work.

C. The compaction of the mixture shall be accomplished by the steel wheel roller. Immediately following the initial rolling, the asphalt concrete shall be compacted using pneumatic-tired or steel wheel rollers operating in a sequence to assure the most efficient results. Rolling of the mixture shall begin immediately behind the finishing or laying machine. For breakdown, the steel wheel roller shall be used. The pneumatic-tired roller, if utilized, shall be used for secondary rolling; the finish rolling shall be accomplished with the steel wheel roller.

D. The speed of the rollers shall not exceed (2½) miles per hour and shall at all times be slow enough to avoid displacement of the hot mixture and any displacement occurring as a result of reversing the direction of the roller, or from any other cause, shall at once be corrected by the use of rakes and of fresh mixture where required. Rolling shall proceed continuously until all roller marks are eliminated and no further compression is possible. To prevent adhesion of the mixture to the roller, the wheel shall be kept properly moistened, but excess of either water or oil will not be permitted. The rollers shall be in good condition, capable of reversing without backlash. They shall be operated by competent and experienced rollermen and must be kept in continuous operation as nearly as practicable in such a manner that all parts of the pavement shall receive substantially equal compression.

E. At all places not accessible to the roller, thorough compaction must be secured by means of hot tampers.

F. Surface Requirements: The course after final compression shall be smooth, of uniform texture, and true to the established grade. It shall have an average thickness as specified on the Construction Drawings. Any low or defective places shall immediately be remedied by cutting out the course at such spots and replacing it with fresh, hot mixture that shall be immediately compacted to conform with the surrounding area and shall be thoroughly bonded to it. The surface of the finished pavement shall be free from depressions exceeding one-eighth (1/8) inch as measured with a ten (10) foot straight edge.

G. Asphalt Concrete Mixture Density: After final compression, the finished course shall at no point have a density less than ninety-five (95) percent of the laboratory compacted density.

H. Longitudinal and Transverse Joints shall be made in a careful manner. Well-bonded and sealed joints are required. Joints between old and new pavements or between successive days' work shall be carefully made in such a manner as to insure a thorough and continuous bond between the adjoining surfaces. The edge of the previously laid course shall be cut back to its full depth so as to expose a fresh surface, after which the hot mixture shall be placed in contact with it and raked to a proper depth and grade. Infra-red joint heaters shall be carefully employed in such a manner as to heat up all joints sufficiently (without burning) to insure a proper bond. Before placing mixture against them, all contact surfaces or longitudinal joints, shall be painted with a thin uniform coating of hot asphalt cement or asphalt cement dissolved in naphtha or emulsified asphalt.

I. In making the joint along any adjoining pavement, and after the hot mixture is placed by the finishing machine, just enough of the hot material shall be carried back to fill any space left open. This joint shall be properly "set-up" with the back of a rake at proper height and beveled to receive the maximum compression under rolling. The work of "setting-up" this joint shall be performed always by competent workmen, who are capable of making a correct, clean and neat joint.

J. Patching of Deficient Areas: For repairs at joints or other areas behind the paving machine, the mixture shall be hand raked immediately in a fan-shaped pattern and the loose mix left slightly higher than the surrounding mat and immediately rolled. Mix shall be dumped into areas deficient in material, carefully mixed, smoothed and rolled. "Broadcasting" of the mixture will not be permitted at any time.

K. After compaction has been completed, joints shall be painted with RC liquid asphalt.

3.03 TACK COAT INSTALLATION

A. Tack coat shall be applied only when the existing surface is dry, and when the atmospheric temperature is above 50 °F. The liquid asphalt shall be applied at a uniform rate by an approved pressure distributor at a spraying temperature and application rate specified hereinafter.

B. All equipment used in the distribution of the tack coat shall have measuring and recording devices in good working order so as to accurately measure and record the quantities of bituminous materials distributed.

C. Immediately before applying the tack coat, the full width of surface to be treated shall be swept. Care shall be taken to remove all loose dirt, asphalt or other loose objectionable material.

D. After the operation of removing the dust has been completed, and prior to the application of the tack coat, an inspection shall be made of the surface to determine its fitness to receive the asphalt cement. That portion of the surface of the course proposed for immediate treatment must be dry and altogether in a satisfactory condition.

E. The tack coat shall be applied to the surfaces of existing pavement upon which surface course material will be placed as shown on the Construction Drawings and to exposed edges of existing pavement surfaces to be in contact with new pavement. Tack coat shall completely cover the surface to be paved and shall not be applied more than 12 hours before the overlaying course is laid. Rate of application shall be between 0.03 to 0.07 gallons per square yard. The exact amount will be determined in the field as directed by the CONSULTANT/ENGINEER.

F. Following the application, the surface shall be allowed to cure without being disturbed for such period of time as may be necessary to permit drying out and settling of the tack coat. That period shall be determined by the CONSULTANT/ENGINEER. The surface shall then be maintained until the next course has been placed. Suitable precautions shall be taken by the subcontractor to protect the surface against damage during this interval, including any sand necessary to blot up excess asphalt cement.

3.04 WEARING SURFACE INSTALLATION

A. After the tack coat or the stabilized base course has thoroughly cured, an asphalt concrete wearing surface course shall be constructed, as herein specified, to a compacted thickness as indicated on the Construction Drawings.

B. Surface Course Mixing, Transporting and Placing: The mixing, including the plant used in the preparation of the mix; transporting and placing of the mix, shall be in accordance with the New York State DOT Specification for Top Course Type "7" and in accordance with standard practices for quality work.

C. The compaction of the mixture shall be accomplished by the steel wheel roller. Immediately following the initial rolling, the asphalt concrete shall be compacted using pneumatic-tired or steel wheel rollers operating in a sequence to assure the most efficient results. Rolling of the mixture shall begin immediately behind the finishing or laying machine. For breakdown, the steel wheel roller shall be used. The pneumatic-tired roller, if utilized, shall be used for secondary rolling; the finish rolling shall be accomplished with the steel wheel roller.

D. The speed of the rollers shall not exceed (2½) miles per hour and shall at all times be slow enough to avoid displacement of the hot mixture and any displacement occurring as a result of reversing the direction of the roller, or from any other cause, shall at once be corrected by the use of rakes and of fresh mixture where required. Rolling shall proceed continuously until all roller marks are eliminated and no further compression is possible. To prevent adhesion of the mixture to the roller, the wheel shall be kept properly moistened, but excess of either water or oil will not be permitted. The rollers shall be in good condition, capable of reversing without backlash. They shall be operated by competent and experienced rollermen and must be kept in continuous operation as nearly as practicable in such a manner that all parts of the pavement shall receive substantially equal compression.

E. At all places not accessible to the roller, thorough compaction must be secured by means of hot tampers.

F. Surface Requirements: The course after final compression shall be smooth, of uniform texture and true to the established grade. It shall have an average thickness as specified on the Construction Drawings and shall at no point vary more than one-quarter (1/4) inch from this thickness. Any low or defective places shall immediately be remedied by cutting out the course at such spots and replacing it with fresh, hot mixture which shall be immediately compacted to conform with the surrounding area and shall be thoroughly bonded to it. The surface of the finished

pavement shall be free from depressions exceeding one-eighth (1/8) inch as measured with a ten (10) foot straight edge.

G. Asphalt Concrete Mixture Density: After final compression, the finished course shall at no point have a density less than ninety-five (95) percent of the laboratory compacted density.

H. Longitudinal and Transverse Joints shall be made in a careful manner. Well-bonded and sealed joints are required. Joints between old and new pavements or between successive days' work shall be carefully made in such a manner as to insure a thorough and continuous bond between the adjoining surfaces. The edge of the previously laid course shall be cut back to its full depth so as to expose a fresh surface, after which the hot mixture shall be placed in contact with it and raked to a proper depth and grade. Infra-red joint heaters shall be carefully employed in such a manner as to heat up all joints sufficiently (without burning) to insure a proper bond. Before placing mixture against them, all contact surfaces or longitudinal joints, shall be painted with a thin uniform coating of hot asphalt cement or asphalt cement dissolved in naphtha or emulsified asphalt.

I. In making the joint along any adjoining pavement, and after the hot mixture is placed by the finishing machine, just enough of the hot material shall be carried back to fill any space left open. This joint shall be properly "set-up" with the back of a rake at proper height and beveled to receive the maximum compression under rolling. The work of "setting-up" this joint shall be performed always by competent workmen, who are capable of making a correct, clean and neat joint.

J. Patching of Deficient Areas: For repairs at joints or other areas behind the paving machine, the mixture shall be hand raked immediately in a fan-shaped pattern and the loose mix left slightly higher than the surrounding mat and immediately rolled. Mix shall be dumped into areas deficient in material, carefully mixed, smoothed, and rolled. "Broadcasting" of the mixture will not be permitted at any time.

K. After compaction has been completed, joints shall be painted with RC liquid asphalt.

3.05 FIELD QUALITY CONTROL

A. The CONSULTANT/ENGINEER will perform a field inspection for conformance with these Specifications.

3.06 PROTECTION

A. The CONTRACTOR shall, immediately after placement of the asphalt, protect the pavement from mechanical injury until the pavement has fully hardened and is capable of supporting vehicular traffic without sustaining damage.

3.07 REPAIR

A. The CONTRACTOR shall repair all damage to existing asphalt concrete paving which occurs during execution of the Work.

END OF SECTION

SECTION 02831
CHAIN LINK FENCING AND GATE

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. The CONTRACTOR shall furnish and install, complete in every detail, all new galvanized chain-link fencing to enclose the proposed treatment building as shown on the Construction Drawings.

B. The fence height shall be 6 feet.

C. One gate shall be provided at the location shown on the Construction Drawings.

D. In general this work shall include the furnishing and installation of the following:

1. All new galvanized chain-link fence framework, fabric, and accessories.

2. The excavation (3-feet and 6-inches deep and 1-foot diameter) for post bases.

3. Concrete anchorage to fill the excavated hole for posts.

4. Manual gate (11-feet wide including gate post). The gate shall be hinged to swing out.

1.02 RELATED SECTIONS

A. Section 01090 - Reference Standards.

B. Section 01300 - Submittals.

C. Section 01400 - Quality Control.

D. Section 01600 - Material and Equipment.

1.03 REFERENCES

A. ANSI/ASTM F567 - Installation of chain-link fence.

B. ASTM A123 - Zinc (Hot Galvanized) coatings of products fabricated from rolled, pressed, and forged steel shapes, plates, bars and strips.

C. ASTM A120 - Pipe, steel, black, and hot-dipped zinc-coated (Galvanized) welded and seamless, for ordinary uses.

D. ASTM C94 - Ready mix concrete.

1.04 QUALITY ASSURANCE

A. MANUFACTURER: Company specializing in commercial quality chain-link fencing with a minimum of two years experience.

B. All equipment and materials furnished under this Contract shall be new, suitable for the conditions of service to which they will be subject and equal to the best of their respective classes. Grade and quality shall meet the applicable cited specifications and standards.

C. Workmanship shall be of the highest quality and shall be carried out by competent and experienced workmen.

1.05 SUBMITTALS

A. CONTRACTOR shall submit product data and installation instructions prior to construction of fence.

B. CONTRACTOR shall include plan layout, grid, spacing of components, accessories, fittings, hardware, anchorages, and schedule of components in accordance with Section 01300 (Submittals).

PART 2 - PRODUCTS

2.01 FENCE MATERIALS

A. All posts and rails shall be hot dipped, zinc-coated steel meeting ASTM specifications A120-83, A128-78 or A153-82, whichever is applicable.

B. The fence fabric shall be No. 9 gauge wire woven meeting ASTM Specification F668.

C. Privacy slats shall be sized (minimum 1.5 inches wide) to fit every link of the fence fabric weave, and forest green color.

2.02 CONCRETE MATERIALS

A. Cement: ASTM C150 - Type I - All cement shall be dry, free from lumps, and its color shall be a uniform bluish-gray.

B. Ready-Mix Concrete: Type I General Purpose .

C. Fine Aggregates: ASTM C 33 - The fine aggregate shall be clean, high-silica sand, having not more than three (3) percent by weight of foreign matter such as loam, clay, dirt, or other impurities and shall be free from injurious amounts of organic impurities. Fine aggregates shall be well graded from coarse to fine.

D. Coarse Aggregates: ASTM C33 - Coarse aggregate, unless otherwise specified, shall be well graded.

E. Water: The water used in mixing concrete shall be clean and accurately measured for each batch. In general, all water for mixing and curing purposes shall be obtained from a local municipality water supply. Water contaminated with sewage or oil, or water containing dirt, clay, filth or vegetable matter, or river or lake water, shall not be used.

2.03 CONCRETE MIX

A. Proportions: Concrete shall be composed of a thorough mixture of cement and fine and coarse aggregates with mixing water. Prior to the beginning of concrete work, a statement of the proportions proposed for the concrete mixture shall be submitted to the CONSULTANT/ENGINEER in quadruplicate, for his information and appropriate action.

B. Cement: Unless specifically permitted by the ENGINEER, the cement content of the concrete shall not be less than the following:

Class A - 6 bags per cubic yard

The weight of a bag of Portland cement will be taken as ninety-four (94) pounds.

C. Aggregates: The relative volume of fine and coarse aggregates shall be subject to adjustments by the CONSULTANT/ENGINEER to obtain the concrete mix best suited to the use intended, but except as otherwise required, the fine aggregate shall

constitute not less than thirty (30) percent nor more than fifty (50) percent of the total volume of aggregates.

D. Water: The amount of water used in concrete, inclusive of free water contained in the aggregates but exclusive of water absorbed by the aggregates, shall not exceed five (5) gallons per sack of cement for Class A concrete. So long as the water-cement ratio is kept below this maximum, the water content may be varied by the ENGINEER to obtain desired consistencies measured by "slump," not to exceed 4 inches determined by the procedures of "Standard Test Method for Slump of Portland Cement Concrete," A.S.T.M. Designation: C 143-78.

2.04 COMPONENTS

A. Line posts shall be 2.0 - inch diameter galvanized steel pipe.

B. Corner posts shall be 3.0 - inch diameter galvanized steel pipe.

C. Gate posts shall be 2.0 - inch diameter galvanized steel pipe.

D. Top rail shall be 2 - inch diameter, plain end, sleeve-coupled steel pipe.

E. Brace rail shall be 1 5/8 - inch diameter, plain end, sleeve-coupled steel pipe.

F. Bottom rail shall be 2 - inch diameter, plain end, sleeve-coupled steel pipe

G. The fence fabric shall be 2-inch diamond-shaped mesh, interwoven, 8 gauge thickness, and shall have forest green privacy slats incorporated. Top selvages are to have twisted and barbed ends. Bottom selvages shall be knuckled.

H. Gate frame shall be the same height as the fence and shall be approximately 11-feet wide at the location shown on the Construction Drawings.

I. Post top shall be steel or malleable iron, galvanized; sized to post dimensions with set screw.

J. Fittings shall include: galvanized steel sleeves, bands, clips, rail end, tension bars, fasteners, and fittings.

K. Top and bottom tension wires of the fence shall be No. 7 gauge galvanized wire.

L. The gate shall be provided with suitable hinges, stops, latching, and locking devices.

2.05 FINISHES

A. Galvanized: ASTM A123; 0.2 oz. / sq. ft. coating.

B. Accessories: Same finish as framing.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install framework, fabric, accessories, and gate in accordance with ANSI/ASTM F567 and FS RR-F-191.

B. Set terminal gate and posts plumb, in concrete footings with top of footing at finished grade.

C. Provide top rail through line post tops and splice with 7 inch long rail sleeves.

D. Brace each gate and corner post back to adjacent line post with horizontal center brace rail and diagonal truss rods. Install brace rail, one bay from end and gate posts.

E. Install center and bottom brace rail on corner and gate leaves.

F. Stretch fabric between terminal posts.

G. Position bottom of fabric 2 inches above finished grade.

H. Fasten fabric to top rail, line posts, braces, and bottom tension wire with wire ties a maximum of 15 inches on center.

I. Attach fabric to end, corner, and gate posts with tension bars and tension bar clips.

J. Install bottom tension wire stretched taut between terminal posts.

K. Install gate with fabric to match fence. Install three hinges, latch, catches, retainer and locking clamp.

L. Posts, fabric, and gate assemblies shall be erected in accordance with the MANUFACTURER's standard specifications, the Construction Drawings, and shall be subject to the approval of the CONSULTANT/ENGINEER.

END OF SECTION

SECTION 03110
CONCRETE FORMWORK

PART 1 - GENERAL

1.01 WORK INCLUDED

This section prescribes materials and methods to be used in fabricating, erecting, and removing forms for cast-in-place concrete. The CONTRACTOR shall furnish all form design, forms, shoring, ties, form coating, and materials and all labor, equipment, and other items necessary or convenient to the CONTRACTOR for the fabrication, erection, and removal of formwork.

1.02 RELATED SECTIONS

A. Section 01300 - Submittals

B. Section 03300 - Cast-in-Place Concrete

1.02 GENERAL

A. Forms shall be fabricated, erected, and removed as specified herein and shall be of a type, size, shape, quality and strength to produce hardened concrete having the shape, lines, and dimensions indicated on the Construction Drawings. The forms shall be true to line and grade in accordance with the tolerances as specified in Section 03300 (Cast-in-Place Concrete) and shall be mortar tight and sufficiently rigid to resist deflection during concrete placement. The surfaces of forms shall be smooth and free from irregularities, dents, sags, and holes that would deface the finished surfaces.

B. The CONTRACTOR shall be responsible for designing, erecting, supporting, bracing, and maintaining formwork to support vertical and lateral loads that might be applied until such loads can be supported by the concrete structure. It shall be the responsibility of the CONTRACTOR to correctly assess and analyze the erection stresses induced upon the structure, its elements and supporting foundations during construction. Since the CONSULTANT/ENGINEER does not dictate or determine the CONTRACTOR'S sequence of operations of construction, the CONSULTANT/ENGINEER cannot determine erection stresses and therefore assumes no responsibility or obligation to do so.

C. The CONTRACTOR shall be responsible for adequate formwork design for construction of cast-in-place reinforced concrete.

D. Except as modified herein, form design, fabrication, and erection shall conform to the requirements of the latest editions of ACI 347 and ACI 318 and shall be acceptable to the CONSULTANT/ENGINEER. Design criteria for plywood shall conform to APA Form V345.

E. Formwork shall comply with the requirements of ANSI A10.9 and OSHA Construction Standards, Part 1926, Subpart Q, "Concrete, Concrete Forms, and Shoring."

1.03 SUBMITTALS

A. The CONTRACTOR shall submit to the CONSULTANT/ENGINEER for review Shop Drawings and design calculations for formwork the CONTRACTOR intends to use during construction in accordance with Section 01300 (Submittals).

B. Product data for the formwork shall be submitted as indicated in Section 01300 (Submittals).

1.04 STORAGE

All form materials and accessories shall be stored above-ground on framework or blocking and shall be covered with a suitable water-proof covering providing adequate air circulation and ventilation.

PART 2 - PRODUCTS

2.01 FORMS

A. Forms for surfaces which will be exposed to view when construction is completed shall be prefabricated plywood panel forms, job-built plywood forms, or forms that are lined with plywood or fiberboard.

B. Plywood or lined forms will not be required for surfaces which are normally below grade or not ordinarily exposed to view. Other types of forms, such as steel or unlined wooden forms, may be used for surfaces which are not restricted to plywood or lined forms, and may be used as backing for form linings. Forms are required above all extended footings.

C. Forms for cast-in-place concrete shall conform with the following requirements:

- Prefabricated Steel Forms shall be Simplex "Industrial Steel Frame Forms," Symons "Steel Ply," Universal "Uniform," or equal.
- Plywood Forms shall be Product Standard PS-1, waterproof, resin- bonded, exterior type douglas fir. For normal finish, face adjacent to concrete Grade B or better. For architectural finish, face adjacent to concrete Grade B or better with plastic overlay.
- Lumber Forms Straight, dressed all sides, uniform width and thickness, and free from knots, offsets, holes, dents, and other surface defects.
- Fiberboard Forms Federal Specification LLL-B-810, Type IX, tempered, waterproof, screenback, concrete form hardboard.
- Chamfer Strips Clear white pine, surface against concrete planed.

D. Reuse of job-built plywood forms shall be permitted only when specifically approved by the CONSULTANT/ENGINEER. Plywood shall be furnished and placed in 48-inch widths and in uniform lengths of not less than 96 inches, except where the dimension of the component to be formed is less. Where plywood is attached directly to studs or joists, the panels shall be not less than 5/8 inch thick. Studs shall be provided sufficiently sized and spaced to prevent bulging of the plywood sheeting.

E. Where earth is too unstable to serve as a form for sides of footings and foundations, the sides against the earth may be formed with 3/4 inch thick No. 2C Yellow Pine with tight butt joints, securely braced to hold a straight line.

2.02 FORM TIES

Form ties shall be approved by the CONSULTANT/ENGINEER and shall be of the snap cone or she-bolt with cone type as manufactured by a recognized MANUFACTURER of concrete forming accessories. Cones shall leave a hole or depression in the concrete no larger than 7/8-inch in diameter. Plain snap ties or flat bar ties, unless otherwise approved by the CONSULTANT/ENGINEER, shall not be used. Ties shall be of a type that will accurately tie, lock, and spread the forms. Tie spacing shall be designed to withstand concrete pressures without bulging, spreading, or lifting of the forms. The tie shall be of such a design that when forms are removed no metal shall be within 2 inches of any surface unless stainless steel ties are used, in which case no metal shall be within 1 inch of any surface. Permanently embedded

portions of form ties which are not provided with threaded ends shall be constructed so that the removable ends are readily broken off without damage to the concrete.

2.03 FORM COATINGS

Where specified herein, forms shall be coated with a nonstaining form release agent prior to concrete placement. Form coatings shall be Industrial Lubricants "Nox-Crete Form Coating," L&M "Debond," Prater "Pro-Cote," Richmond "Rich Cote," or equal.

PART 3 - EXECUTION

3.01 FABRICATION AND ERECTION

A. Forms shall be substantial and sufficiently tight to prevent leakage of concrete. Forms shall be braced or tied to maintain the desired position, shape, and alignment during and after concrete placement. Walers, studs, internal ties, and other form supports shall be sized and spaced so that proper working stresses are not exceeded. Joints in forms shall be bolted tightly and shall bear on solid construction. Forms shall be constructed so they can be removed without hammering, wedging, or prying against the concrete. Form ties in exposed surfaces shall be uniformly spaced and aligned in horizontal and vertical rows. The forms shall produce finished surfaces that are free from off-sets, ridges, waves, and concave or convex areas.

B. Forms to be reused shall be thoroughly cleaned and repaired. Split, frayed, delaminated, or otherwise damaged forms shall not be used.

C. All form panels shall be placed in a neat, symmetrical pattern with horizontal joints level and continuous. The CONTRACTOR shall place special attention on mating forms to previously placed walls so as to minimize steps or rough transitions. Form panels shall be of the largest practical size to minimize joints and to improve rigidity.

D. Beams and slabs supported by concrete columns shall be formed so the column forms may be removed without disturbing the supports for the beams or slabs.

E. Wherever the top of a wall will be exposed to weathering, the forms on at least one side shall not extend above the top of the wall and shall be brought to true line and grade. At other locations forms for concrete which is to be finished to a specified elevation, slope, or contour, shall be brought to a true line and grade, or a wooden guide strip shall be provided at the proper location on the forms so that

the top surface can be finished with a screed or template. At horizontal construction joints in walls the forms on one side shall not extend more than 2 feet above the joints.

F. Temporary openings shall be provided at the bottom of column and wall forms and at other points where necessary to facilitate cleaning and inspection prior to concrete placement.

G. Unless shown otherwise or specified by the CONSULTANT/ENGINEER, all salient corners and edges of beams, columns, walls, slabs, and curbs shall be provided with a 3/4- by 3/4-inch chamfer formed by a wood or metal chamfer strip.

H. Forms for exposed surfaces and all steel forms shall be coated with a nonstaining form release agent which shall be applied just prior to placement of steel reinforcement. After coating, any surplus form release coating on the form surface shall be removed. Wood forms for unexposed surfaces may be thoroughly wetted with water in lieu of coating immediately before concrete placement, except in freezing weather form release coating shall be used.

I. Should misalignment of forms or screeds, excessive deflection of forms, or displacement of reinforcement occur during concrete placement, immediate corrective measures shall be taken to ensure acceptable lines and surface to required dimensions and cross sections.

J. If any forms bulge or show excessive deflection, in the opinion of the CONSULTANT/ENGINEER, the concrete shall be removed and the forms rebuilt and strengthened at the expense of the CONTRACTOR.

3.02 FORM REMOVAL

A. Forms shall not be removed or disturbed until the concrete has attained sufficient strength to safely support all dead and live loads. Shoring beneath beams or slabs shall be left in place and reinforced as necessary to carry any construction equipment or materials placed thereon.

B. No forms shall be removed without the approval of the CONSULTANT/ENGINEER. In general and under normal conditions the CONSULTANT/ENGINEER will approve removal of forms after the following time has elapsed:

Item	Time After Placement
Walls	3 days
Other Concrete	2 days

C. When ambient air temperatures during the curing period fall below 45°F, form removal will take place based on job-cured test cylinder strength only.

D. Care shall be taken in form removal to avoid surface gouging, corner or edge breakage, or other damage to the concrete. Immediately after form removal, any damaged or imperfect work shall be repaired as specified in "Cast-in-Place Concrete" of these Specifications.

END OF SECTION

SECTION 03200
CONCRETE REINFORCEMENT

PART 1 - GENERAL

1.01 WORK INCLUDED

A. The CONTRACTOR shall furnish all required materials and shall properly place for imbedment in the concrete, at locations to be specified or as directed by the CONSULTANT/ENGINEER, all required reinforcing steel for properly reinforcing all structures built as part of this Work. This shall include the steel reinforcing as shown on the Construction Drawings.

1.02 RELATED SECTIONS

A. Section 01300 - Submittals

B. Section 03300 - Cast-in-Place Concrete

1.03 SUBMITTALS

A. The location, size, and configuration of the reinforcing steel shall be specified by the CONSULTANT/ENGINEER and submitted in the Shop Drawings as indicated in Section 01300 (Submittals).

B. Product data shall be submitted as indicated in Section 01300 (Submittals).

1.04 REFERENCES

A. ACI 301- Specification for Structural Concrete for Buildings.

B. ACI 315 - Details and Detailing of Concrete Reinforcement.

C. ACI 318 - Building Code Requirements for Reinforced Concrete.

D. American Welding Society (AWS) D1.4- Structural Welding Code- Reinforcing Steel.

E. ASTM A184 - Fabricated Deformed Steel Bar Mats for Concrete Reinforcement.

F. ASTM A185 - Steel Welded Wire Fabric, Plain, for Concrete Reinforcement.

G. ASTM A615 - Deformed and Plain Billet Steel Bars for Concrete Reinforcement.

PART 2 - PRODUCTS

2.01 QUALITY AND GRADE

A. Reinforcing Bars: Reinforcing bars shall be deformed billet-steel bars conforming to ASTM A 615. All bars No. 4 and larger shall be Grade 60. All bars No. 3 and smaller shall be Grade 40. All bars shall be shop-fabricated and bent cold. Bars shall be free from defects and kinks and from bends not indicated on the Drawings or approved bending diagrams.

B. Mesh Reinforcement: Mesh reinforcement shall be electrically-welded, cold--drawn, mild-steel, plain wire fabric conforming to ASTM A 185. Wire shall be cold-drawn steel conforming to ASTM A 82.

C. Support Chairs: Reinforcement supports shall conform to Product Standard PS7 and CRSI *Manual of Standard Practice*, Class D or E. Reinforcement support chairs shall be stainless steel or shall be plastic-tipped when used in walls and elevated slabs. Support chairs used in slabs on grade shall be stainless steel or shall be hot-dip galvanized after fabrication or plastic-tipped in such a manner as to provide a minimum 12 inches of protection from the subgrade. Nails shall not be used to support reinforcement.

D. Tie Wire: Tie wire shall conform to Federal Specification QQ-W-461 and shall be of black annealed steel, 16-gauge minimum.

E. All steel used for reinforcement purposes shall be clean, new stock, and free from defects and bends not specified by the CONTRACTOR or the CONSULTANT/ENGINEER. Only corrugated or deformed bars, of an approved type, shall be used in the Work.

F. No reinforcing steel shall be welded unless specifically approved by the CONSULTANT/ENGINEER. Welding of reinforcing bars shall be per AWS D 1.4.

G. All structural steel (sole plates, angle seats, clips) shall be hot dip galvanized when surfaces will be exposed after the concrete is finished.

H. Deformed steel bar mats shall be per ASTM A184.

2.02 TESTS

A. Reinforcement bars and wire mesh shall be inspected and tested at the mill at which they are rolled or fabricated, in accordance with A.S.T.M. Designation: A 615-82 and A 185-79, respectively.

B. The CONTRACTOR shall provide two (2) certified copies of the reinforcing steel mill test reports to the CONSULTANT/ENGINEER upon request.

PART 3 - EXECUTION

3.01 BENDING

A. All reinforcement bars shall be cold bent as specified on the approved Shop Drawings.

B. Bars of a single length shall be used in all cases, except where the length required is such that they cannot be so obtained, or where the CONSULTANT/ENGINEER shall give permission to use shorter lengths or allow lapping. Cold bends shall be made around a pin having a diameter at least six (6) times the least dimension of the reinforcing bar, for No. 3 through No. 8 bars, and around a pin having a diameter at least eight (8) times the least dimension of the reinforcing bar for No. 9 through No. 11 bars.

C. Reinforcement partially embedded in concrete shall not be field bent without the prior permission of the CONSULTANT/ENGINEER.

3.02 STORAGE AND PROTECTION

A. All steel for reinforcement shall be delivered to the SITE without rust, other than that which may have accumulated in normal transit. It shall be sorted for size and length and shall be properly tagged, with substantial tags securely attached to each bundle properly identifying the bars as to use intended.

B. Reinforcement shall be protected from the weather and stored at least 12 inches above ground on timber mats or other supports acceptable to the CONSULTANT/ENGINEER. Contact between reinforcement and the ground shall not be permitted during storage. Reinforcement shall be supported so as not to bend or deflect excessively under its own weight.

C. All steel shall be kept free from oil, grease, dirt, or other objectionable adhering substances, and it shall be satisfactorily cleaned of scale and heavy or flaky rust before being placed in the Work.

D. If, after having been placed in the Work, installation of the concrete shall be delayed or interrupted for any considerable number of days, the steel shall be well protected.

3.03 SURFACE PREPARATION

A. Before placement, all reinforcement shall be thoroughly cleaned of oil, dirt, mill scale, rust scale, and other coatings that would tend to destroy or reduce bond. A thin coating of orange rust resulting from short exposure will not be considered objectionable, but any reinforcement having heavy rust scale or thick rust coating shall be thoroughly cleaned to the satisfaction of the CONSULTANT/ENGINEER or shall be rejected and removed from the job site. When there is a considerable delay between placement of reinforcement and placement of concrete, the reinforcement shall be reinspected prior to placement of concrete and recleaned if necessary.

3.04 PLACEMENT

A. Reinforcement shall be accurately positioned and tied at intersections with annealed wire or suitable clips approved by the CONSULTANT/ENGINEER. Reinforcement shall be supported by concrete or metal chairs, stays, spacers, hangers, or other supports acceptable to the CONSULTANT/ENGINEER.

B. Reinforcing bars shall be fastened with wire ties at a minimum of three places per bar. Bars shall be tied at every intersection around the periphery of slabs. Wall steel shall be tied at every fourth intersection as a minimum.

C. Reinforcement supports shall have sufficient strength and stability to maintain the reinforcement in place throughout placement and concreting operations. Supports and ties shall not be exposed at the face of the concrete nor shall they discolor the surface of the finished concrete.

D. Movement of steel reinforcement in place during concreting operations shall be prevented. Any reinforcement which is displaced shall be accurately repositioned in the proper place before being completely covered.

E. Dowels for successive work shall be securely fastened in correct position before placing concrete. The sticking of dowels after placing concrete shall not be permitted.

F. Reinforcement that has been exposed for bonding with future work shall be protected from corrosion by heavy wrappings of burlap saturated with a bituminous material.

G. No bars partially embedded in concrete shall be field-bent unless approved by the CONSULTANT/ENGINEER.

H. Welding of crossing bars shall not be permitted unless approved by the CONSULTANT/ENGINEER.

3.05 CONCRETE COVER/SPACING

A. The minimum concrete cover for the protection of embedded steel reinforcement, unless specified otherwise in the Construction Drawings, shall be as follows:

Surfaces cast against crushed rock, sand, or earth:

All bar sizes	3 inches

Surfaces exposed directly to water, backfill, or weather after form removal:

All bar sizes	2 inches

Surfaces not exposed directly to water, backfill, or weather after form removal:

Elevated slabs	1 inch
Floors, walkways, pavement	1/2 inch
Walls:	
Less than 12 inches thick	1/2 inch
12 inches or thicker	2 inches
Beams:	
Stirrups	1/2 inch
Principal reinforcement	2 inches

B. The minimum clearance between adjacent parallel bars shall not be less than the nominal diameter of the bars, not less than 1.5 times the maximum coarse aggregate size, and not less than 1 inch in beams, 12 inches in columns, and 2 inches in other locations.

3.06 TOLERANCES

A. Allowable tolerances for fabricating steel reinforcement shall be as follows:

Item	Maximum Tolerance	
Sheared length of bars	+1"	-1"
Depth of truss bars	+0.0"	-2"
Outside dimensions of stirrups, ties, and spirals	+2"	-2"
Location of bends	+1"	-1"

B. Allowable tolerances for placing steel reinforcement shall be as follows:

Item	Maximum Tolerance	
Concrete cover from outside of bar to finished surface	+3"	-0.0"
Lateral spacing of bars in plane of reinforcement in beams and joists	+3"	-0.0"
Lateral spacing of bars in plane of reinforcement in slabs and walls	+1"	-1"
Spacing of stirrups, ties, and spirals along longitudinal axis of member	+2"	-3"
Height of bottom bars in slabs, beams and joists	+3"	-3"
Height of top bars in slabs, beams and joists		
Depth 8" and less	+3"	-3"
Depth 9-24"	+2"	-2"
Depth 25" and greater	+1"	-1"

3.07 SPLICES

A. Lap splices shall be permitted as specified or directed by the CONSULTANT/ENGINEER, or where bar length is not sufficient to permit continuous reinforcing. All lap splices shall be clearly indicated on the Shop Drawings, and are subject to the approval of the CONSULTANT/ENGINEER. All lap splices shall be Class B as per ACI 318-89.

B. The following are the minimum tension lap splice lengths that are permitted, unless otherwise specified or directed by the CONSULTANT/ENGINEER:

No. 3 Rebar: 24"
No. 4 Rebar: 24"
No. 5 Rebar: 28"
No. 6 Rebar: 34"

C. The following are the minimum compression lap splice lengths that are permitted, unless otherwise specified or directed by the CONSULTANT/ENGINEER.

No. 3 Rebar: 18"
No. 4 Rebar: 18"
No. 5 Rebar: 20"
No. 6 Rebar: 24"

D. Welded splices are permitted only with the permission of the CONSULTANT/ENGINEER. All welding shall conform to the American Welding Society (AWS) "Structural Welding Code-Reinforcing Steel" (AWS #D1.4).

END OF SECTION

SECTION 03300
CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Formwork.

B. Cast-in-place concrete foundation, slabs, pipe supports and trench.

C. Concrete curing and finishing.

1.02 RELATED WORK

A. Section 01400 - Quality Control.

B. Section 03200 - Concrete Reinforcement.

1.03 REFERENCES

A. ACI-318 - Building Code Requirements of Reinforced Concrete

B. ACI-MCP-1-74 - Manual of Concrete Practice

C. ASTM C 33 - Concrete Aggregates

D. ASTM C 94 - Ready-Mixed Concrete

E. ASTM C 150 - Portland Cement

F. RP 4-6-1 - Reinforced Concrete Foundation

1.04 QUALITY ASSURANCE

A. Perform testing and placement of concrete in accordance with Section 01400 and ACI 301.

B. Obtain materials from same source throughout the Work.

C. Defective Work: Any concrete found to be defective from any cause whatever, at any time before the final acceptance of the Work, shall be either repaired or removed and replaced at the expense of the CONTRACTOR.

D. Codes and Standards:

1. ACI 301, "Specifications for Structural Concrete for Buildings."

2. ACI 304, "Recommended Practice for Measuring, Mixing, Transporting, and Placing Concrete."

3. ACI 308, "Standard Practice for Curing Concrete."

4. ACI 318, "Building Code Requirements for Reinforced Concrete."

5. Concrete Reinforcing Steel Institute, "Manual of Standard Practice."

1.05 TESTS

A. Compression Tests: During the progress of the work, compression tests shall be made in accordance with the "Standard Method of Making and Curing Concrete Test Specimens in the Field" (A.S.T.M. Designation: C 31-84) and Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens (A.S.T.M. Serial Designation: C 39-83b).

1. The CONTRACTOR shall arrange for laboratory testing of the compression cylinders by the construction quality assurance (CQA) laboratory.

2. Strength tests shall be performed not less than once a day, one per pour, and once for each 150 cubic yards of concrete.

3. The concrete used shall have an ultimate strength of 4,000 psi.

B. Slump Tests:

1. Slump tests shall be performed by the CONTRACTOR. The slump for all concrete shall be within plus or minus one inch of that determined for the design mix (2.02 E) and in no case shall the slump be more than four inches.

2. Obtain samples for one slump test for each pour in accordance with ASTM C-172.

3. Not less than four (4) specimens shall be made for each pour totaling fifty (50) or more cubic yards in any one day. Concrete used in making slump

tests shall not be used to make test cylinders. No water shall be added to the batch after the test cylinders are taken.

PART 2 - PRODUCTS

2.01 CONCRETE MATERIALS

A. Cement: ASTM C150 - Type I - All cement shall be dry, free from lumps, and its color shall be a uniform bluish-gray.

B. Ready-Mix Concrete: Type I General Purpose.

C. Fine Aggregates: ASTM C 33 - The fine aggregate shall be clean, high-silica sand, having not more than three (3) percent by weight of foreign matter such as loam, clay, dirt, or other impurities and shall be free from injurious amounts of organic impurities. Fine aggregates shall be well graded from coarse to fine.

D. Coarse Aggregates: ASTM C33 - Coarse aggregate, unless otherwise specified, shall be well graded.

E. Admixtures: ASTM C260 - Admixtures to the concrete may be used to provide a benefit in water reduction, increased density, improved workability, control of shrinkage, or control of rate of setting, but only with the permission of the CONSULTANT/ENGINEER.

1. The admixture selected shall produce an air content in the freshly mixed concrete of 6% plus or minus 1% as determined in accordance with "Standard Test Method for Air Content of Freshly Mixed Concrete By the Pressure Method", A.S.T.M. Designation C 231-82; or "Standard Test Method for Air Content of Freshly Mixed Concrete By the Volumetric Method", A.S.T.M. Designation: C 173-78.

2. Acceptable evidence must be presented to the CONSULTANT/ENGINEER that such proposed admixtures, in addition to imparting the desired quality, shall cause no detrimental effect in any of the other desirable properties of the concrete.

3. The admixture, if used, shall be added by means of an approved dispenser, to accurately control the amount used in each batch of concrete.

F. Water: The water used in mixing concrete shall be clean and accurately measured for each batch. In general, all water for mixing and curing purposes shall be obtained from a local municipality water supply. Water contaminated with sewage or oil, or water containing dirt, clay, filth or vegetable matter, or river or lake water, shall not be used.

2.02 CONCRETE MIX

A. Proportions: Concrete shall be composed of a thorough mixture of cement and fine and coarse aggregates with mixing water. Prior to the beginning of concrete work, a statement of the proportions proposed for the concrete mixture shall be submitted to the CONSULTANT/ENGINEER in quadruplicate, for his information and appropriate action.

B. Cement: Unless specifically permitted by the CONSULTANT/ENGINEER, the cement content of the concrete shall not be less than the following:

Class A - 6 bags per cubic yard

The weight of a bag of Portland cement will be taken as ninety-four (94) pounds.

C. Aggregates: The relative volume of fine and coarse aggregates shall be subject to adjustments by the CONSULTANT/ENGINEER to obtain the concrete mix best suited to the use intended, but except as otherwise required, the fine aggregate shall constitute not less than thirty (30) percent nor more than fifty (50) percent of the total volume of aggregates.

D. Water: The amount of water used in concrete, inclusive of free water contained in the aggregates but exclusive of water absorbed by the aggregates, shall not exceed five (5) gallons per sack of cement for Class A concrete. So long as the water-cement ratio is kept below this maximum, the water content may be varied by the CONSULTANT/ENGINEER to obtain desired consistencies measured by "slump," not to exceed 4 inches determined by the procedures of "Standard Test Method for Slump of Portland Cement Concrete," A.S.T.M. Designation: C 143-78.

2.03 FORMWORK

A. The forms for exposed surfaces shall be of metal or plywood, adequately supported, or shall be lined with plywood, masonite board or similar lining, and/or with metal.

The design of the forms shall be satisfactory to the CONSULTANT/ENGINEER, but need not be submitted for approval unless specifically requested.

B. Metal wall ties shall be of a type that will permit removal to a distance approximately 1½ inches from the face of the wall, free from spilling and allowing for patching immediately after removal of forms.

C. Twisted wire ties will not be permitted: Concrete blocks or other approved means must be used to maintain proper distance between steel and forms.

2.04 REINFORCING MATERIALS

A. Reinforcing Bars: ASTM A615, Grade 60, deformed.

B. Steel Wire: ASTM A82, plain, cold-drawn steel.

2.05 ACCESSORIES

A. Non-shrink Grout: Premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents; capable of developing minimum compressive strength of 7,000 psi in 28 days.

B. Joint Filler: Ram-Nek Plastic Joint Sealer or approved equal, thickness indicated on Construction Drawings.

C. Epoxy: Mastic Coating.

D. Moisture Barrier: Provide moisture barrier over prepared sub-base material in the concrete slab area. Use only materials which are resistant to decay when tested in accordance with ASTM E154 as follows: polyethylene sheet not less than 6 mils thick.

E. Water Stop: Greenstack Dumbell with Center Bulb water stop or equal.

PART 3 - EXECUTION

3.01 PREPARATION

A. Design, erect, support, brace, and maintain formwork to support vertical and lateral loads that might be applied until such loads can be supported by the concrete

structure. Construct formwork so concrete members and structures are of correct size, shape, alignment, elevation, and position.

B. Design formwork to be readily removable without impact, shock, or damage to cast-in-place concrete surfaces and adjacent materials.

C. Construct forms to sizes, shapes, lines, and dimensions shown, and to obtain accurate alignment, location, grades, and level in finished structures. Provide for openings, offsets, keyways, anchorages, and inserts, and other features required in Work. Use selected materials to obtain required finishes. Solidly butt joints and provide back-up at joints to prevent leakage of cement paste.

D. Provide and install pipe penetrations as shown on the Construction Drawings or as directed by the CONSULTANT/ENGINEER.

E. All forms shall be thoroughly cleaned and wetted just before placing the concrete, and if necessary to secure a smooth surface, they shall be coated with an approved nonstaining substance. Suitable moldings or bevel strips shall be placed in the forms to prevent inside or outside sharp edges. No sharp edges will be permitted in the finished Work. All exposed corners and edges of concrete shall have 3/4-inch chamfer unless otherwise shown on the Construction Drawings.

F. Verify anchors, pre-cast sections, reinforcement, and other items to be cast into concrete are accurately placed, held securely, and will not cause hardship in placing concrete.

G. Prepare previously placed concrete by cleaning with steel brush and applying bonding agent. Apply bonding agent in accordance with MANUFACTURER's instructions.

H. At locations where new concrete is doweled to existing Work, drill holes in existing concrete, insert steel dowels, and pack solid with non-shrink grout.

3.02 PLACING REINFORCEMENT

A. Comply with Concrete Reinforcing Steel Institute's recommended practice for "Placing Reinforcing Bars," for details and methods of reinforcement placement and supports, and as herein specified.

B. Clean reinforcement of loose rust and mill scale, earth, and other materials which reduce or destroy bond with concrete.

C. Accurately position, support, and secure reinforcement against displacement by formwork, construction, or concrete placement operations. Locate and support reinforcing by metal chairs, runners, bolsters, spacers, and hangers, as required.

D. Place reinforcement at joints as shown on Construction Drawings and as herein specified.

3.03 PLACING CONCRETE

A. Notify CONSULTANT/ENGINEER a minimum of 24 hours prior to commencement of concreting operations. Comply with ACI 304, "Recommended Practice for Measuring, Mixing, Transporting, and Placing Concrete," and as herein specified.

B. Delivery: Weigh-tickets shall be prepared for each truck showing the normal batch size; the actual weights of cement, aggregate and water; and the time of loading at the plant.

1. A blank shall also be provided on the weigh ticket for the time of arrival at the site, to be filled in and initialed by the CONTRACTOR's Superintendent or Foreman.

2. A copy of the weigh-ticket shall be delivered to the CONSULTANT/ENGINEER for each batch of concrete delivered to the site.

C. Rejection of Concrete: Ready-mixed concrete (central-mixed and transit-mixed) will be rejected if there is evidence of any of the following:

1. Improper proportions of ingredients, inclusive of water;

2. Initial set;

3. More than sixty (60) minutes transpires after batching or mixing before concrete is placed;

4. Mixers or trucks are overloaded; and/or

5. Successive batches are not uniform.

D. Except as provided herein, water shall not be added to the concrete mixtures at the SITE unless approved by the CONSULTANT/ENGINEER for each instance.

E. Consolidation: Concrete shall be consolidated by means of mechanical vibration equipment.

1. Vibrators shall be of the immersion type, and shall maintain a speed of not less than 7,000 impulses per minute when in operation submerged in concrete.

2. They shall be used only by personnel experienced in their use, and shall be inserted and removed vertically (not dragged horizontally) at such regular intervals to insure uniform consolidation throughout the entire section of concrete being placed.

3. In no case shall vibrators be used to transport concrete inside the forms.

4. The number of vibrators used shall be sufficient to consolidate the concrete properly.

5. At least one standby vibrator shall be on hand at all times.

F. Sloped Surfaces: In special cases, as where concrete is deposited on slopes, a comparatively dry mixture may be used, but care shall be exercised to spread such concrete evenly, in layers not more than four (4) inches in thickness, and to ram it thoroughly. In general, the methods shall be such as to give a compact, dense and impervious concrete with a smooth surface.

G. Ensure reinforcement, inserts, embedded parts, and formed joints are not disturbed during concrete placement.

H. In no case shall the concrete have a free fall sufficient to cause segregation of the aggregate. In general, the limit of free fall shall be six (6) feet.

3.04 BONDING AND JOINTS

A. Joints, either vertical or horizontal, shall be made only where called for by the Construction Drawings or as permitted by the CONSULTANT/ENGINEER.

B. If the CONTRACTOR chooses to make his major slab pours in sections smaller than those indicated on the Construction Drawings between expansion joints or

between edges and expansion joints, he shall submit his schedule of pours for approval at the same time that the reinforcing bars for those pours are submitted. The CONTRACTOR shall take into account the location of reinforcing bar laps when determining the limits of each pour.

C. All joints subject to hydrostatic pressure and all joints which are at or below finished grade shall be provided with plastic water stops.

3.05 FINISHING

A. In general, forms shall not be removed until the concrete has attained sufficient strength to assure structural stability under all dead and construction loads, and until removal can be accomplished without marring concrete surfaces.

B. All form ties shall be carefully snapped back, to a depth of at least one and one-half (1-1/2) inches below the concrete surface. The tie holes shall be patched with the driest 1:2 cement-sand mortar that can be made to stay in place.

C. All horizontal surfaces shall receive the following initial floating operation:

1. The concrete surface shall be accurately struck off and leveled with a long straight edge to the required elevation; suitable guides shall be used, as necessary, to carry the proper grade, pitch or slope; and

2. The surface shall be bull-floated to an even surface, with no unevenness exceeding 1/8-inch in 10 feet in any direction.

D. The bottom slabs of all tanks, channels, conduits, sumps, pits and similar surfaces shall be given a non-slip, heavy-patterned finish with a wood float. All other floor slabs, decks or horizontal surfaces, unless otherwise indicated in the room finish schedule or elsewhere in these specifications, shall be given a non-slip, medium-patterned finish with an aluminum or magnesium float.

E. Float Finish: After screeding, consolidating, and leveling concrete slabs, do not work surface until ready for floating. Begin floating when surface water has disappeared or when concrete has stiffened sufficiently to permit operation of power-driven floats, or both. Consolidate surface with power driven floats, or by hand floating if area is small or inaccessible to power units. Check and level surface plane so that depressions between high spots do not exceed 5/16 inch under a 10-foot straightedge. Cut down high spots and fill low spots. Uniformly slope surfaces

as shown on Construction Drawings. Immediately after leveling, refloat surface to a uniform, smooth, granular texture.

F. Unless otherwise directed, all edges and corners which will be exposed in the finished Work shall be beveled or rounded by the use of appropriate forms or form inserts, and care shall be taken to prevent chipping or cracking of finished edges.

3.06 FIELD QUALITY CONTROL

A. Field inspection and testing shall be performed under provisions of Section 01400 (Quality Control).

B. Maintain records of placed concrete items. Record date, location of pour, quantity, air temperature, and test samples taken.

3.07 CONCRETE CURING AND PROTECTION

A. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.

B. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.

C. Concrete shall be maintained above fifty (50) degrees Fahrenheit and in a continuously moist condition for at least the first seventy-two (72) hours after placement. Curing compounds shall not be used. Concrete curing shall be in accordance with ACI 308, "Standard Practice for Curing Concrete."

3.08 WEATHER CONDITIONS

A. When the temperature is below forty (40) degrees Fahrenheit, or predicted to go below thirty-six (36) degrees in the next twenty-four (24) hours, or predicted to go below thirty-two (32) degrees in the next seventy-two (72) hours, no concrete shall be poured without express permission of the CONSULTANT/ENGINEER. All concrete placed during cold weather shall conform to AC1 306R.

1. Permission so granted shall be for the day and location only, and must again be requested on subsequent days when temperatures are as above.

2. When such permission is granted, no concrete shall be poured until adequate covering material is on site, and until a sufficient number of workmen are

present to expedite finishing and covering to keep both as close behind the pouring as is practicable.

3. The CONTRACTOR shall provide and use proper facilities for heating water and aggregates and protecting the newly mixed concrete from freezing, and satisfactory appliances shall be provided and used for covering and keeping the newly laid concrete warm.

4. The use of chemicals in the concrete mix to reduce the temperature of freezing will not be permitted.

B. All concrete materials, and all reinforcement, forms, inserts and ground with which the concrete is to come in contact, shall be free from frost.

C. All concrete placed shall have a temperature of between fifty (50) and ninety (90) degrees Fahrenheit.

D. The housing, covering or other protection used in connection with the curing shall remain in place and intact at least twenty-four (24) hours after artificial heating is discontinued.

E. When concrete is mixed during extremely warm weather, the CONSULTANT/ENGINEER may require the CONTRACTOR to pre-cool aggregates with water sprays and to schedule the placing of successive layers of concrete so as to cause maximum release and dissipation of the heat of setting. All concrete placed during hot weather shall conform to AC1 305R.

3.09 INSERTS AND OPENINGS

A. The CONTRACTOR shall build into the concrete the steel reinforcement, sleeves, anchor bolts, sump, and other inserts as shown on the Construction Drawings or as directed. Great care shall be taken to keep inserts and openings at proper lines and grade, and to thoroughly tamp under and around them so that there will not be a passage for water. Where inserts are placed in the floors for openings, the top of such shall be four (4) inches above the elevation of the finished floor, unless otherwise specified. Also, pipe sleeves shall be sealed with a watertight seal following installation.

3.10 EQUIPMENT BASES

A. Where the Construction Drawings or these specifications call for concrete foundations to support equipment, such bases shall be formed as shown on the Construction Drawings.

1. Anchor bolts, where required, shall be positioned by template (furnished under the equipment item) to proper elevation and secured in place. Upper edges shall be chamfered on all sides.

B. After the equipment has been set in position and shimmed to elevation, the space between the concrete foundation and the equipment metal base shall be completely filled with a non-shrink, non-metallic grout, Masterflow 713 Grout by Master Builders, Supreme Grout by Gifford-Hill and Company, Inc., or approved equal.

1. Exterior edges of the fill shall be projected slightly beyond the equipment metal base and chamfered.

2. Where practicable, mortar filling as described shall be placed in the presence of the erector of the equipment.

END OF SECTION

SECTION 03500
CONCRETE WELL VAULTS

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. The CONTRACTOR shall furnish and install, complete in every detail, all concrete well vaults for pumping and injection wells as shown on the Construction Drawings.

1.02 RELATED SECTIONS

A. Section 01300 - Submittals.

B. Section 01400 - Quality Control.

C. Section 02222 - Excavation.

D. Section 02223 - Backfilling.

E. Section 03300 - Cast-in-Place Concrete.

1.03 REFERENCES

A. ASTM A615 - Deformed and Plain Billet Steel Bars for Concrete Reinforcement.

B. ACI-MCP-1-74 - Manual of Concrete Practice.

C. ASTM C 33 - Concrete Aggregates.

D. ASTM C 94 - Ready-Mixed Concrete.

E. ASTM C 150 - Portland Cement.

1.04 SUBMITTALS

A. Submit under provisions of Section 01300.

B. Submit shop drawings, field sketches, and MANUFACTURER's technical data to the CONSULTANT/ENGINEER for review and approval prior to purchase and installation of the concrete vault and accessories as per the requirements of Section 1300 (Submittals)

C. Indicate material specifications, dimensions, capacity, size and location of openings, reinforcing details, and accessory locations on any shop drawings or field sketches submitted.

D. Submit MANUFACTURER's installation instructions for review by the CONSULTANT/ENGINEER.

1.05 QUALITY ASSURANCE

A. Perform work in accordance with the requirements of PCI MNL-116, PCI MNL-123, PCI MNL-120.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect, and handle products to the SITE under provisions of Section 01600.

B. Lifting or Handling Devices: Capable of supporting structure in positions anticipated during manufacture, storage, transportation, and erection.

PART 2 - PRODUCTS

2.01 CAST-IN-PLACE CONCRETE VAULTS

The CONTRACTOR shall supply and install cast-in-place concrete vaults conforming to the following:

A. Cast-in-place concrete shall have a minimum compressive strength of 4000 psi and shall meet all requirements set forth in Section 3300 - Cast-in-Place Concrete.

B. The vaults shall be as specified on the Construction Drawings.

C. All openings for pipe penetrations shall contain pipe sleeves as indicated on the Construction Drawings.

D. Pumping well vault covers shall be diamond-plate steel traffic covers, capable of H-20 traffic loadings.

E. Injection well vault covers shall be cast-iron traffic rated road boxes, capable of H-20 traffic loadings.

2.02 FINISHES

A. Ensure exposed-to-view finish surfaces of concrete structure are uniform in color and appearance.

B. Cure structure under conditions necessary to develop required concrete quality, and minimize appearance blemishes such as non-uniformity, staining, or surface cracking.

2.03 FABRICATION TOLERANCES

A. Maximum Variation From Nominal Dimension: 1/4 inch.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that site conditions are ready to receive work and field measurements are as shown on shop drawings and Construction Drawings.

3.02 INSTALLATION

A. The excavation for vault shall be free of debris, standing water, snow and ice and any obstructions. A minimum clearance of 12 inches shall be provided around the perimeter of the vault.

B. Install and seal all sections in accordance with the MANUFACTURER's instructions.

C. Waterproof exterior and interior surfaces of all sections following installation.

D. Install the piping as shown on the Construction Drawings.

E. Waterproof exterior and interior joints, and patch at the pipe penetration points after the concrete has fully cured.

F. Coordinate placement of concrete well vault structure with installation of the compressed air injection and recovery lines as shown on the Construction Drawings.

G. Backfill around vault walls shall consist of good compatible material. No voids shall remain in between walls and native soil excavation. Each layer of backfill shall not exceed 6 inches in depth and shall be compacted.

H. All excavated materials shall be disposed of as specified in Section 02222 - Excavation.

I. Maintain elevations and grades as shown on the Construction Drawings.

END OF SECTION

SECTION 05500
METAL FABRICATIONS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. General standards and specifications related to the manufacture, supply, and installation of various carbon steel equipment and accessories.

1.02 RELATED SECTIONS

A. Section 01300 - Submittals.

B. Section 01600 - Material and Equipment.

C. Section 15000 - Process Piping and Accessories.

D. Section 15020 - Air Stripping System.

E. Section 15040 - Mixing and Holding Tanks.

1.03 REFERENCES

A. ASTM A36 - Structural Steel.

B. ASTM A53 - Welded and Seamless Steel Pipe.

C. ASTM A123 - Zinc (Hot-Galvanized) Coatings on Products Fabricated From Rolled, Pressed, and Forged Steel Shapes, Plates, Bars, and Strips.

D. ASTM A153 - Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

E. ASTM A283 - Carbon Steel Plates, Shapes, and Bars.

F. ASTM A307 - Carbon Steel Externally Threaded Standard Fasteners.

G. AWS A2.0 - Standard Welding Symbols

H. AWS D1.1 - Structural Welding Code.

1.04 SUBMITTALS

A. The SUPPLIER shall submit information required under provisions of Section 01300 (Submittals).

B. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, gasket materials, anchorage, size and type of fasteners, and accessories. Include erection drawings and instructions, elevations, and details where applicable.

C. Indicate welded connections using standard AWS A2.0 welding symbols. Indicate net weld lengths.

1.05 QUALIFICATIONS

A. The SUPPLIER shall prepare Shop Drawings under direct supervision of a Professional Engineer experienced in design of this work and licensed in the State of New York.

B. Welders' Certificates: Submit under provisions of Section 01300 certifying welders employed on the Work, verifying AWS qualification within the previous 12 months.

1.06 FIELD MEASUREMENTS

A. The SUPPLIER shall verify that field measurements are as indicated on the Construction Drawings.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Steel Sections: ASTM A36.

B. Plates: ASTM A283.

C. Pipe: ASTM A53, Grade B, Schedule 40- and 80 Carbon Steel.

D. Fasteners: Galvanized, slotted strut channels (1 5/8 inch x 13/18 inch) with zinc plated steel pipe clamps from McMaster-Carr or equivalent.

E. Bolts, Nuts, and Washers: ASTM A325, A307, galvanized to ASTM A153.

F. Welding Materials: AWS D1.1; type required for materials being welded.

2.02 FABRICATION

A. Fit and shop assemble in largest practical sections, for delivery to the SITE.

B. Fabricate items with joints tightly fitted and secured.

C. Continuously seal joined members by continuous welds.

D. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.

E. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.

F. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

2.03 FINISHES

A. Shop prime all surfaces with standard coating for corrosion protection, and as shown on the Construction Drawings.

B. Do not prime surfaces in direct contact with concrete or where field welding is required.

C. Apply bitumastic coating to all surfaces in contact with concrete.

PART 3 - EXECUTION

3.01 EXAMINATION

A. The SUPPLIER shall verify that field conditions are acceptable and are ready to receive work.

3.02 PREPARATION

A. The SUPPLIER shall clean and strip primed steel items to bare metal where site welding is required.

B. The SUPPLIER shall supply items required to be cast into concrete with setting templates, to appropriate sections.

C. The SUPPLIER shall provide anchor bolt kits.

3.03 INSTALLATION

A. The on-site CONTRACTOR shall be responsible for installing all equipment. The equipment SUPPLIER shall supervise and inspect the equipment installation in accordance with Section 11200 and relevant equipment specifications in Division 15 of these Technical Specifications. The CONTRACTOR shall:

1. Install items plumb and level, accurately fitted, free from distortion and defects.

2. Allow for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachment.

3. Perform field welding (if necessary) in accordance with AWS D1.1.

4. Obtain the CONSULTANT/ENGINEER'S approval prior to site cutting or making adjustments not scheduled.

5. After erection, prime welds, abrasions, and surfaces not shop primed, except surfaces to be in contact with concrete.

6. Anchor the equipment to the concrete base using 1/2-inch diameter anchor bolts or approved equivalent at all corners unless otherwise specified.

3.04 ERECTION TOLERANCES

A. Maximum offset from true alignment: 1/4-inch.

END OF SECTION

SECTION 13121
PRE-ENGINEERED BUILDINGS

PART 1 - GENERAL

1.01 WORK INCLUDED

The CONTRACTOR shall furnish and install one pre-engineered gable style treatment building. The treatment building shall include the following:

A. All necessary structural steel of sufficient size and strength to support the building's ceiling panels, wall panels, hanging process piping, electrical conduit, and light fixtures.

B. Insulated metal wall and double sloped roof system including gutters, downspouts, and splash blocks.

C. Exterior door, overhead steel roll-up door, exhaust fan, ventilating louver, interior and exterior lighting, and sky panels.

D. A mounting framing/unistrut system on all walls and ceiling for mounting of electrical/mechanical equipment, piping, conduit, etc...

1.02 RELATED WORKS

A. Section 01300 - Submittals.

B. Section 03200 - Concrete Reinforcement.

C. Section 03300 - Cast-In-Place Concrete.

D. Section 05500 - Metal Fabrications.

1.03 REFERENCES

A. AISC - Specification for the Design, Fabrication, and Erection of Structural Steel for Buildings.

B. ASTM - A36/A36M-97ae1 Standard Specification for Carbon Structural Steel.

C. ASTM A153 - Zinc Coating (Hot Dip) on Iron and Steel Hardware.

D. ASTM A307 - Carbon Steel Externally Threaded Standard Fasteners.

E. ASTM A325 - High Strength Bolts for Structural Steel Joints.

F. ASTM A386 - Zinc-coating (Hot-Dip) on Assembled Steel Products.

G. ASTM A490 - Quenched and Tempered Alloy Steel Bolts for Structural Steel Joints.

H. ASTM A572 - High Strength Low Alloy Columbium-Vanadium Steel of Structural quality.

I. A653/A653M-99a Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

J. ASTM A792/A792M-99 - Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.

K. AWS A2.0 - Standard Welding Symbols.

L. AWS D1.1 - Structural Welding Code.

M. SSPC - Steel Structures Painting Council.

1.04 SUBMITTALS

A. Submit under provisions of Section 01300.

B. Shop Drawings:

1. Indicate design loads, including dead loads, live loads, and applied safety factor.

2. Indicate assembly dimensions, locations of structural members, connections, and openings.

3. Indicate wall and roof system dimensions, panel layout, general construction details, anchorages and method of anchorage, including the framing/unistrut system, and method of installation.

4. Indicate framing anchor bolt settings, sizes, and locations from datum, and foundation loads.

5. Indicate welded connections with AWS A2.0 welding symbols. Indicate net weld lengths.

C. Product Data: Provide data on profiles, component dimensions, and fasteners.

D. Detailed instructions for the building assembly, maintenance instructions, and other data pertaining to proper upkeep and operation of the building.

1.05 REQUIREMENTS

A. All work and materials shall be in full accordance with local and state ordinances, and with any other prevailing rules and regulations regarding potentially hazardous equipment or locations.

B. Conform to applicable construction codes for submission of design calculations and reviewed shop drawings as required for acquiring building permits.

C. Cooperate with regulatory agency or authority and provide data as requested.

D. The structural design drawings shall be signed and sealed by a New York State-licensed professional engineer.

1.06 SYSTEM DESCRIPTION

Treatment Building:

The Treatment Building shall be:

A. Gable style, constructed with prefabricated modular structural members, wall and roof systems, and to have a minimum clearance (exterior of wall to exterior of wall) of 24' - 0" in length, 20' - 0" in width, and 12' - 0" in height.

B. Well insulated, having a minimum R value of 20.

C. Supplied with 3-inch thick wall panels with friction fit insulation.

D. Provided with a finished exterior of sand-tan polyester paint.

E. Furnished with one (1) 10'- 8" wide x 11' high steel, roll-up, insulated overhead door, and one (1) 2-inch thick insulated double hinged solid door. All the doors shall have locking devices containing the Best Lock System, keyed by Broome Security.

F. Equipped with roof ventilator, intake louver, interior and exterior lighting, exhaust stacks, and sky panels as shown on the Construction Drawings.

G. Equipped with a framing/unistrut system on all walls and ceiling for mounting of electrical/mechanical equipment. Framing/unistrut members shall be spaced no farther then 6 feet apart.

H. Equipped with gutters, downspouts, and splash blocks.

I. Constructed to withstand snow and wind loads in accordance with the applicable New York State construction codes. The supporting steel structure shall be designed by the CONTRACTOR of sufficient size and strength and, written approval must be obtained from the CONSULTANT/ENGINEER prior to fabrication.

1.07 QUALIFICATIONS

A. MANUFACTURER: Company specializing in manufacturing the products specified in this Section with minimum of 3 years experience.

B. Design structural components under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State of New York.

1.08 WARRANTY

A. The CONTRACTOR shall obtain at least a ten (10) year warranty from the MANUFACTURER and submit to the CONSULTANT/ENGINEER.

B. The warranty shall include coverage for exterior pre-finished surfaces against chipping, cracking or crazing, blistering, peeling, chalking, or fading.

C. The warranty shall include coverage for weather tightness of the building enclosure after installation.

PART 2 - PRODUCTS

A. MANUFACTURERS - MODULAR STRUCTURES

1. Acceptable MANUFACTURER: Parkline North East, Inc. located at P.O. Box 30127, Wilmington, Delaware 19805, or approved equivalent.

B. MATERIALS

Panels:

1. Exterior wall panels shall be a single continuous length from the base to the roof line of the building at the sidewalls and endwalls of the building except where interrupted by wall openings.

2. Wall panels shall be 16" wide with a 3" deep inward turned interlocking side rib. Wall panels shall contain two 3/4" deep by 3 1/8" wide fluted recesses, each starting 2 7/16" from the panel edge.

3. Wall panels shall be fastened internally to the base channel and wall cap of the building with 3/8" diameter electro-galvanized machine bolts placed within the panel interlock. The fastening system shall be designed so that no wall fasteners are exposed on the exterior surface of the walls.

4. Wall panels shall be a minimum of 24 gauge galvanized steel conforming to ASTM A-653-94 specifications with the galvanized coating conforming to G90 (1.25 ounce) standards. Minimum yield strength of panel material shall be 50,000 psi. Panel material shall be embossed with a random pattern pebble embossure of approximately .007 - .008" depth.

5. The bases of the wall panels shall be closed off with closure plugs conforming to the panel profile.

C. DOOR AND FRAME

1. The door and frame shall be constructed with material equivalent or better in quality than the panels.

2. The door shall be sized and installed at the location shown on the Construction Drawings.

3. A thermoplastic gasket shall be mounted on the top edge and along both sides of the door to keep the door closed and the gasket shall form a tight seal.

4. Latch and strike assembly: The latch and strike assembly shall be satin-polished or chrome-finish. The latch shall be made to accommodate a padlock but must include an inside safety release mechanism.

5. Hinges: The hinges shall match the latch in general finish and design. Blades shall be no less than 9-inch long and hinges shall be of the up-lift type with Delrin cams on 3/8 inch diameter pins.

6. The bottom edge of the door shall contain a flexible, dual-blade wiper gasket.

7. The door shall be supplied with a metal shield above the door to divert rain and snow from the door opening.

8. An extruded aluminum sillplate shall be provided.

9. Lock System: The door shall be installed with the Best Lock System keyed by Broome Security.

D. OVERHEAD STEEL ROLL-UP DOOR

1. The door and frame shall be constructed with material equivalent or better in quality than the panels.

2. The door shall be sized 10' - 8" wide by 11' - 0" height with 4:1 reduction gear chain operator and installed at the location as shown on the Construction Drawings.

3. Framed opening for overhead door shall be constructed from minimum 14 gauge high strength galvanized steel.

4. The jambs and head shall provide minimum 2-1/2" wide inside surface for field mounting of overhead door track and hardware.

5. Head and jamb covers to be 24 gauge, embossed, painted wall color.

6. The door shall include a latch and strike assembly to lock and shall contain the Best Lock System keyed by Broome Security.

7. The door shall be insulated to the level of the building wall panels.

E. ROOF

1. The treatment building shall have a gable style roof with a minimum 1 1/2" pitch interlocking panel roof system. Roof panels shall be attached to the wall cap through factory punched holes.

2. Transmission of horizontal wind loads across the buildings shall be made through the panel roof system.

3. Roof panels shall be supplied in a single continuous length from eave line to roof ridge and be designed to tightly interlock so that no fasteners are required at intermediate points along the panel side laps.

4. Roof panels shall be 16" wide with a smooth surface between the interlocking side ribs. The interlocking ribs shall be 3" high and turned upward.

5. Roof panels shall be minimum 24 gauge steel coated on both sides with a coating of corrosion resistant aluminum zinc alloy applied by a continuous hot dipping process. Coating weight shall be a minimum of 0.32 ounce of aluminum zinc alloy per square foot of coated sheet (both sides) equivalent to about 0.80 mil thickness on each side. Minimum yield strength of panel material shall be 50,000 PSI.

F. GUTTERS AND DOWNSPOUTS

1. Rain gutters and downspouts shall be provided to match the exterior finish of the buildings.

PART 3 - EXECUTION

A. EXAMINATION

1. Verify that foundation, slab, mechanical and electrical utilities, and anchor bolts are in the correct positions.

B. ERECTION - WALL AND ROOFING SYSTEMS

1. Install the structural steel, wall panels and roof system in accordance with MANUFACTURER's instructions.

2. Exercise care when cutting pre-finished material to ensure cuttings do not mar the finished surface.

3. Fasten the wall panels to the concrete footings with anchor bolts.

4. The finished building shall be free of rattles and noise due to thermal movement and wind whistles.

C. ERECTION - GUTTER AND DOWNSPOUT

1. Rigidly support and secure components. Join lengths with formed seams sealed watertight. Flash and seal gutters to downspouts.

2. Apply bituminous paint on surfaces in contact with cementitious materials.

3. Slope gutters a minimum of .06 inch/ft.

4. Install splash pans and direct the rain water to the existing storm water system.

D. ELECTRICITY

1. The electricity for the buildings shall be supplied from the sources specified in the Construction Drawings.

E. INSTALLATION - ACCESSORIES

1. Install door frames, doors, prefab roof, and roof ventilator and intake louver, and mounting/unistrut members in accordance with MANUFACTURER's instructions.

2. Install vents, stack, and interior and exterior lights in accordance with MANUFACTURER's instructions, the Construction Drawings and these Technical Specifications.

3. Seal wall and roof accessories watertight with sealant.

END OF SECTION

SECTION 15000
PROCESS PIPING AND ACCESSORIES

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Related Sections.

B. Work Description.

C. References.

D. Acceptable MANUFACTURERs.

E. Recovery Well Piping.

F. Treatment System Piping.

G. Discharge Piping.

H. Valves.

I. Flowmeters.

J. Sample Taps.

K. Pipe Sleeves.

L. Hangers, Supports and Anchoring for Piping.

M. Scheduling of Work.

N. Protection of Work.

O. Pipe Preparation.

P. Pipe Installation.

Q. Pipe Sleeve Installation.

R. Hangers, Supports, and Anchoring Installation.

S. Identification Marker Installation.

T. Marker Tape

U. Testing

1.02 RELATED SECTIONS

A. Section 01300 - Submittals.

B. Section 01400 - Quality Control.

C. Section 01450 – Testing.

1.03 WORK DESCRIPTION

A. The CONTRACTOR is responsible for the installation of all process piping and accessories including, but not limited to, the following items as shown on the Construction Drawings: high density polyethylene pipe and fittings, Sch. 40 carbon steel pipe and fittings; Sch. 40 and Sch. 80 PVC pipe and fittings; valves; pipe sleeves; pipe supports and pipe hangers; fasteners and mounting hardware; and flow meters, pressure indicators, and sample taps.

B. Testing of piping.

1.04 REFERENCES

A. ASTM D1784 - Standard Specification for Rigid Polyvinyl Chloride (PVC) and Chlorinated Polyvinyl Chloride (CPVC) Compounds.

B. ASTM D2466 - Standard Specification for Polyvinyl Chloride (PVC) Socket Type Fittings.

C. ASTM D3350 – Standard Specification for Polyethylene Plastic (PE) Pipe and Fittings Materials.

D. ASTM F714 – Standard Specification for Polyethylene Plastic (PE) Pipe (SDR-PR) Based on Outside Diameter.

E. ASTM F402 - Standard Practice for Safe Handling of Solvent Cement and Primer Used for Joining Thermoplastic Pipe and Fittings.

F. BOCA Union Plumbing Code.

G. ANSI B16.5 - Pipe Flanges and Flanged Fittings.

H. ASTM A53 - Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.

I. ASTM A105 - Carbon Steel Forgings and Fittings.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Materials and equipment supplied for the Work shall conform to the requirements of these Technical Specifications and Construction Drawings. Suggested SUPPLIERs are indicated in some cases, however the CONTRACTOR may offer substitute material and equipment that is equivalent in all respects to that indicated. The CONTRACTOR shall provide technical data that defines the offered substitute and supports the substitution as an equal to the equipment or materials specified. The ENGINEER will review the technical data submittals from the CONTRACTOR and accept or reject the substitution. If the offered substitution is rejected, the CONTRACTOR shall be responsible for compensating the CONSULTANT/ENGINEER's costs to review the offered substitute. All submittals and substitutions shall be handled in accordance with Section 01300 of these Technical Specifications.

2.02 RECOVERY PIPING

A. Recovery well piping shall be High Density Polyethylene (HDPE), SDR 11, and shall be extended from the existing recovery wells to the proposed treatment building in accordance with applicable standards as shown on the Construction Drawings. HDPE Piping shall have a minimum pressure rating of 125 PSI.

2.03 TREATMENT BUILDING PIPING

A. All piping located in the treatment building shall be Sch. 40 Galvanized Carbon Steel (unless otherwise noted) and shall be installed as shown on the Construction Drawings and shall conform to applicable standards.

2.04 DISCHARGE PIPING

A. Discharge piping (treated water bypass to North Stream) shall be Sch. 40 PVC and installed as shown on the Construction Drawings in accordance with applicable standards.

2.05 INJECTION WELL PIPING

A. All injection well piping from the treatment building up to the injection wells shall be HDPE, SDR. 11 with a minimum pressure rating of 125 PSI.

B. All piping and fittings located within the injection wells shall be Sch. 80 PVC and shall be installed as shown on the Construction Drawings in accordance with applicable standards.

2.06 VALVES

A. Valves for the process piping shall be manufactured by an approved SUPPLIER with pressure ratings conforming to those of the piping. The CONTRACTOR shall submit his selection of a MANUFACTURER and technical data to the ENGINEER for approval prior to installation.

1. All similar valves shall be purchased from one MANUFACTURER.

2.07 FLOW METERS

A. All flow meters shall be manufactured by Badger or an approved equivalent as described on the Construction Drawings and the Technical Specifications.

2.08 SAMPLE TAPS

A. All sample taps shall include a threaded nipple, isolation valve, and hose bib connection as described on the Construction Drawings.

2.09 PIPE SLEEVES

A. All pipes passing through walls and floors of the well vaults and treatment building shall be provided with sleeves. All pipe penetrations shall be made water tight as specified or indicated on the Construction Drawings.

2.10 HANGERS, SUPPORTS AND ANCHORS FOR PIPING

A. All piping shall be supported by means of an approved combination of hangers, supports, and attachments, assuring that no weight is imposed upon the connected equipment.

B. All aboveground exterior pipe supports shall be constructed as indicated on the Construction Drawings or by a method approved by the CONSULTANT/ENGINEER.

C. All piping and supports shall utilize the building mounting/unistrut system.

PART 3 - EXECUTION

3.01 SCHEDULING OF WORK

A. The CONTRACTOR shall coordinate and schedule mechanical installation with the CONSULTANT/ENGINEER to accommodate the CONSULTANT/ENGINEER'S requirements.

3.02 PROTECTION OF WORK

A. The CONTRACTOR shall protect all piping from entry of dirt, pipe cuttings, lubricants, debris, stormwater and other foreign material. The CONTRACTOR shall remove any foreign materials and clean piping to the satisfaction of the CONSULTANT/ENGINEER.

3.03 PIPE PREPARATION

A. The CONTRACTOR shall:

1. Mark pipe sections with required identification prior to assembly.

2. Inspect for defective or damaged spool pieces prior to assembly.

3. Remove scale, dirt, pipe fittings, and lubricants inside and outside, prior to assembly.

4. Complete piping connections to equipment with flanges or unions.

3.04 PIPE INSTALLATION

A. The CONTRACTOR shall cut the pipe to exact measurement and install without forcing or springing.

B. The CONTRACTOR shall install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

C. The CONTRACTOR shall provide adequate clearance, install unions, and orient fittings and appurtenances for ease of installation of equipment and access to valves, fittings, and appurtenances.

D. The CONTRACTOR shall install all piping and equipment as indicated on the Construction Drawings. In the event of an installation requirement that is unclear, the CONTRACTOR shall consult with the CONSULTANT/ENGINEER before proceeding with the work in question.

E. The CONTRACTOR shall install all couplings, elbows, tees, and valves as shown on the Construction Drawings. However, the CONTRACTOR may install additional fittings, as necessary to complete the Work. The CONTRACTOR shall consult with CONSULTANT/ENGINEER prior to installation of additional fittings.

3.05 PIPE SLEEVE INSTALLATION

The CONTRACTOR shall:

A. Install pipe sleeves around pipes protruding through walls and roofs prior to installing the pipe, as shown on the Construction Drawings.

B. Seal all pipe sleeve openings with non-shrink caulking.

C. Rigidly anchor pipe to stable structures where necessary. Provide pipe guides so that movement takes place along the axis of pipe only.

3.06 HANGERS, SUPPORT, AND ANCHORS INSTALLATION

A. Hangers must be absolutely vertical and are to be secured to supplementary steel, using clamps as attachments, wherever possible. Where necessary to obtain the required vertical alignment, furnish and install angle or channel irons of ample strength and length to bridge between walls and ceilings to receive hanger attachments or supports for piping, ductwork, and equipment. Structural equipment storage container members shall not be drilled, otherwise weakened or overloaded. Hangers shall not be attached to piping, and shall not pierce or be sustained from ductwork. Supplementary steel must be kept as high as possible.

B. Wire, rope, wood, perforated band iron, tape or other makeshift material shall not be used for hangers or attachments. Threaded hangers shall have lock nuts.

C. Interior piping shall be supported, guided and anchored to maintain the required alignment and pitch, without sagging or swaying, and to provide controlled expansion, using adjustable split clevis or trapeze type hangers. Spacing of hangers and sizes shall be in accordance with ANSI B31.1. All interior piping and hangars shall utilize the building mounting/unistrut system.

D. A set of piping drawings shall be marked with approximate hanger locations and a standard hanger sheet showing typical random support arrangements shall be furnished for field guidance.

E. The CONSULTANT/ENGINEER shall have the option to direct the CONTRACTOR to either support piping from above or below at any time at no additional cost to the CONSULTANT/ENGINEER or OWNER.

F. Fittings with support bases cast with the fitting shall be used to support pipe from floors or walls whenever possible or as directed by the CONSULTANT/ENGINEER. Piping shall be supported from the floor by means of pipe stanchion saddles and U-bolts. Maximum spacing of hangers shall comply with ASA B31.3. Arrangements and location of all anchors shall be submitted to the CONSULTANT/ENGINEER for approval before installation.

3.07 IDENTIFICATION MARKER INSTALLATION

The CONTRACTOR shall identify:

A. Flow Meters and Valves: Identify all valves and flow meters on the system with brass tags with the valve or flow meter designation permanently stamped on the tag (dog tag style). The CONTRACTOR shall prepare a valve schedule including alpha-numeric designations for each valve as designated on the Construction Drawings, and submit the schedule to the CONSULTANT/ENGINEER for approval prior to purchasing and installing the tags. The valve schedule shall include the valve and flow meter designation, type, and location and shall be submitted in accordance with Section 01300 Submittals.

B. Piping: Identify piping, concealed or exposed, with plastic pipe markers. Identify service, flow direction, contents, and pressure. Install in clear view and align with axis of piping. Locate identification so as not to exceed 10 feet on straight runs including risers and drops, adjacent to each valve and branch tee and at each point of penetration of enclosures, and at other obstructions to the pipe run.

C. Insulated sections of piping and valves shall be identified on the pipe and on the exterior of the insulation jacketing.

3.08 MARKER TAPE

A. Marker tape installed over all direct burial process piping shall be six (6") inches in width, and shall be Terra Tape "D" detectable as manufactured by Griffolyn, Inc. or approved equal. The tape shall be an inert, bonded layer plastic material with a metallized foil core, so that process piping locations can be determined with a metal detector. The color of the tape shall be blue with the following imprints:

"CAUTION! BURIED PROCESS PIPING LINE BELOW!"

3.09 TESTING

A. Field inspection and testing shall be performed under provisions of Section 01450. Equipment which is not included in the test shall be disconnected from the piping or isolated by valves.

B. Leak tests shall be performed on all piping. If tests indicate work does not meet specified requirements, remove work, replace and re-test at CONTRACTOR'S expense.

C. The tests for piping shall be observed by the CONSULTANT/ENGINEER and written acceptance shall be given to the CONTRACTOR after successful completion of the test.

D. Any damaged or defective pipe, fittings, valves, or joints that are discovered following the pressure tests shall be repaired or replaced at no cost to the OWNER or CONSULTANT/ENGINEER. The test shall be observed by the CONSULTANT/ENGINEER and written acceptance shall be given to the CONTRACTOR after successful test completion.

END OF SECTION

SECTION 15020
AIR STRIPPING SYSTEM

PART 1 - GENERAL

1.01 WORK INCLUDED

A. This section includes requirements for the delivery, installation and functional testing during initial start-up of the air stripping system with the CONSULTANT/ENGINEER as specified in these Technical Specifications and as shown on the Construction Drawings. The air stripping system will include, but not be limited to: one (1) low profile air stripper complete with internals, attached piping, blower, discharge pump, pressure and level switches, and miscellaneous appurtenances (collectively referred to as the "low profile air stripper skid").

1.02 RELATED SECTIONS

A. Section 01090 - Reference Standards.

B. Section 01300 - Submittals.

C. Section 01400 - Quality Control.

D. Section 01600 - Material and Equipment.

E. Section 01650 - Starting of Systems.

F. Section 01700 - Contract Closeout.

G. Section 15000 - Process Piping and Accessories.

H. Section 16000 - Electrical - General Provisions.

1.03 GENERAL

A. The CONTRACTOR shall supply and install the low profile air stripper skid. The VENDOR will deliver the low profile air stripper skid, however, the CONTRACTOR shall arrange for the delivery. CONTRACTOR shall be responsible for any extra costs incurred in the event of a rush in the manufacturing, delivery and installation as required to make up for delays in schedule caused by the CONTRACTOR. Delivery, storage, and handling of equipment shall conform to the specifications in Section 01600, Materials and Equipment.

B. The CONTRACTOR shall be responsible for obtaining mounting and installation details for the low profile air stripper skid and shall install the low profile air stripper in accordance with the VENDOR'S requirements.

C. The CONTRACTOR is responsible for the process equipment installations (i.e.; prepare access, tie-in influent and effluent process lines, break and seal access holes through walls, roof, etc.) and shall provide any miscellaneous materials and labor necessary to complete a workable system in accordance with the Construction Drawings and these Technical Specifications.

D. The CONTRACTOR shall be responsible to supply and install the influent, interconnecting, and effluent piping to the low profile air stripper skid.

E. The CONTRACTOR shall be responsible for all electrical installations associated with the air stripping system. This includes but is not limited to electrical supply and controls. The CONTRACTOR shall obtain a list of electrical supply requirements and controls from the VENDOR. .

1.04 SUBMITTALS

A. The CONTRACTOR shall submit to the CONSULTANT/ENGINEER for review Shop Drawings for the low profile air stripper skid and all associated appurtenances therewith, in accordance with Section 01300 (Submittals).

1.05 PERMITS AND REGULATIONS

A. The CONTRACTOR shall comply with all Local, State, and Federal regulations.

1.06 DELIVERY, STORAGE, AND HANDLING

A. All arrangements for delivery and storage of equipment shall conform to the specifications in Section 01600 (Material and Equipment) and shall be the CONTRACTORS responsibility.

PART 2 - PRODUCTS

2.01 MANUFACTURER

A. The low profile air stripper skid will be a Model 1321-P as manufactured by North East Environmental Products, Inc. located at 17 Technology Drive, West Lebanon, New Hampshire 03784; phone number 603-298-7061.

2.02 GENERAL DESCRIPTION

A. A low profile air stripper skid will be provided for the treatment of recovered groundwater. The skid will be capable of treating 2 gallons per minute (gpm) of groundwater contaminated with volatile organic compounds (VOCs).

B. System equipment will be suitable for operation in areas designated as unclassified by the National Electric Code (NEC).

2.03 INSTRUMENTATION AND CONTROLS

A. General

1. Instrumentation and controls shall be provided as specified herein and as shown on the Construction Drawings. The low profile air stripper skid MANUFACTURER is responsible for providing the sump level switches, pressure switches and gauges, and necessary fittings and supports for instrumentation.

2. All instrumentation and controls shall be suitable for operation in areas designated as unclassified per NEC.

3. All controls and control panels shall be supplied and installed by the CONTRACTOR or electrical subcontractor.

4. A central control panel, located in the treatment building, shall house a programmable logic controller (PLC) to monitor and integrate the operation of the complete groundwater remediation system (compressor, transfer pumps, mixing and injection sequences, and low profile air stripper system). The panel shall be connected to each major component in the groundwater remediation system and will provide an interface for remote access via a telephone line. This panel shall be supplied by the CONTRACTOR or electrical subcontractor.

2.04 PERFORMANCE AND DESIGN CRITERIA

A. Design Criteria:

1.	Water Flow Rate:	2 gpm
2.	Minimum Water Temperature:	50° F
3.	Airflow Rate:	150 scfm
4.	Number of Trays:	2

B. Influent Groundwater Concentrations:

The influent groundwater concentrations listed below are estimates for design purposes and may not be all inclusive. Actual groundwater quality characteristics may vary. The air stripping system MANUFACTURER/SUPPLIER must guarantee the performance of the air stripping system to meet the effluent requirements and removal efficiencies specified herein. Evaluation of the treatment system's performance shall be conducted during start-up of the system.

Parameter	Estimated Influent Concentration (ug/L)	Estimated Effluent Concentration (ug/L)	% Removal
Trichloroethene (TCE)	66	≤ 1	≥ 99.99
Tetrachloroethene (PCE)	307	≤ 1	≥ 99.99
cis-1,2-Dichloroethene	88	≤ 1	≥ 99.97
1,1-Dichloroethene	56	≤ 1	≥ 99.99
1,1,1-Trichloroethane	110	≤ 1	≥ 99.99
Chloroform	4	≤ 1	≥ 99.99
Methylene Chloride	50	≤ 1	≥ 99.96
Total	681	≤ 1	≥ 99.99

C. It is the responsibility of the column MANUFACTURER to select and size all components to meet the removal criteria.

PART 3 - EXECUTION

3.01 INSTALLATION AND INSPECTION

A. The CONTRACTOR is responsible for supply, delivery and installation of the low profile air stripping system in accordance with these Technical Specifications and the Construction Drawings and instructions supplied by the VENDOR.

B. The low profile air stripper MANUFACTURER will provide a field technician as required for installation supervision, and one (1) day of operator training during startup.

END OF SECTION

SECTION 15040
MIXING AND HOLDING TANKS

PART 1 - GENERAL

1.01 WORK INCLUDED

A. This section includes requirements for coordinating the delivery, installation and functional testing during initial start-up of the feed solution mixing tank and treated water holding tank with the CONSULTANT/ENGINEER as specified in these Technical Specifications and as shown on the Construction Drawings. The feed solution mixing tank will include: one (1) 730 gallon cone bottom mixing tank, one (1) variable speed drive mixing tank mixer, (1) tank washing nozzle, and all fittings and appurtenances. The treated water holding tank will include: one (1) 1000 gallon vertical bulk storage tank, and all fittings and appurtenances.

1.02 RELATED SECTIONS

A. Section 01090 - Reference Standards.

B. Section 01300 - Submittals.

C. Section 01400 - Quality Control.

D. Section 01600 - Material and Equipment.

E. Section 01650 - Starting of Systems.

F. Section 01700 - Contract Closeout.

G. Section 05500 - Metals Fabrication.

H. Section 15000 - Process Piping and Accessories.

I. Section 15060 - Process Pumps and Appurtenances.

J. Section 16000 - Electrical - General Provisions.

1.03 GENERAL

A. The CONTRACTOR is responsible for supplying, delivering, and installing the feed solution mixing and treated water holding tanks according to the MANUFACTURER's requirements and in accordance with these Technical Specifications and the Construction Drawings. Delivery, storage, and handling of equipment shall conform to the specifications in Section 01600 (Material and Equipment).

B. Installation shall include, but not be limited to; installation of both tanks per VENDOR's requirements, installation of mixing tank mixer; installation of all level switches; installation of all piping and appurtenances, and; integration of all electrical components and levels switches into the Main Control Panel for complete system integration.

1.04 REFERENCES

A. ASTM D1998-97 Standard Specification for Polyethylene Upright Storage Tanks.

B. A668/A668M-96e1 Standard Specification for Steel Forgings, Carbon and Alloy, for General Industrial Use.

C. A266/A266M-99 Standard Specification for Carbon Steel Forgings for Pressure Vessel Components.

D. ASTM A105 - Carbon Steel Forgings and Fittings.

1.05 SUBMITTALS

The CONTRACTOR shall submit to the CONSULTANT/ENGINEER for review Shop Drawings for the feed solution mixing tank, mixing tank mixer, and treated water holding tank and all associated appurtenances therewith, in accordance with Section 01300 (Submittals). Shop Drawings shall include proposed MANUFACTURER, materials, mixer specifications, proposed level switch locations, and proposed pipe connection locations.

1.06 PERMITS AND REGULATIONS

A. The CONTRACTOR shall comply with all Local, State, and Federal regulations.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. The feed solution mixing tank and mixer shall be manufactured and supplied by Dantco Mixers Corporation located at 9 Oak Street, Paterson, NJ 07501-3013; phone number 973-278-8776, or an approved equivalent.

B. The treated water holding tank shall be manufactured and supplied by Chem-tainer Industries, Inc. located at 361 Neptune Avenue, West Babylon, NY 11704; phone number 631-661-8300, or an approved equivalent.

C. The feed solution mixing tank washing nozzle shall be a Model 6353 Tank Washing Nozzle, or approved equivalent, and shall be manufactured and supplied by Spraying Systems Co. located at P.O Box 7900, Wheaton, Illinois 60189-7900; phone number 630-665-5000, or an approved equivalent.

2.02 GENERAL DESCRIPTION

A. A feed solution mixing tank and variable speed drive mixer will be provided as per the specifications on the Construction Drawings to facilitate mixing and holding of the molasses feed solution. The tank will be constructed of carbon steel and have a coned bottom and closed top. Ports shall be installed on the top of the mixing tank to house the mixer, create a vent line (discharge at the roof of the treatment building), and allow for a tank washing nozzle to be used as a tank rinse. A 1-inch carbon steel pipe will be installed on the side of the mixing tank to house level switches.

B. A treated water holding tank will be provided as per the specifications on the Construction Drawings to contain treated water for use in the molasses mixing sequence. The tank will be constructed of polyethylene and be designed for vertical bulk storage. Ports (bulkhead fittings) shall be installed on the side of the tank to house level switches. Additional ports shall be installed to facilitate a treated water intake and treated water discharge to the feed solution mixing tank.

2.03 INSTRUMENTATION AND CONTROLS

A. <u>General</u>

1. Instrumentation and controls shall be provided as specified herein and as shown on the Construction Drawings.

2. All instrumentation and controls shall be suitable for the operation in area designated as unclassified per NEC.

3. All instrumentation and controls shall be supplied and installed by the CONTRACTOR or electrical subcontractor.

4. A central control panel, located in the treatment building, shall house a programmable logic controller (PLC) to monitor and integrate the operation

of the groundwater remediation system (compressor, transfer pumps, mixing and injection sequences, and low profile air stripper system). The panel shall be connected to each major component in the groundwater remediation system and will provide an interface for remote access via a telephone line. This panel shall be supplied by the CONTRACTOR or electrical subcontractor.

PART 3 - EXECUTION

3.01 INSTALLATION AND INSPECTION

A. The CONTRACTOR is responsible for coordinating the delivery and installing the feed solution mixing and treated water holding tanks according to the VENDOR's requirements and in accordance with these Technical Specifications and the Construction Drawings. Delivery, storage, and handling of equipment shall conform to the specifications in Section 01600 (Material and Equipment).

B. Installation shall include, but not be limited to; installation of both tanks, installation of mixing tank mixer; installation of all level switches; installation of all piping and appurtenances, and; installation of all electrical components and levels switches into the Main Control Panel for complete system integration.

END OF SECTION

SECTION 15060
PUMPS AND APPURTENANCES

PART 1 - GENERAL

1.01 WORK INCLUDED

A. This specification applies to the installation of pumps and associated drivers. All components necessary for the safe and satisfactory operation of the specified equipment which are not specifically included shall be considered to be a part of this specification. The CONTRACTOR shall supply, deliver, and install all transfer pumps and associated drivers, and pneumatic autopumps as described in these Technical Specifications and Construction Drawings.

B. Design Criteria

	Recovery Well Pumps	Transfer Pump TP-400	Transfer Pump TP-600	Molasses Pump* MP-700	Transfer Pump TP-900
Design Point-GPM	2	10	10	10	10
Design Point - TDH - FT	100	46	50	25	75
Min HP	NA	1	¾	1	1.5
Motor Voltage, Phase	NA	230, 1	230, 1	230, 1	230, 1
Media Pumped	Water	Water	Water	Pure Molasses	Molasses/Water Solution
Type	Pneumatic	Centrifugal	Centrifugal	Rotary Gear	Centrifugal
Manufacturer	CEE	Mepco	Marlow	Viking	Marlow
Model No.	AP-4, Bottom Loading, Autopump	R5-1	M22BF2DG0	G125	M1SS1H4G0

* Molasses Pump MP-700 shall also be incorporated with a variable speed drive.
NA – Designates indicated parameter not available. Recovery well pumps are pneumatic, therefore do not require direct voltage.
CEE – Clean Environment Equipment

SECTION 15060
PUMPS AND APPURTENANCES

PART 1 - GENERAL

1.01 WORK INCLUDED

A. This specification applies to the installation of pumps and associated drivers. All components necessary for the safe and satisfactory operation of the specified equipment which are not specifically included shall be considered to be a part of this specification. The CONTRACTOR shall supply, deliver, and install all transfer pumps and associated drivers, and pneumatic autopumps as described in these Technical Specifications and Construction Drawings.

B. Design Criteria

	Recovery Well Pumps	Transfer Pump TP-400	Transfer Pump TP-600	Molasses Pump* MP-700	Transfer Pump TP-900
Design Point-GPM	2	10	10	10	10
Design Point - TDH - FT	100	46	50	25	75
Min HP	NA	1	¾	1	1.5
Motor Voltage, Phase	NA	230, 1	230, 1	230, 1	230, 1
Media Pumped	Water	Water	Water	Pure Molasses	Molasses/Water Solution
Type	Pneumatic	Centrifugal	Centrifugal	Rotary Gear	Centrifugal
Manufacturer	CEE	Mepco	Marlow	Viking	Marlow
Model No.	AP-4, Bottom Loading, Autopump	R5-1	M22BF2DG0	G125	M1SS1H4G0

* Molasses Pump MP-700 shall also be incorporated with a variable speed drive.
NA – Designates indicated parameter not available. Recovery well pumps are pneumatic, therefore do not require direct voltage.
CEE – Clean Environment Equipment

1.02 RELATED SECTIONS

A. Section 15000 - Piping and Accessories

B. Section 16000 - Electrical General Provisions

1.03 QUALITY ASSURANCE/QUALITY CONTROL

A. Quality assurance/quality control measures shall conform to the requirements of the conditions of the contract, as follows:

1. The CONTRACTOR shall comply with applicable provisions and recommendations of the following standards except as otherwise shown on the Construction Drawings or specified herein:

a. American Petroleum Institute Standard for Centrifugal Pumps (API 610 -For pump test tolerances only).

b. Hydraulic Institute Standards.

c. National Electric Code (NEC).

d. National Electrical Manufacturer's Association (NEMA).

e. Institute of Electrical and Electronic Engineers (IEEE).

f. Anti-Friction Bearing Manufacturer's Association (AFBMA).

g. American National Standards Institute (ANSI).

h. Steel Structures Paints Council (SSPC).

1.04 PERMITS AND REGULATIONS

A. The CONTRACTOR, at his expense, shall procure all necessary permits and licenses to conduct the Work specified herein.

B. If the CONTRACTOR believes that the specifications are at variance with any law or regulation, he shall promptly notify the CONSULTANT/ENGINEER in writing,

and any necessary adjustments shall be submitted to the CONSULTANT/ENGINEER for approval.

1.05 SUBMITTALS

A. The CONTRACTOR shall submit Shop Drawings and Technical Specifications, for all proposed pumps in accordance with Section 01300 (Submittals).

1.06 DELIVERY, STORAGE, AND HANDLING

A. The CONTRACTOR shall store equipment and materials so as to ensure the preservation of their quality and fitness for the Work. When considered necessary, they shall be placed on wooden platforms, or other hard, clean surfaces and shall be placed under cover when directed. Stored materials shall be located, so as to facilitate prompt inspection. In the event any material, part, or equipment is damaged during this period, the CONTRACTOR shall notify the CONSULTANT/ENGINEER. The CONTRACTOR shall coordinate the re-delivery of another part/equipment and install it at no additional cost to the CONSULTANT/ENGINEER or the OWNER

1.08 TECHNICAL INSPECTION

A. All Work shall be subject to inspection by the CONSULTANT/ENGINEER, but such inspection shall not relieve the CONTRACTOR from obligation to perform said Work in accordance with these specifications and MANUFACTURER'S requirements, or any modifications thereof, as herein provided, shall be corrected and made good by the CONTRACTOR whenever so ordered by the CONSULTANT/ENGINEER, without reference to any previous oversight or error in inspection.

B. All directions given to the CONTRACTOR by the CONSULTANT/ENGINEER or MANUFACTURER'S representative, pertaining to the scope of work during routine inspection, shall be binding on the CONTRACTOR.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Transfer pump TP-400 shall be incorporated as part of the low profile air stripper skid. The low profile air stripper skid shall be manufactured and supplied by North East Environmental Products, Inc. located at 17 Technology Drive, West Lebanon, New Hampshire 03784; phone number 603-298-7061.

B. Transfer pumps TP-600, MP-700, and TP-900 shall be supplied by Argo Industrial located at 33 Terminal Avenue, Clark, New Jersey 07066; phone number 732-574-2400.

C. Recovery well pumps shall be manufactured and supplied by Clean Environment Equipment located at 1133 Seventh Street, Oakland, California 94607; local branch phone number 1-800-397-5414.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Installation of all pumps shall be completed per these Technical Specifications and Construction Drawings, and in accordance with MANUFACTURER's instructions.

B. Installation shall include furnishing and applying an initial supply of grease and oil, of a type recommended by the pump and motor MANUFACTURER's, if applicable.

3.02 TESTING

A. Field Tests

1. The CONTRACTOR shall furnish all facilities, certified calibrated instruments, personnel, and the service needed for their preparation and execution.

2. The CONSULTANT/ENGINEER, at his own and exclusive option, may provide substitutes for some or all of the instruments supplied by the CONTRACTOR. Proper calibration of every measuring device shall be

checked and agreed upon between the CONTRACTOR and the CONSULTANT/ENGINEER before running any test.

3. A preliminary field test shall be made to determine the adequacy of the instruments and apparatus. When conditions do not permit such a preparatory run, operations may be started, and later when conditions are satisfactory, the test shall be made.

4. A careful inspection shall be made before, during and after the field tests to insure the proper operation of each pump. The following items shall be inspected:

   a. Alignment of pump.

   b. Direction of rotation and flow.

   c. Electrical connections.

   d. Gauge openings.

   e. Operation of lubricating system (if applicable).

   f. Liquid passages.

   The liquid passages of the pumps should be inspected before installation to guard against error during the test caused by obstructions clogging the passage. If obstructions are found in the pump, the test shall be re-run.

5. Complete records shall be kept of all information relevant to all field tests, with test report copies to be submitted to all interested parties.

3.03 START-UP

A. CONTRACTOR shall verify that structures, pipes and equipment are compatible.

B. Make adjustments required to place system in proper operating condition.

END OF SECTION

SECTION 15080
BAG FILTER SYSTEM

PART 1 - GENERAL

1.01 WORK INCLUDED

A. This CONTRACTOR shall be responsible for the supply, installation, start-up and testing of two (2) bag filter house assemblies, each containing seven (7) bag filters as shown on the Construction Drawings.

1.02 RELATED SECTIONS

A. Section 01300 - Submittals.

B. Section 01600 - Material and Equipment.

C. Section 01650 - Starting of Systems.

D. Section 15000 - Process Piping and Accessories.

1.03 GENERAL

A. The CONTRACTOR is responsible for supplying, delivering, and installing the two (2) bag filter houses and associated bag filters according to the MANUFACTURER's requirements and in accordance with these Technical Specifications and the Construction Drawings. Delivery, storage, and handling of equipment shall conform to the specifications in Section 01600 (Material and Equipment).

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. The bag filter houses and filter cartridges shall be Harmsco Stainless Steel Up-flow Filters Model HIF-7. Bag filter and filter cartridges shall be supplied by US Filter Westates located at 30 Technology Drive, Warren, New Jersey 07059, or an approved equivalent.

2.02 PERFORMANCE AND DESIGN CRITIRIA

A.	Normal System Flow	2 gpm
	Maximum pressure drop with filter bags	1 psi
B.	Design Criteria for Filter Bags	
	Influent iron concentration (total)	1.6 mg/l
	Micron Rating	1.0
	Filtration Efficiency	95 percent

PART 3 - EXECUTION

3.01 INSTALLATION AND INSPECTION

A. The CONTRACTOR is responsible supplying, delivering, and installing the bag filter houses and associated bag filters in accordance with the MANUFACTURER's requirements and in accordance with these Technical Specifications and the Construction Drawings. Delivery, storage, and handling of equipment shall conform to the specifications in Section 01600 (Material and Equipment).

B. The bag filter housings shall be tested for leaks when all proper piping connections are complete.

END OF SECTION

SECTION 15400
COMPRESSED AIR SYSTEM

PART 1 - GENERAL

1.01 WORK INCLUDED

A. This section includes requirements for the supply, delivery, installation and functional testing during initial start-up of the compressed air system with the CONSULTANT/ENGINEER as specified in these Technical Specifications and as shown on the Construction Drawings. The compressed air system will include, but not be limited to: one (1) Ingersoll-Rand Model 2340N3 reciprocating compressor, complete with internals, attached piping, electronic condensate automatic drain valve, pressure switches, desiccant dryer, filter, regulators, and miscellaneous appurtenances.

1.02 RELATED SECTIONS

A. Section 01090 - Reference Standards.

B. Section 01300 - Submittals.

C. Section 01400 - Quality Control.

D. Section 01450 - Testing.

E. Section 01600 - Material and Equipment.

F. Section 01650 - Starting of Systems.

G. Section 01700 - Contract Closeout.

H. Section 15000 - Process Piping and Accessories.

I. Section 16000 - Electrical - General Provisions.

1.03 GENERAL

A. The CONTRACTOR shall supply, deliver, and install the reciprocating compressor and all appurtenances as shown on the Construction Drawings. CONTRACTOR shall be responsible for any extra costs incurred in the event of a rush in the manufacturing, delivery and installation is required to make up for delays in schedule caused by the CONTRACTOR. Delivery, storage, and handling of equipment shall conform to the specifications in Section 0-1600, Materials and Equipment.

B. The CONTRACTOR shall be responsible for obtaining mounting and installation details for the reciprocating compressor and appurtenances, and shall install the compressed air system in accordance with the VENDOR'S requirements, these Technical Specifications and the Construction Drawings.

C. The CONTRACTOR is responsible for the process equipment installations (i.e.; prepare access, tie-in effluent process line and condensate drain line, break and seal access holes through walls, roof, etc.) and shall provide any miscellaneous materials and labor necessary to complete a workable system in accordance with the Construction Drawings and these Technical Specifications.

D. The CONTRACTOR shall be responsible to supply and install the desiccant dryer, filter/regulator assembly, effluent process line, and the electronic condensate drain valve and associated piping (including two steel, closed top, 55-gallon drums to collect condensate drain water).

E. The CONTRACTOR shall be responsible for all electrical installations associated with the compressed air system. This includes but is not limited to electrical supply and controls. The CONTRACTOR shall obtain a list of electrical supply requirements and controls from the VENDOR.

1.04 REFERENCES

A. ASME - Boiler and Pressure Vessel Code.

B. ASME B16.3 - Malleable Iron Threaded Fittings.

C. ASME B31.9 - Building Services Piping.

D. ASTM A234 - Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures.

E. ASTM B32 - Solder Metal.

F. NFPA 70 - National Electrical Code.

1.05 SUBMITTALS

A. The CONTRACTOR shall submit to the CONSULTANT/ENGINEER for review Shop Drawings for the reciprocating air compressor and all associated appurtenances, including but not limited to, the desiccant dryer assembly, filter/regulator assembly, and electronic condensate drain valve, in accordance with Section 01300 (Submittals).

1.06 PERMITS AND REGULATIONS

A. The CONTRACTOR shall comply with all Local, State, and Federal regulations.

1.07 DELIVERY, STORAGE, AND HANDLING

A. All arrangements for delivery and storage of equipment shall conform to the specifications in Section 01600 (Material and Equipment) and shall be the CONSULTANT/ENGINEER responsibility.

PART 2 - PRODUCTS

2.01 MANUFACTURER

A. The reciprocating compressor will be a Model 2340N3, as manufactured by Ingersoll-Rand, or approved equivalent. The closest product distributor to the SITE is Syracuse Air Center, 28 Corporate Circle, Suite 2, E. Syracuse, NY 13057-1015; phone number 315-434-9040.

B. The desiccant dryer shall be a Pneupac Model 5PC, as manufactured by Pneumatic Products located at 4647 SW 40th Avenue, Ocala, Florida 34474; phone number 352-237-5500, or an approved equivalent.

2.02 GENERAL DESCRIPTION

A. An Ingersoll-Rand Model 2340N3, or approved equivalent, reciprocating air compressor shall be provided for supplying the three (3) pneumatic pumps with compressed air. Specific requirements are provided below:

Type	Tank Mounting	Tank Capacity (gal)	Maximum Air Flow (cfm)	Maximum Pressure (psi)	Voltage	Horsepower	Phase
Reciprocating	Vertical	80	9.1	175	230	3	1

B. Desiccant dryer assembly shall be a Pneupac Model 5PC. Dessicant dryer shall be regenerative, wall mounted, housed in cast aluminum, 230 psig maximum operating pressure, and contain a moisture indicator.

C. System equipment will be suitable for operation in areas designated as unclassified by the National Electric Code (NEC).

2.03 INSTRUMENTATION AND CONTROLS

A. General

1. Instrumentation and controls shall be provided as specified herein and as shown on the Construction Drawings.

2. All instrumentation and controls shall be suitable for operation in areas designated as unclassified per NEC.

3. All controls and control panels shall be supplied and installed by the CONTRACTOR or electrical subcontractor.

4. A central control panel, located in the treatment building, shall house a programmable logic controller (PLC) to monitor and integrate the operation of the complete groundwater remediation system (compressor, transfer pumps, mixing and injection sequences, and low profile air stripper system). The panel shall be connected to each major component in the groundwater remediation system and will provide an interface for remote access via a telephone line. This panel shall be supplied by the CONTRACTOR or electrical subcontractor.

PART 3 - EXECUTION

3.01 INSTALLATION AND INSPECTION

A. The CONTRACTOR is responsible for arranging for supply, delivery and installation of the compressed air system in accordance with these Technical Specifications and the Construction Drawings and instructions supplied by the VENDOR.

END OF SECTION

SECTION 16010
BASIC ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.01 WORK INCLUDED

A. The work covered by this section consists of furnishing and installing all materials, equipment, labor, supervision and services necessary to complete all electrical work specified herein and shown on Construction Drawings 9 and 10.

B. Principal Features:

1. Provide and install a complete system of conduits, cables and conductors for electrical power, control, instrumentation and monitoring of the Groundwater Remediation System.

2. Provide and install new power distribution panel (PNL-1) and power distribution network as shown on the Construction Drawings.

3. Provide and install new combination motor starters as shown on the Construction Drawings and described herein.

4. Complete the installation of the system in compliance with all New York State, local and federal regulations.

5. Install all underground raceways, conductors, and remote mounted instrumentation to complete the system as described in these Technical Specifications and in the Construction Drawings.

6. Provide all labor and materials necessary to complete the installation of the utility connection to the Groundwater Remediation System, including all raceways, wiring, overhead and/or underground feeds and concrete pads, and the electrical upgrade to a 120/240V, 1 phase, 3W, 200A service.

7. Provide appropriate trade labor at startup to assist with any necessary equipment calibration, modification or repairs.

1.02 RELATED DOCUMENTS

A. General provisions of Contract apply to this and the other sections of Division 16.

B. The following Drawings apply to this Division:

1. Drawing 9, Electrical Single Line.

2. Drawing 10, Electrical Layout.

C. General: This Section includes general administrative and procedural requirements for electrical installations. The following administrative and procedural requirements are included in this Section to expand the requirements specified in Division 1:

1. Submittals.

2. Coordination drawings.

3. Record documents.

4. Maintenance manuals.

5. Rough-ins.

6. Electrical installations.

7. Cutting and patching.

8. Delivery, Storage, and Handling.

1.03 REFERENCES

A. Broome County, New York State, and National Electrical codes.

B. National Electrical Code (NFPA 70), 1999 Edition.

C. Life Safety Code 101.

D. NECA Standards of Installation.

E. NFPA (National Fire Protection Association)-all applicable codes.

1.04 FEES AND TESTS

A. CONTRACTOR shall be responsible for all fees for permits, inspections and tests necessary to complete the work described herein. CONTRACTOR shall demonstrate to the CONSULTANT/ENGINEER that all items of equipment installed are completely operational and free of defects in all modes.

1.05 COORDINATION WITH OTHER TRADES

B. CONTRACTOR shall furnish and locate all anchor bolts, inserts and supports for installation by the other trades as required. CONTRACTOR shall coordinate the location of all fixtures, outlets, equipment and devices with other trades to avoid conflicts.

1.06 INSPECTION OF THE SITE AND EXISTING CONDITIONS

A. Prior to submitting a bid, CONTRACTOR shall visit the site and determine existing conditions at the site and all existing structures to become familiar with existing conditions and electrical systems which may, in any manner, affect the work required under this Contract.

B. The CONTRACTOR shall carry out any work involving shutdown of the existing services to any piece of equipment now functioning in existing areas at such time as to provide the least amount of inconvenience to the CONSULTANT/ENGINEER. CONTRACTOR shall do such work when directed by the CONSULTANT/ENGINEER.

C. After award of the Contract, the CONTRACTOR shall confer with the CONSULTANT/ENGINEER to verify, at each stage of construction activity, the

location(s) of existing utilities and facilities. CONTRACTOR shall protect all existing underground utilities during construction. The CONTRACTOR shall pay for all required repairs for damage inflicted during construction without increase in Contract cost.

D. Responsibility: The CONTRACTOR shall be responsible for completing the systems in accordance with the intent of these Contract Documents:

1. Coordination of the details of the facility equipment and construction for all Specification divisions which affect the work covered under Division 16, Electrical.

2. Furnishing and installing all incidental items not actually shown or specified, but which are required by good trade practice to provide complete, functioning systems.

E. Departures from the Contract Documents: The CONTRACTOR shall submit to the CONSULTANT/ENGINEER, in writing, details of any necessary, proposed departures from these Contract Documents, and the reasons therefore. Such requests must be submitted as soon as is practically possible, and within 30 days after award of the Contract. No such departures shall be made without the written review of the CONSULTANT/ENGINEER.

F. Substitution of Materials and Equipment: In accordance with provisions elsewhere in these Contract Documents, MANUFACTURERs' names and catalog numbers stated herein are intended to indicate the type and quality of equipment or materials desired. Unless substitution is specifically forbidden, proposed alternatives may be submitted for review.

1.07 SUBITTALS

A. General: Follow the procedures specified in Division 1 Section "SUBMITTALS."

B. Additional copies may be required by individual sections of these Specifications.

C. List of Proposed Materials: The CONTRACTOR shall submit a complete list of the proposed MANUFACTURERs for each of the items listed in these electrical specifications. Additional submittal data, sufficient to determine equality, shall be required if the CONTRACTOR proposes to substitute another MANUFACTURER's equipment. The opinion of the

CONSULTANT/ENGINEER shall be final in the decision to accept or reject proposed MANUFACTURER(s) and substitutions.

1.08 COORDINATION DRAWINGS

A. Prepare coordination drawings in accordance with Division 1 Section-1300 "SUBMITTALS," to a scale of 1/4" = 1'-0" or larger; detailing major elements, components, and systems of electrical equipment and materials in relationship with other systems, installations, and building components. Indicate locations where space is limited for installation and access and where sequencing and coordination of installations are of importance to the efficient flow of the Work, including (but not necessarily limited to) the following:

1. Indicate the proposed locations of major raceway systems, equipment, and materials. Include the following:

   a. Clearances for servicing equipment, including space for equipment disassembly required for periodic maintenance.

   b. Exterior wall and foundation penetrations.

   c. Fire-rated wall and floor penetrations.

   d. Equipment connections and support details.

   e. Sizes and location of required concrete pads and bases.

   f. Service entrance, disconnect and utility metering equipment.

1. Indicate scheduling, sequencing, movement, and positioning of large equipment into the building during construction.

2. Prepare floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.

3. Prepare schematic, connection, and interconnection wiring diagrams required for installation, checkout, trouble shooting, and maintenance. Interconnection drawings are required for wiring between equipment items which is not covered by connection diagrams supplied by equipment VENDORs. Interconnection drawings shall use the same terminal

numbers and device and conductor designations that are used in connection diagrams.

1.09 RECORD DOCUMENTS

A. Prepare record documents in accordance with the requirements in Division 1 Section-1300 "SUBMITTALS." In addition to the requirements specified in Division 1, indicate installed conditions for:

1. Major raceway systems, size and location, for both exterior and interior; locations of control devices; distribution and branch electrical circuitry; and fuse and circuit breaker size and arrangements.

2. Equipment locations (exposed and concealed), dimensioned from prominent building lines.

3. Approved substitutions, Contract Modifications, and actual equipment and materials installed.

1.10 MAINTENANCE MANUALS

A. Prepare maintenance manuals in accordance with Division 1 Section "SUMMARY OF WORK." In addition to the requirements specified in Division 1, include the following information for equipment items:

1. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts.

2. MANUFACTURER's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; and summer and winter operating instructions.

3. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.

4. Servicing instructions and lubrication charts and schedules.

1.11 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to the project properly identified with names, model numbers, types, grades, compliance labels, and other information needed for identification.

PART 2 - PRODUCTS

2.01 REFERENCE TO DRAWINGS

A. Reference shall be made to Drawing Schedules, Details, Notes and Specifications for: MANUFACTURER, model, catalog number, size, capacity, performance, ratings and installation of equipment and material.

2.02 CHOICE OF MATERIALS AND EQUIPMENT

A. In submitting substitutions, bidders should note the following minimum considerations: (1) capacities shown are absolute minimum and must be equaled, (2) physical size limitations for space allotted, (3) structural properties, (4) noise level, (5) interchangeability, (6) compatibility with other materials and assemblies, (7) similar items shall be same MANUFACTURER and style wherever possible, and; (8) electrical hazardous area classification of equipment shall not be downgraded under any circumstances.

B. All materials and equipment, for which a UL, ANSI or a NEMA Standard is established, shall be so approved, and will be labeled or stamped as such.

C. Adhesives are not an acceptable technique for mounting, supporting or assembling any system components or assemblies, unless noted otherwise herein.

2.03 SUBMITTALS DURING CONSTRUCTION

A. Certified arrangement drawings, outline dimensions and weights for all major (engineered) equipment.

B. Functional description or logic diagrams for all control systems furnished under Division 16, Electrical, and not listed above.

C. Characteristic curves for all protective devices.

D. Schematic (Elementary) drawings for any electrical control, and bills of material for equipment including, but not limited to:

1. Main Control Panel (MCP).

2. All combination motor controllers

E. Interconnection elementary diagrams for each of the following conductor types:

1. Service conductors, feeder conductors and any branch circuit conductors which have a connection point between the branch circuit overcurrent protection or motor starter, and the utilization equipment.

2. Discrete control conductors.

3. Analog control conductors.

PART 3 - EXECUTION

3.01 ROUGH-INS

A. CONTRACTOR shall verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.

3.02 ELECTRICAL INSTALLATIONS

A. The CONTRACTOR shall be responsible for all electrical power, control and instrumentation wiring and connections to all equipment requiring electrical power. This responsibility applies to all equipment supplied by the CONTRACTOR, as well as all equipment supplied under this and other Divisions, and/or by the CONSULTANT/ENGINEER.

B. General: Sequence, coordinate, and integrate the various elements of electrical systems, materials, and equipment. Comply with the following requirements:

1. Coordinate electrical systems, equipment, and materials installation with other building and well installation components.

2. Verify all dimensions by field measurements.

3. Arrange for chases, slots, and openings in other building components during progress of construction, to allow for electrical installations.

4. Coordinate the installation of required supporting devices and sleeves to be set in poured-in-place concrete and other structural components, as they are constructed.

5. Sequence, coordinate, and integrate installations of electrical materials and equipment for efficient flow of the Work.

6. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum headroom possible.

7. Coordinate connection of electrical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations.

8. Install systems, materials, and equipment to conform with approved submittal data, including coordination drawings, to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the Work are shown only in diagrammatic form. Where coordination requirements conflict with individual system requirements, refer conflict to the CONSULTANT/ENGINEER.

9. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed exposed in finished spaces.

10. Install electrical equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations.

11. Install systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope.

3.03 CUTTING AND PATCHING

A. General: Perform cutting and patching in accordance with the requirements specified below:

1. Perform cutting, fitting, and patching of electrical equipment and materials required to:

a. Uncover Work to provide for installation of ill-timed Work.

b. Remove and replace defective Work.

c. Remove and replace Work not conforming to requirements of the Contract Documents.

d. Remove samples of installed Work as specified for testing.

e. Install equipment and materials in existing structures.

f. Upon written instructions from the CONSULTANT/ENGINEER, uncover and restore Work to provide for CONSULTANT/ENGINEER observation of concealed Work.

2. Protection of Installed Work: During cutting and patching operations, protect adjacent installations.

3.04 RECORD AND AS-BUILT DRAWINGS

A. CONTRACTOR shall maintain at the job site, a set of Contract Documents kept current by indicating thereon, all changes, revisions and substitutions between work as specified and as installed.

B. CONTRACTOR shall furnish CONSULTANT/ENGINEER with 1 complete set of reproducible drawings, and 2 complete, clean sets of Specifications, showing installed locations, size, catalog numbers, etc., of all work and material as taken from record documents.

C. For each piece of equipment, the CONTRACTOR shall provide 4 sets of MANUFACTURER's printed catalog pages of operating and maintenance instructions and wiring and connection diagrams. This information shall be bound into 8 1/2 x 11 inch notebooks.

3.05 EQUIPMENT OPERATION

A. This Division is responsible for: (1) proper motor rotation, (2) observing that lubrication has been properly performed, (3) that motors operate within nameplate limits, and (4) adjustment or circuit breaker and motor controller trip settings.

3.06 IDENTIFICATION

A. CONTRACTOR shall identify all major items of equipment, including: controls, panelboards, switches, contactors, motor starters and enclosures, junction boxes and metering with permanent nameplates, with verbiage approved by the CONSULTANT/ENGINEER. Secure any nameplates using stainless steel screws or rivets. Adhesives are acceptable on components within NEMA 1 enclosures only.

B. Nameplates, after installation, shall be easily visible and shall bear notations identical to those shown on record drawings. P&ID tag designations shall be utilized wherever they exist.

C. Each instrument shall be identified with a stamped stainless steel tag system (Brady or approved equal). Instrument tags shall be permanently attached to each individual instrument and stamped with the appropriate tag designation as described in the instrument specification section.

D. Each wire and/or cable shall be identified with a permanent labeling system (Brady Catalog Number B-292 with printed legends, or approved equal). Instrumentation cables shall be labeled with the appropriate instrument number of the originating signal (ex: FT-201). Multiplex cables, power and control cables shall be labeled with the appropriate cable number as shown in the conduit and cable schedule.

E. All motor controllers, power panels, lighting panels, control panels, control cabinets and transformers shall be identified with permanently mounted phenolic labels.

F. All power and lighting panels shall have breaker schedules typed and mounted inside their respective door(s).

3.07 TEST PERIOD

A. Each piece of equipment shall continue to meet performance specifications throughout the first year of actual operation, beginning with the date of acceptance of completed Work. The CONTRACTOR shall replace or repair any defect due to faulty workmanship or material which shall develop within 1 calendar year from date of acceptance. This warrantee shall cover both material and workmanship.

3.08 ELECTRICAL TESTING AND STARTUP

A. General:

1. Prior to energizing any equipment, the CONTRACTOR shall thoroughly vacuum clean the equipment with an industrial type vacuum cleaner. Any sheet metal parts shall be thoroughly cleaned with degreaser to remove any oil deposited during fabrication or installation. The outside of all electrical equipment shall be cleaned and touched up with VENDOR-supplied touch-up paint, in order to leave the equipment in an "as-purchased" condition.

2. During startup of new equipment, the CONTRACTOR shall provide sufficient manpower to aid with the startup of the electrical equipment, to remove any faults, and to make any necessary adjustment for proper operation of electrical equipment.

3. All testing equipment shall be furnished by the CONTRACTOR.

4. All failures under tests due to defective material or poor workmanship shall be corrected by the CONTRACTOR, at no expense to the CONSULTANT/ENGINEER.

5. The CONTRACTOR shall not, under any circumstances, energize any electrical equipment covered by these Specifications, without first obtaining the permission of the CONSULTANT/ENGINEER.

B. All power and replacement fuses, bulbs and spare parts necessary for testing shall be furnished and paid for by the CONTRACTOR under this item. All spare parts and fuses shall be obtained prior to startup.

END OF SECTION

SECTION 16050
BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

B. Requirements specified in Division 16 Section 16010 "Basic Electrical Requirements" apply to this Section.

1.02 SUMMARY

A. This Section includes limited scope general construction materials and methods for application with electrical installations as follows:

1. Miscellaneous metals for support of electrical materials and equipment.

1.03 SUBMITTALS

A. Shop drawings detailing fabrication and installation for metal fabrications and anchorage for electrical materials and equipment.

B. Welder certificates, signed by CONTRACTOR, certifying that welders comply with requirements specified under "Quality Assurance" article of this Section. This shall include performance of "Cadweld".

1.04 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced Installer for the electrical equipment installation and "Cadweld" terminations.

1.05 SEQUENCE AND SCHEDULING

A. Coordinate the shut-off and disconnection of electrical service with the CONSULTANT/ENGINEER (if necessary).

PART 2 - PRODUCTS

2.01 MISCELLANEOUS METALS

A. Steel plates, shapes, bars, and bar grating: ASTM A 36.

B. Cold-Formed Steel Tubing: ASTM A 500.

C. Hot-Rolled Steel Tubing: ASTM A 501.

D. Steel Pipe: ASTM A 53, Schedule 40, welded.

E. Fasteners: Zinc-coated, type, grade, and class as required.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting installation and application of joint sealers and access panels. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.02 ERECTION OF METAL SUPPORTS AND ANCHORAGE

A. Cut, fit, and place miscellaneous metal fabrications accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

B. CONTRACTOR must utilize the existing building interior framing/unistrut system on all walls and ceiling for mounting electrical equipment, piping and conduit.

END OF SECTION

SECTION 16110
RACEWAYS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Design Documents.

B. Requirements of the following Division 16 Sections apply to this Section:

1. Section 16010: "Basic Electrical Requirements."

2. Section 16050: "Basic Electrical Materials and Methods."

1.02 SUMMARY

A. This Section includes raceways for electrical wiring. Types of raceways in this section include the following:

1. Rigid galvanized steel conduit.

2. Rigid Nonmetallic conduit.

3. Liquidtight flexible conduit.

A. Related Sections: The following Division 16 Sections contain requirements that relate to this Section:

1. "Wires and Cables" for other wiring methods.

2. "Supporting Devices" for raceway supports.

3. "Cabinets, Boxes, and Fittings" for boxes used with conduit and tubing systems.

1.03 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.

B. Product Data for the following products:

1. Rigid galvanized steel conduit.

2. Rigid nonmetallic conduit.

3. Liquidtight flexible conduit.

C. Installation Instructions: MANUFACTURER's written installation instructions for wireway, galvanized steel raceway products.

1.04 QUALITY ASSURANCE

A. Electrical Component Standard: Components and installation shall comply with NFPA 70 "National Electrical Code."

B. NEMA Compliance: Comply with applicable requirements of NEMA standards pertaining to raceways.

C. UL Compliance and Labeling: Comply with applicable requirements of UL standards pertaining to electrical raceway systems. Provide raceway products and components listed and labeled by UL, ETL, or CSA.

1.05 SEQUENCING AND SCHEDULING

A. Coordinate with other Work, including metal and concrete deck installation, as necessary to interface installation of electrical raceways and components with other Work.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. MANUFACTURERs: Subject to compliance with requirements, provide products by the following:

1. Rigid galvanized steel conduit:
   a. Allied Tube and Conduit.
   b. Wheatland.
   c. General Electric.
   d. Approved equivalent.
2. Rigid nonmetallic conduit:
   a. Carlon.
   b. Borg-Warner.
   c. Approved equivalent.
3. Conduit Bodies:
   a. Appleton Electric Co.
   b. Crouse-Hinds Division, Cooper Industries, Inc.
   c. O-Z/Gedney.
   d. Spring City Electrical Mfg. Co.
4. Conduit Fittings and Bushings:
   a. O-Z/Gedney, Type B.
   b. Thomas & Betts Company.
   c. Panduit Manufacturing.
   d. Appleton Electric Co.
   e. Myers Electric Products, Inc.

2.02 CONDUIT BODIES

A. General: Types, shapes, and sizes as required to suit individual applications and NEC requirements. Provide matching cast gasketed covers secured with corrosion-resistant screws.

2.03 GALVANIZED STEEL CONDUIT

A. General: Rigid metal conduit shall be heavy wall, mild steel conduit conforming to ANSI C80.1 and Federal Specification WW-C-581, hot dip galvanized both inside and out. All conduits shall bear the approved stamp of the Underwriters Laboratories.

B. Rigid Steel Conduit: ANSI C80.1.

C. Fittings and Conduit Bodies: ANSI/NEMA FB 1; steel and malleable iron fittings.

D. Conduit (or cable) schedules shown on Drawing 10.

2.04 LIQUIDTIGHT FLEXIBLE METAL CONDUIT

A. General: Flexible conduit shall have an oil-resistant, liquid-tight jacket, in combination with flexible metal reinforcing tubing and shall be designed for use with waterproof fittings. An integral ground wire shall be included. Only UL Listed fittings shall be used.

2.05 RIGID NONMETALLIC CONDUIT

A. General: Rigid nonmetallic conduit for voltages 600V and less shall be SCH 80 heavy wall polyvinyl chloride (PVC) electrical conduit rated for 90° C conductors and conforming to NEMA TC-2, Type EPC-80-PVC. It shall be listed by Underwriters Laboratories in conformance with the National Electrical Code. Conduit fittings, elbows, and joint cement shall be produced by the same MANUFACTURER as the conduit.

2.06 CONDUIT FITTINGS AND BUSHINGS

A. General: Wherever conduits terminate in sheet steel boxes, cast hubs shall be used to form the conduit connection to the box. All bushings shall be insulated metallic type, equal to O. Z. Electrical Manufacturing Company, Type B; T & B Company, 1200 Series; Appleton Electric Company, Type BU-I; or equal.

PART 3 - EXECUTION

3.01 WIRING METHOD

A. Connection to Vibrating Equipment: Including hydraulic, pneumatic, or electric solenoid or motor-driven equipment: liquidtight flexible galvanized steel conduit or explosion-proof flexible conduit, as appropriate for the atmospheric classification and code requirements.

3.02 GENERAL

A. Install electrical raceways in accordance with MANUFACTURER's written installation instructions, applicable requirements of NEC, and as follows:

1. Use galvanized steel conduit for above-grade raceways unless otherwise specified.

2. Use rigid nonmetallic conduit for below-grade raceways, unless otherwise specified.

B. Expose conduit, unless indicated otherwise, on walls, and ceilings. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot water pipes. Install raceways level and square and at proper elevations. Do not block access to openings, louvers, equipment, etc.

C. Elevation of Raceway: Where possible, install horizontal raceway runs above water and steam piping. All conduit runs shall be routed overhead unless explicitly called out otherwise in either the specifications or Drawings.

D. Installation of all electrical raceways shall be completed prior to starting installation of conductors within raceways.

E. Supports for raceways shall be provided and installed as specified elsewhere in Division 16.

F. Prevent foreign matter from entering raceways by using temporary closure protection.

G. All conduit runs in the building shall be exposed; conduit may not be run in the floor slab.

H. Make bends and offsets so the inside diameter is not effectively reduced. Unless otherwise indicated, keep the legs of a bend in the same plane and the straight legs of offsets parallel.

I. Use raceway fittings that are of types compatible with the associated raceway and suitable for the use and location.

J. Run raceways buried in the earth with a minimum of bends in the shortest practical distance considering the type of building construction and obstructions except as otherwise indicated.

K. Install exposed raceways parallel and perpendicular to nearby surfaces or structural members and follow the surface contours as much as practical. Where conduit is run overhead, clearance above floor shall not be less than the vertical opening of the overhead door.

L. Run exposed, parallel, or banked raceways together. Make bends in parallel or banked runs from the same center line so that the bends are parallel. Factory elbows may be used in banked runs only where they can be installed parallel. This requires that there be a change in the plane of the run such as from wall to ceiling and that the raceways be of the same size. In other cases provide field bends for parallel raceways.

M. Join raceways with fittings designed and approved for the purpose and make joints tight. Make raceway terminations watertight. Where terminations are subject to vibration, use flexible conduit, as required by the NEC and atmospheric classification.

N. Terminations: All conduit terminations in sheet metal enclosures shall utilize O-ring-type oil-tight hub connections, manufactured by Thomas & Betts or equal. Terminations shall be separable and watertight.

O. Where terminating in threaded hubs, screw the raceway or fitting tight into the hub so the end bears against the wire protection shoulder.

P. Install pull wires in empty raceways. Use no. 14 AWG zinc-coated steel or monofilament plastic line having not less than 200-lb. tensile strength. Leave not less than 12 inches of slack at each end of the pull wire.

Q. Telephone and Signal System Raceways 2-Inch Trade Size and Smaller: In addition to the above requirements, install raceways 2-inch and smaller trade size in maximum lengths at 150 feet and with a maximum of two, 90-degree. bends or equivalent. Install pull or junction boxes where necessary to comply with these requirements.

R. Flexible Connections: Use short lengths (maximum of 2 ft.) of flexible metal conduit for connections to motors, equipment subject to vibration, noise transmission, or movement and shall include a built-in, continuous copper ground conductor and terminating fittings suitable to assure adequate bonding connection to conduit.

S. Buried Conduits: All buried conduits shall be a minimum of 24" below finished grade. All fill material for first 6" of backfill above buried conduit(s) shall be free of stones, pebbles or other debris larger than 1/4" diameter. Buried conduits shall be vertically separated from process piping by a minimum of 6" of compacted fill material, Provide continuous plastic warning tape 6" above all buried conduits.

T. Expansion and Deflection Fittings: For long straight conduit runs or at a crossing of expansion joint, expansion and deflection fittings must be utilized.

U. Conduit Drains: Slope conduits to boxes and drains and provide a drain at a low points in trapped conduit runs.

END OF SECTION

SECTION 16120
WIRES AND CABLES

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Work covered by this section included furnishing all labor, equipment and materials required to install, connect and test all wire and cable, including splices, terminations, connectors, and accessories for a complete installation as shown on the Drawings and/or specified herein.

1.02 RELATED DOCUMENTS

A. Design Documents and Drawings.

B. Requirements of the following Division 16 Sections apply to this section:

1. "Basic Electrical Requirements."

1.03 SUMMARY

A. This Section includes wires, cables, and connectors for power, lighting, signal, control and related systems rated 600 volts and less.

B. Related Sections: The following Sections contain requirements that relate to this section:

1. Division 2- "Site Work" for trenching and backfilling.

2. Division 16- Section 16135 "Cabinets, Boxes and Fittings" for connectors for Terminating Cables in boxes and other electrical enclosures.

1.04 SUBMITTALS

A. Product Data for electrical wires, cables and connectors.

1.05 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with provisions of the following code:

B. NFPA 70 "National Electrical Code."

1. Conform to applicable codes and regulations regarding toxicity of combustion products of insulating materials.

C. UL Compliance: Provide components which are listed and labeled by UL under the following standards.

1. UL Std. 83 Thermoplastic-Insulated Wires and Cables.

2. UL Std. 486A Wire Connectors and Soldering Lugs for Use with Copper Conductors.

3. UL Std. 854 Service Entrance Cable.

D. NEMA/ICEA Compliance: Provide components which comply with the following standards:

1. WC-5 Thermoplastic-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.

2. WC-7 Cross Linked Thermosetting Polyethylene-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.

E. IEEE Compliance: Provide components which comply with the following standard.

1. Std. 82 Test procedures for Impulse Voltage Tests on Insulated Conductors.

1.06 SIZING OF CONDUCTORS

A. Unless otherwise required or directed by the CONSULTANT/ENGINEER, conductors shall be furnished in the sizes and types specified on Drawing 9. No wire for lighting, power or motor control circuits shall be smaller than No. 12 AWG. No wire for instrumentation and low-level signal transmission shall be smaller than No. 18 AWG for single pairs or No. 20 AWG for bundled cable.

B. Where the size of the lighting and HVAC wiring is not given on the Drawings, it shall be of such size that the voltage drop on the branch circuit is not more than 2 percent.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. MANUFACTURERs: Subject to compliance with requirements, provide products by one of the following:

1. Wire and Cable:

a. American Insulated Wire Corp.

b. Cablec Continental

c. Senator Wire and Cable Co.

d. Southwire Company.

1. Connectors for Wires and Cable Conductors:

a. AMP.

b. 3M Company.

c. O-Z/Gedney Co.

d. Square D Company.

2.02 WIRES AND CABLES

A. General: Provide wire and cable suitable for the temperature, conditions and location where installed.

B. Conductors: Provide solid conductors for power and lighting circuits no. 10 AWG and smaller. Provide stranded conductors for sizes no. 8 AWG and larger.

C. Conductor Material: copper for all wires and cables.

D. Insulation: Provide THHN/THWN insulation for all conductors for branch circuit power, lighting, control, signal and alarm wiring, 120 to 480 volts. Where cable is for signal wiring below 120 volts cable shall be #18 twisted pair similar to above with aluminum/polyester shield and PVC jacket. All wire shall have insulation rating of not less than 600 Volts.

E. Color Coding for phase identification in accordance with Table 1 in Part 3 below.

F. Flexible power cords shall be moisture-resistant, oil-resistant, neoprene-sheathed service cable designed for extra hard usage, Type SO, rated 600 volts at 90 degrees C continuous conductor temperature. All flexible cords shall be UL Listed.

G. Instrumentation wiring shall consist of a shielded, twisted pair of conductors, with a minimum conductor size of No. 18 AWG. Shield coverage should be 100 percent. Instrumentation wiring shall be provided by Belden, Inc., or Alpha.

2.03 CONNECTORS FOR CONDUCTORS

A. Provide UL-listed factory-fabricated, solderless metal connectors of sizes, ampacity ratings, materials, types and classes for applications and for services indicated. Use connectors with temperature ratings equivalent to or greater than those of the wires upon which used.

B. For wires #10 and smaller in non-hazardous locations, use King watertight twist-on insulation "wire nuts", or equal.

PART 3 - EXECUTION

3.01 WIRING METHOD

A. Use the following wiring methods as indicated:

1. Wire: install all wire in raceway as indicated.

2. Service Entrance Cable Type USE: for underground service feeders.

3.02 INSTALLATION OF WIRES AND CABLES

A. General: Install electrical cables, wires, and connectors in compliance with NEC.

B. Coordinate cable installation with other Work.

C. Pull conductors simultaneously where more than one is being installed in same raceway. Use UL listed pulling compound or lubricant, where necessary.

D. Use pulling means including, fish tape, cable, rope, and basket weave wire/cable grips which will not damage cables or raceways. Do not use rope hitches for pulling attachment to wire or cable.

E. Install exposed cable parallel and perpendicular to surfaces or exposed structural members, and follow surface contours, where possible.

F. Keep conductor splices to minimum.

G. Install splice and tap connectors which possess equivalent or better mechanical strength and insulation rating than conductors being spliced.

H. Use splice and tap connectors which are compatible with conductor material. Provide appropriate compression connectors, and make watertight with heat shrink tubing.

I. Provide adequate length of conductors within electrical enclosures and train the conductors to terminal points with no excess. Bundle multiple conductors, with conductors larger than no 10 AWG cabled in individual circuits. Make terminations so there is no bare conductor at the terminal.

J. Tighten electrical connectors and terminals, including screws and bolts, in accordance with MANUFACTURER's published torque tightening values. Where MANUFACTURER's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL 486A.

K. Identification: All conductors, including power, control and instrumentation shall be clearly labeled at each end, using Brady B-500 cloth wire markers, Thomas and Betts "EZ-Code" markers, or approved equal.

L. Unless otherwise specified, splices shall be made at outlet or conduit boxes, pull or junction boxes, manholes or vaults. No splice shall be drawn into a conduit.

Splices in wiring rated 600 volts and below shall be made with enough spare wire for 2 splices to be remade with the same wire at the same location.

3.03 FIELD QUALITY CONTROL

A. Prior to energizing, check installed wires and cables with megohm meter to determine insulation resistance levels to assure requirements are fulfilled.

B. Prior to energizing, test wires and cables for electrical continuity and for short-circuits.

C. Subsequent to wire and cable hook-ups, energize circuits and demonstrate proper functioning. Correct malfunctioning units, and retest to demonstrate compliance.

D. TABLE 1: Color Coding for Phase Identification:

Color code secondary service, feeder, and branch circuit as follows:

240/120 Volts	Phase
Black	A
Red	B
White	Neutral
Green	Ground

END OF SECTION

SECTION 16135
CABINETS, BOXES, AND FITTINGS

PART 1 - GENERAL

1.01 WORK INCLUDED

A. The Work covered by this Section consists of furnishing all materials, tools, equipment and labor necessary to install all electrical cabinets, enclosures, boxes and fittings indicated on the Construction Drawings and in this Specification.

B. Cabinets and enclosures covered by this section include, but are not limited to: the Main Control panel (MCP), as well as the following:

1. All outlet and device boxes.

2. All pull and junction boxes.

3. All cabinets.

4. All hinged door enclosures.

C. Conduit-body-type electrical enclosures and wiring fittings are specified in Division 16 Section 16110, "Raceways."

1.02 RELATED DOCUMENTS

A. Design Documents and Drawings.

B. Requirements of the following Division 16 Sections apply to this section:

1. Section 16010, "Basic Electrical Requirements."

2. Section 16050, "Basic Electrical Materials and Methods."

1.03 REFERENCES

A. NEMA 250- Enclosures for Electrical Equipment (1000 Volts Maximum).

B. ANSI/NEMA ICS-1- Industrial Controls and Systems.

C. ANSI/NEMA ICS-4- Terminal Blocks for Industrial Control Equipment and Systems.

D. ANSI/NEMA ICS-6 - Enclosures for Industrial Control Equipment and Systems.

1.04 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections:

1. Product data for cabinets and enclosures with classification higher than NEMA 1.

2. Shop Drawings for Equipment Panels: Include wiring schematic diagram, wiring diagram, outline drawing and construction diagram as described in ANSI/NEMA ICS-1.

1.05 DEFINITIONS

A. Cabinets: An enclosure designed either for surface or for flush mounting and having a frame, or trim in which a door or doors may be mounted.

B. Device Box: An outlet box designed to house a receptacle device or a wiring box designed to house a switch.

C. Enclosure: A box, case, cabinet, or housing for electrical wiring or components.

D. Hinged Door Enclosure: An enclosure designed for surface mounting and having swinging doors or covers secured directly to and telescoping with the walls of the box.

E. Outlet Box: A wiring enclosure where current is taken from a wiring system to supply utilization equipment.

F. Wiring Box: An enclosure designed to provide access to wiring systems or for the mounting of indicating devices or of switches for controlling electrical circuits.

1.06 QUALITY ASSURANCE

A. UL Listing and Labeling: Items provided under this section shall be listed and labeled by UL.

B. Nationally Recognized Testing Laboratory Listing and Labeling (NRTL): Items provided under this section shall be listed and labeled by a NRTL. The term "NRTL" shall be as defined in OSHA Regulation 1910.7.

C. National Electrical Code Compliance: Components and installation shall comply with NFPA 70 "National Electrical Code."

D. NEMA Compliance: Comply with NEMA Standard 250, "Enclosures for Electrical Equipment (1000 Volts Maximum)."

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. MANUFACTURERs: Subject to compliance with requirements, provide products by the following:

1. Cabinets, Pull and Junction Boxes:

a. Erickson Electrical Equipment Co.

b. Hoffman Engineering Co.

c. Spring City Electrical Mfg. Co.

d. Square D Co.

2.02 CABINETS, BOXES AND FITTINGS, GENERAL

A. Electrical Cabinets, Boxes, and Fittings: Of indicated types, sizes, and NEMA enclosure classes. Where not indicated, provide units of types, sizes, and classes appropriate for the use and location. Provide all items complete with covers and accessories required for the intended use. Provide gaskets for units in damp or wet locations.

2.03 MATERIALS AND FINISHES

A. Sheet Steel: Flat-rolled, code-gage, galvanized steel.

B. Fasteners: Stainless steel screws and hardware.

C. Cast Metal for Boxes, Enclosures, and Covers; Copper-free aluminum except as otherwise specified.

D. Exterior Finish: Gray baked enamel for items exposed in finished locations except as otherwise indicated.

E. Painted Interior Finish: Where indicated, white baked enamel.

F. Fittings for Boxes, Cabinets, and Enclosures: As appropriate for corresponding raceways.

2.04 METAL OUTLET, DEVICE, AND SMALL WIRING BOXES

A. General: Conform to UL 514A, "Metallic Outlet Boxes, Electrical," and UL 514B, "Fittings for Conduit and Outlet Boxes." Boxes shall be of type, shape, size, and depth to suit each location and application. Boxes shall be type FS or FD, or appropriate to device and wiring.

B. Steel Boxes: Conform to NEMA OS 1, "Sheet Steel Outlet Boxes, Device Boxes, Covers, and Box Supports." Boxes shall be sheet steel with no knockouts. Threaded screw holes and accessories shall be suitable for each location including mounting brackets and straps, cable clamps, exterior rings and fixture studs. Indoor boxes shall be NEMA 12.

2.05 PULL AND JUNCTION BOXES

A. General: Comply with UL 50, "Electrical Cabinets and Boxes", for boxes over 100 cubic inches volume. Boxes shall have screwed or bolted on covers of material same as box and shall be of size and shape to suit application.

B. Hot-Dipped Galvanized Steel Boxes: Sheet steel with welded seams. Where necessary to provide a rigid assembly, construct with internal structural steel bracing. Hot-dip galvanized after fabrication. Cover shall be gasketed.

C. Install pull fittings Appleton Model PBFW or approved equivalents for every 100 feet of straight run.

2.06 STEEL ENCLOSURES WITH HINGED DOORS

A. Comply with UL 50, "Cabinets and Enclosures" and NEMA ICS 6, "Enclosures for Industrial Controls and Systems."

B. Construction: Sheet steel, 16 gage, minimum, with continuous welded seams. NEMA class as indicated; arranged for surface mounting.

C. Doors: Hinged directly to cabinet and removable, with approximately 3/4-inch flange around all edges, shaped to cover edge of box. Provide multiple doors where required.

D. Mounting Panel: Provide painted removable internal mounting panel for component installation as noted.

PART 3 - EXECUTION

3.01 INSTALLATION, GENERAL

A. Locations: Install items where indicated and where required to suit code requirements and installation conditions..

B. Cap unused knockout holes where blanks have been removed and plug unused conduit hubs.

C. Support and fasten items securely in accordance with Division 16 Section "Supporting Devices."

D. Sizes shall be adequate to meet NEC volume requirements, but in no case smaller than sizes indicated.

E. Remove sharp edges where they may come in contact with wiring or personnel.

3.02 APPLICATIONS

A. Hinged Door Enclosures: NEMA type 12 enclosure except as indicated.

B. Hinged Door Enclosures Outdoors, Below Grade or Wet Location: NEMA Type 4 and 4X, of stainless steel or painted carbon steel construction - install drip hood, factory tailored to individual units.

3.03 INSTALLATION OF OUTLET BOXES

A. Mounting: Mount outlet boxes for switches with the long axis vertical or as indicated. Mount boxes for receptacles either vertically or horizontally but consistently either way. Three or more gang boxes shall be mounted with the long axis horizontal.

B. Cover Plates for Surface Boxes: Use cast, gasketed plates sized to box front without overlap.

3.04 INSTALLATION OF PULL AND JUNCTION BOXES

A. Box Selection: For boxes in main feeder conduit runs, use sizes not smaller than 8-inches square by 4-inches deep. Do not exceed 6 entering and 6 leaving raceways in a single box.

B. Cable Supports: Install clamps, grids, or devices to which cables may be secured. Arrange cables so they may be readily identified. Support cable at least every 30-inches inside boxes.

C. Size: Provide pull and junction boxes for telephone, signal, and other systems at least 50 percent larger than would be required by Article 370 of NEC, or as indicated. Locate boxes strategically and provide shapes to permit easy pulling of future wires or cables of types normal for such systems.

3.05 INSTALLATION OF CABINTS AND HINGED DOOR ENCLOSUSRES

A. Mount with fronts straight and plumb.

B. Install with bottoms 24 inches above floor or ground level.

3.06 GROUNDING

A. Electrically ground metallic cabinets, boxes, and enclosures. All wiring shall include a grounding conductor. Provide a grounding terminal in the interior of each cabinet, box or enclosure.

3.07 CLEANING AND FINISH REPAIR

A. Upon completion of installation, inspect components. Remove burrs, dirt, and construction debris and repair damaged finish including chips, scratches, abrasions and weld marks.

B. Galvanized Finish: Repair damage using a zinc-rich paint recommended by the enclosure MANUFACTURER.

C. Painted Finish: Repair damage using matching corrosion inhibiting touch-up coating.

END OF SECTION

SECTION 16170
CIRCUIT AND MOTOR DISCONNECTS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

B. Requirements of the following Division 16 Sections apply to this section:

1. Section 16010 - Basic Electrical Requirements.

1.02 SUMMARY

A. This Section includes circuit and motor disconnects not included as part of the combination motor controller units.

B. Related Sections: The following sections contain requirements that relate to this section:

1. Division 16 Section 16481- "Motor Controllers" for combination type starters which incorporate disconnect switches in the same enclosure as the starter and manual motor starters which include the disconnect function as part of the starter switch assembly.

1.03 SUBMITTALS

A. Product data for each type of product specified.

B. Maintenance data for circuit and motor disconnects, for inclusion in Operation and Maintenance Manual specified in Division 1 and Division 16 Section "Basic Electrical Requirements."

1.04 QUALITY ASSURANCE

A. Electrical Component Standards: Provide components complying with NFPA 70 "National Electrical Code" and which are listed and labeled by UL. Comply with UL Standard 98 and NEMA Standard KS 1.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. MANUFACTURERs: Subject to compliance with requirements, provide products by one of the following:

1. Appleton Electric Co.
2. Crouse-Hinds Co.
3. Cutler-Hammer Inc.
4. General Electric Co.
5. Square D Company.
6. Allen-Bradley.

2.02 CIRCUIT AND MOTOR DISCONNECT SWITCHES

A. General: Provide circuit and motor disconnect switches in types, sizes, duties, features ratings, and enclosures as indicated. Provide NEMA 12 enclosure for indoor switches. For motor and motor starter disconnects, provide units with horsepower ratings suitable to the loads. Provide appropriate enclosures for hazardous locations.

B. Non-fusible Disconnects: Heavy duty switches of classes and current ratings as indicated.

2.03 ACCESSORIES

A. Electrical Interlocks: Provide number and arrangement of interlock contacts in switches as indicated.

PART 3 - EXECUTION

3.01 INSTALLATION OF CIRCUIT AND MOTOR DISCONNECTS

A. General: Provide circuit and motor disconnect switches as indicated and where required by the above Code. Comply with switch MANUFACTURERs' printed installation instructions.

3.02 FIELD QUALITY CONTROL

A. Testing: Subsequent to completion of installation of electrical disconnect switches, energize circuits and demonstrate capability and compliance with requirements. Except as otherwise indicated, do not test switches by operating them under load. However, demonstrate switch operation through six opening/closing cycles with circuit unloaded. Open each switch enclosure for inspection of interior, mechanical and electrical connections, fuse installation, and for verification of type and rating of fuses installed. Correct deficiencies then retest to demonstrate compliance. Remove and replace defective units with new units and retest.

END OF SECTION

SECTION 16350
HEATING AND VENTILATING

PART 1 - GENERAL

1.01 WORK INCLUDED

A. The Work covered by this Section includes, but is not limited to, the furnishing and installation of the building electric space heaters and exhaust fans within the treatment system building, including all thermostats, controls, power distribution and miscellaneous equipment.

1.02 RELATED WORK

A. Section 01300 - Submittals

B. Section 16010 - "General Electrical Requirements"

1.03 REFERENCES

A. UL - Underwriters Laboratory

B. Meet the requirements of Section 01400 - Quality Control

1.04 QUALITY ASSURANCE

A. Equipment: MANUFACTURER's name and ratings to be marked on a permanently attached stamped metal label.

1.05 SUBMITTALS

A. Submit product data and shop drawings under provisions of Section 01300.

B. Submit MANUFACTURER's installation instructions under provisions of Section 01300.

PART 2 - PRODUCTS

2.01 BUILDING ELECTRIC SPACE HEATERS

A. The building space heaters shall be UL listed, and shall be the type and rating shown on the drawings and specified herein.

B. The building electric space heaters shall be 240 volts, 1 phase, 5.0 kW, for both units to be deployed in the treatment building.

C. The treatment building shall be equipped with two (2) forced air resistive heaters, Q-Mark, Model MUH-05-21MG, 5.0 kW, 240 V, 1 phase. It shall be equipped with a ceiling mounting bracket.

2.02 EXHAUST FANS

A. The control room exhaust fan shall be a Dayton centrifugal, roof mounted ventilator, Model 4HZ49. This unit is a belt drive model, to be equipped with a 1/3 HP, 240 V single-phase TEFC motor. Mounting curb 4X839 shall be used for roof-mounting of the blower, and shall be equipped with backdraft damper 4XH66. Substitutions: approved equivalent.

2.03 THERMOSTATS AND SWITCHES

A. Each space heater and ventilator shall be equipped with a wall-mounted thermostat, adjustable from 40-85 degrees F. Each thermostat shall be compatible with the environment in which it is deployed, rated at least 22 A, 125V AC. Wall mount 5 feet above floor.

B. Any contactors, relays, enclosures or other accessories required to install the thermostatically controlled heaters and ventilators shall be provided by the CONTRACTOR. Roof ventilator shall have manual motor starter and H-O-A selector switch for thermostat control.

C. All non-integral thermostats shall be wall-mounted to provide easy access. Locations are shown on Drawing 10.

2.04 INTAKE LOUVERS AND SHUTTERS

A. The treatment building shall be equipped with one (1) gravity-actuated louver/shutter assemblies. The unit shall be a model number 1C744, as manufactured by Dayton (Grainger), shall be 18" by 18", and shall be of galvanized steel construction.

B. All louvers shall be equipped with bug screens, with openings no larger than 1/8". The bug screens shall not interfere with the operation of the shutters, and shall be of galvanized or stainless steel construction.

PART 3 - EXECUTION

3.01 INSTALLATION

A. The space heaters shall be installed as directed by the MANUFACTURER's instructions, and in accordance with the National Electrical Code (NEC), 1999 Edition.

B. Route conduit in orderly manner and maintain gradient.

C. Install all equipment in accordance with the Construction Drawings and the MANUFACTURER'S recommendations.

END OF SECTION

SECTION 16470
PANELBOARDS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

B. Requirements of the following Division 16 Sections apply to this Section:

1. Section 16060 "Basic Electrical Requirements."
2. Section 16050 "Basic Electrical Materials and Methods."

1.02 SUMMARY

A. This Section includes lighting and power panelboards and associated auxiliary equipment rated 600 V or less.

B. Related Sections: The following Division 16 Sections contain requirements that relate to this Section:

1. "Overcurrent Protective Devices" for circuit breakers, fusible switches, fuses, and other devices used in panelboards.

1.03 DEFINITIONS

A. Overcurrent Protective Device (OCPD): A device operative on excessive current that causes and maintains the interruption of power in the circuit it protects.

1.04 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.

B. Product data for each type panelboard, accessory item, and component specified.

C. Shop drawings from MANUFACTURERs of panelboards including dimensioned plans, sections, and elevations. Show tabulations of installed devices, major features, and voltage rating. Include the following:

1. Enclosure type with details for types other than NEMA Type 1.

2. Bus configuration and current ratings.

3. Short-circuit current rating of panelboard.

4. Features, characteristics, ratings, and factory settings of individual protective devices and auxiliary components.

D. Wiring diagrams detailing schematic diagram including control wiring, and differentiating between MANUFACTURER-installed and field-installed wiring.

E. Report of field tests and observations certified by the Contractor.

F. Panel schedules for installation in panelboards. Submit final versions after load balancing.

G. Maintenance data for panelboard components, for inclusion in Operating and Maintenance Manual specified in Division 1 and in Division 16 Section "Basic Electrical Requirements." Include instructions for testing circuit breakers.

1.05 QUALITY ASSURANCE

A. Listing and Labeling: Provide products specified in this Section that are listed and labeled.

1. The terms "listed" and "labeled" shall be defined as they are in the National Electrical Code, Article 100.

2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.

B. Electrical Component Standard: Components and installation shall comply with NFPA 70, "National Electrical Code."

C. NEMA Standard: Comply with NEMA PB1, "Panelboards."

D. UL Standards: Comply with UL 61, "Panelboards," and UL 50, "Cabinets and Boxes."

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. ABB Power Distribution, Inc.
2. General Electric Co.
3. Siemens Energy & Automation, Inc.
4. Square D Co.
5. Westinghouse Electric Corp.

2.02 PANELBOARDS, GENERAL REQUIREMENTS

A. Overcurrent Protective Devices (OCPDs): Provide trip size as shown on Single Line Drawing 9. Comply with Division 16 Section "Overcurrent Protective Devices," with OCPDs adapted to panelboard installation. Tandem circuit breakers shall not be used. Multipole breakers shall have common trip.

B. Front: Secured to box with concealed trim clamps except as indicated. Front for surface-mounted panels shall be same dimensions as box.

C. Directory Frame: Metal, mounted inside each panel door.

D. Bus: Hard drawn copper of 98 percent conductivity.

E. Equipment Neutral and Ground Bus: Adequate for feeder and branch-circuit equipment ground conductors. Bonded ground bus to box.

F. Service Equipment Approval: Listed for use as service equipment for panelboards having a separately derived service.

G. Provision for Future Devices: Equip with mounting brackets, bus connections, for future installation of devices.

2.03 DISTRIBUTION PANELBOARD

A. Provide the following products or approved equivalents.

PNL-1: 120/ 240V, 1 Phase, 3 Wire surface mount, NEMA 1, Panelboard
General Electric Type AQ Panelboard 2P3W 240V, 10 KAIC
Equipped with copper bus and ground bus
General Electric 225A main breaker, 10KAIC and Type THQB, 10 KAIC branch breakers

2.04 SURGE PROTECTORS

A. For distribution panelboard PNL-1, provide GE 9L10F series high energy surge protectors or approved equivalents. For the main control panel (MCP) power supply circuit, provide GE 9L10M series high energy surge protector or approved equivalent.

2.05 IDENTIFICATION

A. General: Refer to Division 16 Section "Electrical Identification" for labeling materials.

B. Panelboard nameplates: Engraved laminated plastic or metal nameplate for each panelboard.

PART 3 - EXECUTION

3.01 INSTALLATION

A. General: Install panelboards and accessory items in accordance with NEMA PB 1.1, "General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less" and MANUFACTURERs' written installation instructions.

B. Mounting: Plumb and rigid without distortion of box.

C. Circuit Directory: Typed and reflective of final circuit changes required to balance panel loads. Obtain approval before installing.

D. Install filler plates in unused spaces.

E. Wiring in Panel Gutters: Train conductors neatly in groups, bundle, and wrap with wire ties after completion of load balancing.

3.02 IDENTIFICATION

A. Identify field-installed wiring and components and provide warning signs in accordance with Division 16 Section "Electrical Identification."

3.03 GROUNDING

A. Connections: Make equipment grounding connections for panelboards as required by NEC.

3.04 CONNECTIONS

A. Tighten electrical connectors and terminals, including grounding connections, in accordance with MANUFACTURER's published torque-tightening values. Where MANUFACTURER's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.05 FIELD QUALITY CONTROL

A. Pretesting: Upon completing installation of the system, perform the following preparations for tests:

1. Make insulation resistance tests of panelboard buses, components, and connecting supply, feeder, and control circuits.

2. Make continuity tests of circuits.

B. Quality Control Program: Conform to the following:

1. Procedures: Make field tests and inspections and prepare panelboard for satisfactory operation in accordance with MANUFACTURER's recommendations and these specifications.

2. Schedule tests with at least one week in advance notification.

3. Reports by Contractor: Report written reports of tests and observations. Report defective materials and workmanship and unsatisfactory test results. Include records of repairs and adjustments made.

4. Protective Device Ratings and Settings: Verify indicated ratings and settings to be appropriate for final system configuration and parameters. Where discrepancies are found, recommend final protective device ratings and settings. Use accepted ratings or settings to make the final system adjustments.

C. Visual and Mechanical Inspection: Include the following inspections and related work:

1. Inspect for defects and physical damage, labeling, and nameplate compliance with requirements of up-to-date drawings and panelboard schedules.

2. Exercise and perform of operational tests of all mechanical components and other operable devices in accordance with MANUFACTURER's instruction manual.

3. Check panelboard mounting, area clearances, and alignment and fit of components.

4. Check tightness of bolted electrical connections with calibrated torque wrench. Refer to MANUFACTURER's instructions for proper torque values.

5. Perform visual and mechanical inspection and related work for overcurrent protective devices as specified in Division 16 Section "Overcurrent Protective Devices."

D. Electrical tests: Include the following items performed in accordance with MANUFACTURER's instruction:

1. Ground resistance test on system and equipment ground connections.

2. Test main and subfeed overcurrent protective devices in accordance with Section "Overcurrent Protective Devices."

E. Retest: Correct deficiencies identified by tests and observations and provide retesting of panelboards. Verify by the system tests that the total assembly meets specified requirements.

3.06 CLEANING

A. Upon completion of installation, inspect interior and exterior of panelboards. Remove paint splatters and other spots, dirt, and debris. Touch up scratches and mars of finish to match original finish.

3.07 COMMISSIONING

A. Balancing Loads: After Substantial Completion, but not more than two months after Final Acceptance, conduct load-balancing measurements and circuit changes as follows:

1. Perform measurements during period of normal working load as advised by the Owner.

2. Perform load-balancing circuit changes outside the normal occupancy/working schedule of the system. Make special arrangements with Owner to avoid disrupting critical 24-hour services.

3. Recheck loads after circuit changes during normal load period. Record all load readings before and after changes and submit test records.

4. Tolerance: Difference between phase loads exceeding 20 percent at any one panelboard is not acceptable. Rebalance and recheck as required to meet this minimum requirement.

END OF SECTION

SECTION 16475
OVERCURRENT PROTECTIVE DEVICES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

B. Requirements of the following Division 16 sections apply to this Section:

1. Section 16010- "Basic Electrical Requirements."

1.02 SUMMARY

A. This Section includes overcurrent protective devices (OCPDs) rated 600 V and below and switching devices commonly used with them.

B. Panelboards and Control Panels: Application, installation, and other related requirements for overcurrent protective device installations in distribution equipment are specified in other Division 16 sections.

1.03 DEFINITIONS

A. Overcurrent Protective Device (OCPD): A device operative on excessive current that causes and maintains the interruption of power in the circuit it protects.

B. Ampere-Squared-Seconds: An expression of available thermal energy resulting from current flow. With regard to current-limiting fuses and circuit breakers, the ampere-squared-seconds during fault current interruption represents the energy allowed to flow before the fuse or breaker interrupts the fault current within its current limiting range.

1.04 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.

B. Product data for fuses, fusible switches, circuit breakers, and OCPD accessories specified in this Section, including descriptive data and time-current curves for all protective devices and let-through current curves for those with current limiting characteristics. Include coordination charts and tables and related data.

1.05 QUALITY ASSURANCE

A. Electrical Component Standard: Components and installation shall comply with NFPA 70 "National Electrical Code."

B. Listing and Labeling: Provide products specified in this Section that are listed and labeled.

1. The terms "listed" and "labeled" shall be defined as they are in the National Electrical Code, Article 100.

2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.

C. Single-Source Responsibility: Obtain similar OCPDs from a single MANUFACTURER.

1.06 EXTRA MATERIALS

A. Maintenance Stock, Fuses: For types and ratings required, furnish spare fuses, amounting to one unit for every 5 installed units, but not less than one set of 3 of each kind.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Cartridge Fuses:

   a. Bussmann Div., Cooper Industries, Inc.

   b. General Electric Co.

   c. Gould, Inc.

   d. Littlefuse, Inc.

2. Fusible Switches:

   a. Allen-Bradley Co.

   b. Crouse-Hinds Distribution Equipment.

   c. Eaton Corp.

   d. General Electric Co.

   e. General Switch Corp.

   f. Siemens Energy & Automation, Inc.

   g. Square D Co.

   h. Westinghouse Electric Co.

3. Molded-Case Circuit Breakers:

   a. ABB Power Distribution, Inc.

   b. General Electric Co.

   c. Heinemann Electric Co.

   d. Siemens Energy & Automation, Inc.

   e. Square D Co.

   f. Westinghouse Electric Corp.

2.02 OVERCURRENT PROTECTIVE DEVICES (OCPDs), GENERAL

A. General: Provide OCPDs in indicated types, as integral components of panelboards and motor control panels; and also as individually enclosed and mounted single units.

B. Enclosures: NEMA 250 "Enclosures for Electrical Equipment (1,000 Volts Maximum)."

2.03 CARTRIDGE FUSES

A. General: NEMA Standard FU1, "Low-Voltage Cartridge Fuses." Unless indicated otherwise, provide nonrenewable cartridge fuses of indicated types, classes, and current ratings that have voltage ratings consistent with the circuits on which used.

B. Class RK1 and RK5 Dual Element Time-Delay Fuses: UL 198E, "Class R Fuses."

C. Class RK1 Fast-Acting Fuses: UL 198E, "Class R Fuses."

2.04 MOLDED-CASE CIRCUIT BREAKERS

A. General: UL 489, "Molded Case Circuit Breakers and Circuit Breaker Enclosures," and NEMA AB 1, "Molded Case Circuit Breakers."

B. Construction: Bolt-in type, except breakers where indicated may be plug-in type if held in place by positive locking device requiring mechanical release for removal.

C. Characteristics: Indicated frame size, trip rating, number of poles, and a short-circuit interrupting capacity rating of 10,000 amperes symmetrical, unless a greater rating is indicated. Use thermal magnetic circuit breakers; except in combination motor starters use motor circuit protector breakers.

D. Tripping Device: Quick-make, quick-break toggle mechanism with inverse-time delay and instantaneous overcurrent trip protection for each pole.

E. Adjustable Instantaneous Trip Devices: Factory adjusted to low-trip-setting current values.

F. Enclosure for Panelboard Mounting: Suitable for panel mounting in panelboards and control panels where indicated.

2.05 OCPD ACCESSORIES

A. Shunt-Trip Devices for Circuit Breakers: Where indicated, arrange to trip breaker from an external source of power through a control switch or relay contacts.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Independently Mounted OCPDs: Locate as indicated and install in accordance with MANUFACTURER's written installation instructions.

B. OCPDs in distribution equipment shall be factory installed.

3.02 IDENTIFICATION

A. Identify components in accordance with Division 16 Section 16010, "General Electrical Provisions".

3.03 CONTROL WIRING INSTALLATION

A. Install wiring between OCPDs and control/indication devices as specified in Division 16 Section 16120, "Wires and Cables" for hard wired connections.

3.04 CONNECTIONS

A. Check connectors, terminals, bus joints, and mountings for tightness. Tighten field-connected connectors and terminals, including screws and bolts, in accordance with equipment MANUFACTURER's published torque tightening values. Where MANUFACTURER's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL 486A and UL 486B.

3.05 GROUNDING

A. Provide equipment grounding connections for individually mounted OCPD units as indicated and as required by NEC. Tighten connectors to comply with tightening torques specified in UL Standard 486A to assure permanent and effective grounding.

3.06 FIELD QUALITY CONTROL

A. Reports: Prepare written reports certified by Contractor on tests and observations. Report defective materials and workmanship and unsatisfactory test results. Include complete records of repairs and adjustments made.

B. Schedule visual and mechanical inspections and electrical tests with at least one week's advance notification.

A. Pre-testing: Upon completing installation of the system, perform the following preparations for tests:

1. Make insulation resistance tests of OCPD buses, components, and connecting supply, feeder, and control circuits.

2. Make continuity tests of circuits.

3. Provide set of Contract Documents to test personnel. Include full updating on final system configuration and parameters where they supplement or differ from those indicated in original Contract Documents.

4. Provide MANUFACTURER's instructions for installation and testing of OCPDs to test personnel.

D. Visual and mechanical inspection: Include the following inspections and related work.

1. Overcurrent-Protective-Device Ratings and Settings: Verify indicated ratings and settings to be appropriate for final system arrangement and parameters. Where discrepancies are found, test organization shall recommend final protective device ratings and settings. Use accepted revised ratings or settings to make the final system adjustments.

2. Inspect for defects and physical damage, NRTL labeling, and nameplate compliance with current single line diagram.

3. Exercise and perform operational tests of all mechanical components and other operable devices in accordance with MANUFACTURER's instruction manual.

4. Check tightness of electrical connections of OCPDs with calibrated torque wrench. Refer to MANUFACTURER's instructions for proper torque values.

5. Clean OCPDs using MANUFACTURER's approved methods and materials.

6. Verify installation of proper fuse types and ratings in fusible OCPDs.

E. Electrical Tests: Include the following items performed in accordance with MANUFACTURER's instructions:

1. Insulation resistance test of OCPD conducting parts. Insulation resistance less than 100 megohms is not acceptable.

2. Make adjustments for final settings of adjustable-trip devices.

3. Activate auxiliary protective devices to verify operation of shunt-trip devices.

4. Check interlock and safety devices for operation and sequence. Make closing attempts on locked-open and opening attempts on locked-closed devices including moveable barriers and shutters.

F. Retest: Correct deficiencies identified by tests and observations and provide retesting of OCPDs by Contractor. Verify by the system tests that specified requirements are met.

3.07 CLEANING

A. Upon completion of installation, inspect OCPDs. Remove paint splatters and other spots, dirt, and debris. Touch up scratches and mars of finish to match original finish.

3.08 DEMONSTRATION

A. Training: Contractor shall demonstrate OCPDs and train Owner's maintenance personnel.

END OF SECTION

SECTION 16481
MOTOR CONTROLLERS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

B. Requirements of the following Division 16 Sections apply to this Section:

1. "Basic Electrical Requirements."
2. "Basic Electrical Materials and Methods."

1.02 SUMMARY

A. This Section includes a.c. motor control devices rated 600 V and below that are not supplied as an integral part of motor/controller packages.

B. Overcurrent protective devices and disconnect switches used with motor controllers are specified in Division 16 Section "Overcurrent Protective Devices."

1.03 DEFINITIONS

A. Motor Controller: A device that controls, protects, and energizes an electric motor, and where required, controls its speed or the torque or power delivered by it.

1.04 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.

B. Product data for products specified in this Section. Include dimensions, ratings, and data on features and components.

C. Certified reports of field tests and observations specified in "Field Quality Control" in this Section.

D. Maintenance data for products for inclusion in Operating and Maintenance Manual specified in Division 1 and in Division 16 Section "Basic Electrical Requirements."

E. Load Current and Overload Relay Heater List: Compiled by Contractor after motors have been installed. Arrange to demonstrate selection of heaters to suit actual motor nameplate full load currents.

1.05 QUALITY ASSURANCE

A. Components and Installation: NFPA 70 "National Electrical Code."

B. Listing and Labeling: Provide products specified in this Section that are listed and labeled.

1. The terms "listed" and "labeled" shall be defined as they are in the National Electrical Code, Article 100.

2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.

C. NEMA Compliance: NEMA ICS 2, "Industrial Control Devices, Controllers and Assemblies."

D. UL Compliance: UL 508, "Electric Industrial Control Equipment."

E. Single-Source Responsibility: Obtain similar motor-control devices from a single MANUFACTURER.

1.06 EXTRA MATERIALS

A. Spare Fuses, Coils, Overload Relays and Heaters, Main and Auxiliary Contacts and Incandescent Indicating Lamps: Furnish one spare for every 5 installed units, but not less than one set of 3 of each kind.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Allen-Bradley Co.

2. Square D Co.
3. General Electric
4. Westinghouse/Cutler-Hammer

2.02 MOTOR CONTROLLERS, GENERAL

A. Coordinate the features of each motor controller with the ratings and characteristics of the supply circuit, the motor, the required control sequence, the duty cycle of the motor, drive, and load, and the pilot device, and control circuit affecting controller functions. Provide controllers that are horsepower rated to suit the motor controlled.

B. Contacts shall open each ungrounded connection to the motor.

C. Overload Relays: Ambient-compensated type with inverse-time- current characteristic. Provide with heaters or sensors in each phase matched to nameplate full-load current of the specific motor to which connected with appropriate adjustment for duty cycle.

D. Enclosures: For individually mounted motor controllers and control devices, comply with NEMA Standard 250, "Enclosures for Electrical Equipment (1000 Volts Maximum)." Provide enclosures suitable for the environmental conditions at the controller location.

2.03 MANUAL MOTOR CONTROLLERS

A. Description: Quick-make, quick-break toggle action, with overload relay, 1 hp, 2 pole, 240V, NEMA 12.

2.04 MAGNETIC MOTOR CONTROLLERS

A. Description: Provide full-voltage, non-reversing, across-the-line, magnetic controller, except where another type is indicated.

B. Control Circuit: 120 V. Provide control power transformer integral with controller where no other supply of 120 V control power to controller is indicated. Provide control power transformer with adequate capacity to operate connected pilot, indicating and control devices, plus 100 percent spare capacity. Provide appropriate primary and secondary fuses.

C. Combination Controller: Motor circuit protector; molded-case circuit-breaker type with magnetic-only trip element calibrated to coordinate with the actual

locked-rotor current of the connected motor and the controller overload relays. Provide breakers that are factory assembled with the controller, interlocked with unit cover or door, and arranged to disconnect the controller. Provide motor-circuit protectors with field-adjustable trip elements as specified in Division 16 Section "Overcurrent Protective Devices." In custom control panels breaker and corresponding starter may be separately mounted as noted.

D. Enhanced-Protection Overload Relay: Provide overload relays with NEMA Class 10 tripping characteristics where indicated. Select to protect motor against voltage unbalance and single phasing.

2.05 MULTI-SPEED MOTOR CONTROLLERS

A. General: Match controller to motor type, application, and to number of speeds. Conform to Article "Magnetic Motor Controllers" above. Provide auxiliary devices as indicated. Provide all required relays factory installed in controller enclosure.

B. Controller for Separate Winding Motor: Provide number of contactors to suit motor speeds indicated. Select controller to suit motor type indicated.

2.06 AUXILIARY CONTROL DEVICES

A. General: Factory installed in controller enclosure except as otherwise indicated. Where separately mounted, provide NEMA 12 enclosure except as otherwise indicated.

B. Pushbutton Stations, Pilot Lights, and Selector Switches: Heavy-duty type. Allen Bradley Bulletin 800T 30.5 mm NEMA Type 4 selector switches are to be used. (Substitutions: Approved equivalent.)

C. Control Relays: Auxiliary and adjustable time-delay relays.

D. Elapsed Time Meters: Heavy duty with digital readout in hours.

E. Current Sensors: Rated to suit application.

PART 3 - EXECUTION

3.01 APPLICATION

A. Manual Controllers: Use for single-phase motors except as indicated.

B. Pushbutton Stations: Except as otherwise indicated, momentary-contact, start-stop units. Provide in covers of magnetic controllers and/or face of control panels for manually started motors where indicated; connect start contact in parallel with sealing auxiliary contact for low-voltage protection.

3.02 INSTALLATION

A. General: Install independently mounted motor control devices in accordance with MANUFACTURER's written instructions.

B. Location: Locate controllers as indicated and within sight of motors controlled. Where power supplied to controller has provision for lockout, the "within sight" provision need not apply.

C. Mounting: Provide freestanding racks fabricated of structural steel members and light-weight slotted structural steel channels. Use feet consisting of 3/8-inch thick steel plates, 6 inches square, bolted to the floor. Use feet for welded attachment of 1-1/2-inch by 1-1/2-inch by 1/4-inch vertical angle posts not over three feet on centers. Connect the posts with horizontal lightweight slotted steel channels and bolt the control equipment to the channels.

D. Motor-Controller Fuses: Conform to requirements of Division 16 Section "Overcurrent Protective Devices."

3.03 IDENTIFICATION

A. Identify motor control components and control wiring in accordance with Division 16 Section "Electrical Identification."

3.04 CONTROL WIRING INSTALLATION

A. Install wiring between motor control devices and control/indicating devices as specified in Division 16 Section "Wires and Cables" for hard-wired connections.

B. Install wiring in enclosures neatly bundled, trained, and supported. In Main Control Panel (MCP) interior wiring shall be run in plastic wireway [Panduit or equivalent]. Also maintain separation of power wiring, control wiring and instrumentation wiring.

3.05 CONNECTIONS

A. Tighten connectors, terminals, bus joints, and mountings. Tighten field connected connectors and terminals, including screws and bolts, in accordance with equipment MANUFACTURER's published torque tightening values. Where

MANUFACTURER's torquing requirements are not indicated, comply with tightening torques specified in UL 486A and UL 486B.

3.06 FIELD QUALITY CONTROL

A. Reports: Prepare written reports certified by Contractor of tests and observations. Report defective materials and workmanship and unsatisfactory test results. Include records of repairs and adjustments made.

B. Schedule visual and mechanical inspections and electrical tests with at least one week's advance notification.

C. Pretesting: On completing installation of the system, perform the following preparations for tests:

1. Make insulation resistance tests of conducting parts of motor control components; and of connecting supply, feeder, and control circuits. For devices containing solid-state components, use test equipment and methods recommended by the MANUFACTURER.

2. Make continuity tests of circuits.

3. Provide set of Contract Documents to test personnel. Include full updating on final system configuration and parameters where they supplement or differ from those indicated in original Contract Documents.

4. Provide MANUFACTURER's instructions for installation and testing of motor control devices to test personnel.

D. Visual and mechanical inspection: Include the following inspections and related work.

1. Motor-Control Device Ratings and Settings: Verify that ratings and settings as installed are appropriate for final loads and final system arrangement and parameters. Recommend final protective-device ratings and settings where differences are found. Use accepted revised ratings or settings to make the final system adjustments. Prepare and submit the load current and overload relay heater list.

2. Inspect for defects and physical damage, NRTL labeling, and nameplate compliance with current project drawings.

3. Exercise and perform operational tests of mechanical components and other operable devices in accordance with MANUFACTURER's instructions.

4. Check tightness of electrical connections of devices with calibrated torque wrench. Use MANUFACTURER's recommended torque values.

5. Clean devices using MANUFACTURER's approved methods and materials.

6. Verify proper fuse types and ratings in fusible devices.

7. Electrical Tests: Perform the following in accordance with MANUFACTURER's instructions:

8. Insulation resistance test of motor control devices conducting parts to the extent permitted by the MANUFACTURER's instructions. Insulation resistance less than 100 megohms is not acceptable.

9. Make adjustments for final settings of adjustable-trip devices.

10. Test auxiliary protective features such as loss of phase, phase unbalance and undervoltage to verify operation.

E. Correct deficiencies and retest motor control devices. Verify by the system tests that specified requirements are met.

3.07 CLEANING

A. Remove paint splatters and other spots, dirt, and debris. Touch up scratches and mars of finish to match original finish. Clean devices internally using methods and materials as recommended by MANUFACTURER.

END OF SECTION

SECTION 16512
LIGHTING FIXTURES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions apply to work of this section.

B. Division 16- "Basic Electrical Materials and Methods" applies to work specified in this section.

1.02 SUMMARY

A. Extent of exterior and interior lighting fixture work is indicated by drawings and schedules.

1.03 SUBMITTALS

A. Product Data: Submit MANUFACTURER's product data and installation instructions on each type exterior building lighting fixture and component.

B. Shop Drawings: Submit fixture shop drawings in booklet form with separate sheet for each fixture, assembled in "luminaire type" alphabetical or numerical order, with proposed fixture and accessories clearly indicated on each sheet.

C. Wiring Diagrams: Submit wiring diagrams for lighting fixtures showing connections to electrical panels, switches, and feeders. Differentiate between portions of wiring which are MANUFACTURER-installed and portions which are field-installed.

1.04 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of building lighting fixtures of types and ratings required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Installer's Qualifications: Firm with at least 3 years of successful installation experience on projects with lighting fixture work similar to that required for project.

C. Codes and Standards

1. Electrical Code Compliance: Comply with applicable local code requirements of the authority having jurisdiction and NEC Articles 225, 250, 410, and 501 as applicable to installation, and construction of building lighting fixtures.

2. NEMA Compliance: Comply with applicable requirements of NEMA Standards Pub/No. LE 2 pertaining to lighting equipment.

3. UL Compliance: Comply with requirements of UL standards, including Stds 486A and B, pertaining to lighting fixtures. Provide lighting fixtures and components which are UL-listed and labeled.

4. NFPA Compliance: Comply with applicable requirements of NFPA 78, "Lightning Protection Code," pertaining to installation of lighting fixtures.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver exterior lighting fixtures in factory-fabricated containers or wrappings, which properly protect fixtures from construction debris and physical damage.

B. Store lighting fixtures in original wrappings in a clean dry space. Protect from weather, dirt, fumes, water, construction debris, and damage.

C. Handle lighting fixtures carefully to prevent damage, breaking, and scoring. Do not install damaged fixtures or components; remove units from site and replace with new.

1.06 SEQUENCING AND SCHEDULING

A. Coordinate with other electrical work including wires/cables, electrical boxes and fittings, and raceways, to properly interface installation of exterior lighting fixtures with other work.

B. Sequence lighting installation with other work to reduce possibility of damage and or soiling of fixtures during remainder of construction period.

1.07 MAINTENANCE

A. Maintenance Data: Submit maintenance data and parts list for each lighting fixture and accessory; including "trouble-shooting" maintenance guide. Include

that data, product data, and shop drawings in a maintenance manual, in accordance with requirements of Division 1.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products of one of the following (for each type of exterior lighting fixture):

1. Lighting Fixtures

   a. Appleton Electric Co.

   b. Crouse-Hinds Lighting Products Div; Cooper Industries Inc.

   c. General Electric Co.

   d. Holophane Div; Johns-Manville Corp.

   e. Lithonia Lighting Div; National Services Industries, Inc.

   f. McGraw-Edison Co.

   g. Wide-Light Corp.

   h. Lumark

   i. Metalux

2. High-Intensity Ballasts

   a. Advance Transformer Co.

   b. General Electric Co.

   c. Holophane Div; Johns-Manville Corp.

   d. Jefferson Electric Co.

   e. McGraw-Edison Co.

f. Sola Electric Div; General Signal Corp.

g. Wide-Lite Corp.

2.02 LIGHTING FIXTURES

A. General: Provide lighting fixtures, of sizes, types and ratings as shown on Drawing 10, and specified herein; complete with, but not limited to, housings, energy efficient ballasts, starters and wiring. Furnish indoor lighting fixtures as specified in the Drawings.

B. High-Intensity-Discharge Lamp Ballasts: Provide HID lamp ballasts, of ratings, types and makes as recommended by lamp MANUFACTURER, which properly mates and matches lamps to electrical supply by providing appropriate voltages and impedances for which lamps are designed. Design ballasts to operate lamp within the lamp's power trapezoid requirements.

C. Lamps:

1. Provide lamps to match fixtures.

D. Photo Electric Sensors:

1. Photo electric control shall be furnished and installed with time delay for outdoor lighting and shall be completely self-contained and not affected by moisture, vibration, or temperature changes.

2. ON/OFF adjustments shall be made by movement of a light level selector, without the use of tools, in a range from two to fifty (2 to 50) footcandles.

3. Photo electric control device shall be SPST, and shall have two thousand (2,000) watt tungsten capacity.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine areas and conditions under which lighting fixtures are to be installed, and substrate which will support lighting fixtures. Notify Contractor in writing of conditions detrimental to proper completion of the Work. Do not proceed with

Work until unsatisfactory conditions have been corrected in a manner acceptable to Installer.

3.02 INSTALLATION OF EXTERIOR LIGHTING FIXTURES

A. Install exterior lighting fixtures at locations and heights as indicated, in accordance with fixture MANUFACTURER's written instructions, applicable requirements of NEC, NECA's "Standard of Installation", NEMA standards, and with recognized industry practices to ensure that lighting fixtures fulfill requirements.

B. Tighten connectors and terminals, including screws and bolts, in accordance with equipment MANUFACTURER's published torque tightening values for equipment connectors. Where MANUFACTURER's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Stds 486A and B, and the National Electrical Code.

C. Fasten electrical lighting fixtures and brackets securely to indicated structural supports; and ensure that installed fixtures are plum and level. Conduit for exterior fixtures shall be run on the interior wall, not outside.

D. Contractor shall provide all necessary enclosures, relays and miscellaneous equipment necessary to utilize a single photocell to operate all for specified metal halide floodlights. Mount photo electric sensors per MANUFACTURER's recommendations.

E. Specific Exterior Lighting Fixtures and Appurtenances:

1. Floodlights will be mounted on outdoor service areas as shown in the Drawings. Mounting height for stanchion-mounted fixtures: along top of building wall, below roofline, in locations as indicated.

3.03 GROUNDING

A. Provide equipment grounding connections for exterior lighting fixtures as indicated. Tighten connections to comply with tightening torques specified in UL Std 486A to assure permanent and effective grounds.

3.04 FIELD QUALITY CONTROL

A. At the Date of Substantial Completion, replace lamps in exterior lighting fixtures which are observed to be noticeably dimmed after CONTRACTOR's use and testing, as judged by the ENGINEER.

1. Refer to Division 1 sections for the replacement/restoration of lamps in lighting fixtures, where used for temporary lighting prior to Date of Substantial Completion.

3.05 ADJUSTING AND CLEANING

A. Aim adjustable lighting fixtures and lamps in night test of system.

B. Clean lighting fixtures of dirt and debris upon completion of installation.

C. Protect installed fixtures from damage during construction period.

D. Calibrate photo electric light control sensor in order to turn on flood lights at dusk, and off at dawn.

3.06 DEMONSTRATION

Upon completion of installation of lighting fixtures and associated electrical supply circuitry, apply electrical energy to circuitry to demonstrate capability and compliance with requirements. Where possible, correct malfunctioning units at site, then retest to demonstrate compliance; otherwise, remove and replace with new units, and proceed with retesting.

END OF SECTION

SECTION 16550
HEAT TRACING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

B. Requirements specified in Division 16 Section 16010 "Basic Electrical Requirements" apply to this Section.

1.02 SUMMARY

A. This Section includes limited scope general construction materials and methods for application with electrical installations as follows:

1. Electrical heat tracing and associated controls.

1.03 SUBMITTALS

A. MANUFACTURER's cut sheets detailing makes and models of heat tracing to be deployed.

1.04 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced Installer for the electrical equipment installation and electrical heat tracing.

1.05 SEQUENCE AND SCHEDULING

A. Coordinate the shut-off and disconnection of electrical service with the ENGINEER (if necessary).

PART 2 - PRODUCTS

2.01 HEAT TRACING

A. Heat tracing shall be model # SRL-8, as manufactured by Chromolox, Inc. Substitutions: approved equivalent. Heat tracing shall be 120 volts, rated for 8 watts per foot, and of the self-regulating type.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Heat tracing shall be installed as shown on the Drawings, as described in MANUFACTURER's installation instructions. Where tracing is used to protect plastic pipe, the pipe shall be wrapped in concentric circles, with a spacing of 1-2 feet per wrap. For protection of steel or iron pipe, heat trace may be deployed in a straight run, along the bottom of the pipe in the 5- or 7- o'clock position.

B. The heat tracing run must be equipped with a red "heat trace on" indicator at the end of each run, in order to indicate integrity of tracing. The indicator light shall be oil-tight, and deployed in a location visible to the plant operator. The indicator shall be appropriate for the environment in which it is deployed.

C. Splices shall not be permitted in the heat trace runs. Appropriate manufacturer-supplied heat trace junction boxes shall be used for connections to heat tracing deployed beneath insulation.

END OF SECTION

SECTION 16660
GROUNDING SYSTEM

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. The CONTRACTOR shall furnish all materials and labor, tools, plant, equipment, and incidentals required to furnish and install a complete grounding system in strict accordance with Article 250 of the National Electrical Code (NEC), as required by the contract documents and required by the work to be done.

1.02 REFERENCES STANDARDS

A. National Electrical Code (NEC)

B. Underwriters Laboratory (UL)

1. UL 467

PART 2 - PRODUCTS

2.01 MATERIALS

A. Conduit shall be as specified under Section 16110.

B. Wire shall be as specified under Section 16120.

C. Ground rods shall be ¾" inch diameter by ten (10') feet copper clad steel and constructed in accordance with UL 467. The minimum copper thickness shall be twenty-five hundredths (0.25 mm) millimeters. Ground rods shall be Copperweld or approved equal.

D. Grounding conduit hubs shall be malleable iron type similar to Thomas and Betts Co. Cat. No. 3940, three-fourths (3/4") inch conduit size; Burndy; O-Z/Gedney Co.; or approved equal, and of the correct size for the conduit.

E. Waterpipe ground clamps shall be cast bronze saddle type, similar to Thomas and Betts Co. Cat. No. 2; Burndy; O-Z/Gedney Co.; or approved equal, and of the correct size for the pipe.

F. The building ground grid shall consist of a buried bare stranded tinned, soft-drawn copper cable of not less than ninety-eight (98%) percent conductivity at twenty (20°C) degrees Centigrade #4/0, buried 42" below grade.

G. Buried grounding connections shall be by Cadweld process, or accepted equal exothermic welding system.

H. Ground wire connections to building exterior shall be made with long barrel type one-hole heavy duty copper compression lugs, bolted through one-half (1/2") inch maximum diameter holes drilled in the corner/angle, with stainless steel hex head cap screws and nuts.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Grounding electrode conductors shall be buried at a depth of not less than forty-two (42") inches below finished grade. Grounding cables that penetrate equipment slabs and vertical runs on building exteriors, shall be run in Schedule 80 PVC conduits.

B. Equipment grounding conductors shall be run with all feeders and in all conduits.

C. Liquid-tight flexible metal conduit in sizes one and one-half (1-1/2") inch and larger shall have bonding jumpers. Bonding jumpers shall be external, run parallel (not spiraled), and fastened with plastic tie wraps.

D. All equipment enclosures, motor and transformer frames, conduits systems, cable armor, exposed structural steel, and all other equipment and materials required by the NEC to be grounded, shall be grounded and bonded in accordance with the NEC.

E. Exposed connections between different metals shall be sealed with No-Oxide Paint Grade A or approved equal.

F. Care shall be taken to ensure good ground continuity, in particular between the conduit system and equipment frames and enclosures. Where necessary, jumper wires shall be installed. A code sized equipment grounding conductor shall be included in all conduits and bonded to equipment frames at each end.

G. All grounding type receptacles shall be grounded to the outlet boxes with a #12 THW green conductor connected to the ground terminal of the receptacle, and fastened to the outlet box by means of a grounding screw.

3.02 TESTS

A. Test the resistance of the ground-grid system of the new facility area. All test equipment shall be provided under this Section and as approved by the OWNER. Dry season ground-grid resistance of the system shall not exceed five (5) ohms. If such resistance - values cannot be obtained with the systems shown, provide additional grounding as approved by the CONSULTANT/ENGINEER, at the sole cost and expense of the CONTRACTOR.

END OF SECTION

SECTION 16900
PROCESS CONTROL

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Work covered by this Section consists of furnishing all labor, materials and equipment necessary to program and test the process control loops described herein, including hardware and software.

B. CONTRACTOR shall be responsible for ensuring that all control loops operate properly, regardless of equipment SUPPLIER, VENDOR or CONTRACTOR. The CONTRACTOR shall coordinate repair or replacement of any faulty process equipment, control equipment, wiring, or other system components.

C. Construction Drawings and Technical Specifications are intended to provide process control requirements only. CONTRACTOR is responsible for determining the configuration, design, layout and details of the control loops.

1.02 RELATED WORK

A. Division 1- General Requirements.

B. Division 15- Mechanical.

C. Division 16- Electrical.

PART 2 - PRODUCTS

2.01 CONTROL WIRING

A. CONTRACTOR shall provide all necessary hardware, wiring, raceways and ancillary equipment and materials to provide control wiring between process equipment, instrumentation, and logic devices.

2.02 INSTRUMENTATION

A. Control and monitoring instruments (i.e. Solenoid Valves, Level Switches, Pressure Switches, etc.) as described in this Specification.

PART 3 - EXECUTION

3.01 SYSTEM LAYOUT

The control system consists of the system's Main Control Panel (MCP) located in the treatment building. All operators and indicators located in the treatment building shall be located on the MCP.

3.02 PROGRAMMING

Controls and integration contractor is responsible for configuration and programming of the programmable logic controller (PLC), graphical user interface device (GUI), and any communication devices to achieve the process control and monitoring functions described below.

3.03 OPERATION – MOTORS

All motor and solenoid valve manual override switches (i.e., H-O-A, etc...) as described on Drawing 5 and below, shall be of the "virtual" (computer touch screen) type and shall be located on the GUI (for clarity, the GUI is located on the MCP).

A. Transfer Pump TP-400: The pump is designed to transfer treated groundwater from the low profile air stripper sump and shall be controlled by the MCP.

1. Control Devices:

a. TP-400: The pump shall be controlled by a Hand-Off-Auto (H-O-A) selector switch located on the MCP. When the selector switch is in OFF position, TP-400 shall not operate. When the selector switch is in the HAND position, TP-400 shall operate regardless of the status of alarms and interlocks. When the selector switch is in the AUTO position, TP-400 will be subject to all alarms and interlocks described in the interlock section below. When in its normal "auto" operating mode (interlocks and alarms clear), the TP-400 pump turns on when the airstripper high level switch LSH-100 is engaged, and will run until LSH-100 is disengaged.

2. Indicating Devices:

a. YL-400: When the MS-TP400 motor controller (combination motor controller unit, located on the treatment building wall adjacent to the MCP) engages, closing its auxiliary contact, the

PLC shall illuminate a green YL-400 run indicator, located on the MCP.

b. FL-400: When the PLC calls on the MS-TP400 motor controller, and the PLC does not detect a corresponding close of the motor controller auxiliary contact within 3 seconds, the PLC shall illuminate the red FL-400 indicator on the MCP. The red motor fault FL-500 indicator shall remain illuminated until the RESET pushbutton on the MCP panel is depressed. When the FL-400 alarm is engaged, the PLC output calling on the TP-400 motor controller is disabled, and the autodialer is activated.

B. Transfer Pump TP-600: The pump is designed to transfer treated groundwater from the treated water holding tank and shall be controlled by the MCP.

1. Control Devices:

a. TP-600: The pump shall be controlled by a Hand-Off-Auto (H-O-A) selector switch located on the MCP. When the selector switch is in OFF position, TP-600 shall not operate. When the selector switch is in the HAND position, TP-600 shall operate regardless of the status of alarms and interlocks. When the selector switch is in the AUTO position, TP-600 will be subject to all alarms and interlocks described in the interlock section below. When in its normal "auto" operating mode (interlocks and alarms clear), the TP-600 pump turns on when the program calls for the addition of treated water into the Feed Solution Mixing Tank (MT-800) as described below in the Feed Solution Mixing Sequence section of this Specification.

2. Indicating Devices:

a. YL-600: When the MS-TP600 motor controller (combination motor controller unit, located on the treatment building wall adjacent to the MCP) engages, closing its auxiliary contact, the PLC shall illuminate a green YL-600 run indicator, located on the MCP.

b. FL-600: When the PLC calls on the MS-TP600 motor controller, and the PLC does not detect a corresponding close of the motor controller auxiliary contact within 3 seconds, the PLC shall

illuminate the red FL-600 indicator on the MCP. The red motor fault FL-600 indicator shall remain illuminated until the RESET pushbutton on the MCP panel is depressed. When the FL-600 alarm is engaged, the PLC output calling on the MS-TP600 motor controller is disabled, and the autodialer is activated.

C. Molasses Pump MP-700: The pump is designed to transfer pure molasses from the pure molasses totes and shall be controlled by the MCP. The pump will be incorporated with a variable speed drive.

1. Control Devices:

a. MP-700: The pump shall be controlled by a Hand-Off-Auto (H-O-A) selector switch located on the MCP. When the selector switch is in OFF position, MP-700 shall not operate. When the selector switch is in the HAND position, MP-700 shall operate regardless of the status of alarms and interlocks. When the selector switch is in the AUTO position, MP-700 will be subject to all alarms and interlocks described in the interlock section below. When in its normal "auto" operating mode (interlocks and alarms clear), the MP-700 pump turns on when the program calls for the addition of raw molasses into the Feed Solution Mixing Tank (MT-800), and turns off when the requisite (operator specified) amount of molasses has been added to the MT-800 tank. The MS-MP700 controller shall be equipped with a variable frequency drive, which can have its speed adjusted (manually) locally, or via adjustment via the GUI located on the MCP.

2. Indicating Devices:

a. YL-700: When the MS-MP700 motor controller (combination motor/variable frequency drive controller unit, located on the treatment building wall adjacent to the MCP) engages, closing its auxiliary contact, the PLC shall illuminate a green YL-700 run indicator, located on the MCP.

b. FL-700: When the PLC calls on the MS-MP700 motor controller, and the PLC does not detect a corresponding close of the motor controller auxiliary contact within 3 seconds, the PLC shall illuminate the red FL-700 indicator on the MCP. The red motor fault FL-700 indicator shall remain illuminated until the RESET

pushbutton on the MCP panel is depressed. When the FL-700 alarm is engaged, the PLC output calling on the MS-MP700 motor controller is disabled, and the autodialer is activated. Additionally, is a "fault" condition is detected from the variable frequency drive unit, this condition shall be communicated to the MCP, and the MS-MP700 motor controller deactivated.

D. Transfer Pump TP-900: The pump is designed to transfer molasses feed solution to the various injection points, and shall be controlled by the MCP.

1. Control Devices:

a. TP-900: The pump shall be controlled by a Hand-Off-Auto (H-O-A) selector switch located on the MCP. When the selector switch is in OFF position, TP-900 shall not operate. When the selector switch is in the HAND position, TP-900 shall operate regardless of the status of alarms and interlocks. When the selector switch is in the AUTO position, TP-900 will be subject to all alarms and interlocks described in the interlock section below. When in its normal "auto" operating mode (interlocks and alarms clear), the TP-900 pump turns on when the PLC enters the "injection" cycle, and transfers the requisite amount of molasses/water solution into the assigned well. This process is described in section 3.04 (Injection Sequence).

2. Indicating Devices:

a. YL-900: When the MS-TP900 motor controller (combination motor controller unit, located on the treatment building wall adjacent to the MCP) engages, closing its auxiliary contact, the PLC shall illuminate a green YL-900 run indicator, located on the MCP.

b. FL-900: When the PLC calls on the MS-TP900 motor controller, and the PLC does not detect a corresponding close of the motor controller auxiliary contact within 3 seconds, the PLC shall illuminate the red FL-900 indicator on the MCP. The red motor fault FL-900 indicator shall remain illuminated until the RESET pushbutton on the MCP panel is depressed. When the FL-900 alarm is engaged, the PLC output calling on the MS-TP900 motor controller is disabled, and the autodialer is activated.

E. Blower B-300: The blower is designed to deliver air to Airstripper AS-100 for removing volatile organic compounds from recovered groundwater.

1. Control Devices:

a. B-300: The blower shall be controlled by a Hand-Off-Auto (H-O-A) selector switch located on the Main Control Panel. When the selector switch is in the OFF position, blower B-300 shall not operate. When the selector switch is in the HAND position, B-300 shall operate regardless of the status of alarms and interlocks. When the selector switch is in the AUTO position, B-300 will be subject to the control devices, alarms, and interlocks. When in its normal "auto" operating mode (interlocks and alarms clear), the B-300 Blower runs at all times when its H-O-A switch is in the auto mode, and will run until an interlock resulting in the shut down of the water system engages. Following the engagement of the water system shutdown interlock, the blower will run for twenty (20) minutes, then shut down, until cleared to restart by depressing the "reset" button.

2. Indicating Devices:

a. YL-300: When the MS-B300 motor controller (combination motor controller unit, located on the treatment building wall adjacent to the MCP) engages, closing its auxiliary contact, the PLC shall illuminate a green YL-300 run indicator, located on the MCP

b. FL-300: When the PLC calls on the MS-B300 motor controller, and the PLC does not detect a corresponding close of the motor controller auxiliary contact within 3 seconds, the PLC shall illuminate the red FL-900 indicator on the MCP. The red motor fault FL-900 indicator shall remain illuminated until the RESET pushbutton on the MCP panel is depressed. When the FL-900 alarm is engaged, the PLC output calling on the MS-B300 motor controller is disabled, and the autodialer is activated

F. Air Compressor AC-200: Air compressor AC-200 is designed to deliver compressed air to the pneumatic pumps located in the three (3) recovery wells.

1. Control Devices:

a. AC-200: AC-200 shall be controlled by a H-O-A selector switch located on the MCP. When the selector switch is in the OFF position, AC-200 shall not operate. When the selector switch is in the HAND position, AC-200 shall operate regardless of the status of alarms and interlocks. When the selector switch is in the AUTO position, AC-200 will be subject to the control devices, alarms, and interlocks. When in its "auto" operating mode, AC-200 is operable at all times and will run until an interlock resulting in the shut-down of the water system is engaged.

2. Indicating Devices:

a. YL-200: When the AC-200 motor controller (located in Motor Control Center MS-AC200) engages, closing its auxiliary contact, the PLC shall illuminate a green YL-200 run indicator, located on the MCP.

b. FL-200: When the PLC calls on the AC-200 motor controller, and the PLC does not detect a corresponding close of the motor controller auxiliary contact within 3 seconds, the PLC shall simultaneously illuminate the red FL-200 indicator on the MCP. The red motor fault FL-200 indicator shall remain illuminated until the RESET pushbutton on the MCP panel is depressed. When the FL-200 alarm is engaged, the PLC output calling on the AC-200 motor controller is disabled.

G. Molasses Mixer MM-800: MM-800 is designed to mix molasses and treated water in the feed solution mixing tank. The mixer shall be incorporated with a variable speed drive. No MCP interconnect for analog following or analog feedback capability for this device is specified.

1. Control Devices:

a. HS-800: MM-800 shall be controlled by a H-O-A selector switch located on the MCP. When the selector switch is in the OFF position, MM-800 shall not operate. When the selector switch is in the HAND position, MM-800 shall operate regardless of the status of alarms and interlocks. When the selector switch is in the AUTO position, MM-800 will be subject to the control devices, alarms, and interlocks. When in its normal "auto" operating mode (interlocks and alarms clear), the MM-800 mixer turns on when the

has begun the addition of molasses to the Feed Solution Mixing Tank (MT-800) and turns off when the user specified time interval has been reached. The MS-MM800 controller shall be equipped with a variable frequency drive, which can have its speed adjusted (manually) locally.

2. Indicating Devices:

a. YL-800: When the MM-800 motor controller (located in Motor Control Center MS-MM800) engages, closing its auxiliary contact, the PLC shall illuminate a green YL-800 run indicator, located on the MCP.

b. FL-800: When the PLC calls on the MM-800 motor controller, and the PLC does not detect a corresponding close of the motor controller auxiliary contact within 3 seconds, the PLC shall simultaneously illuminate the red FL-800 indicator on the MCP. The red motor fault FL-800 indicator shall remain illuminated until the RESET pushbutton on the MCP panel is depressed. When the FL-800 alarm is engaged, the PLC output calling on the MM-800 motor controller is disabled.

3.04 OPERATION – INJECTION SEQUENCE DESCRIPTION

A. FEED SOLUTION MIXING SEQUENCE: The Feed Solution Mixing Sequence shall begin upon reaching LSL-800 in Feed Solution Mixing Tank MT-800.

In order for the mixing sequence to begin, the water holding tank HT-500 must be full of water and have triggered the LSH-500 level switch, illuminating the green Water Holding Tank Ready indicator light. If the mixing sequence attempts to start, and the level of the holding tank is not at the requisite level, the red Holding Tank Not Ready indicator light will illuminate and latch. Initially, the Mixing Tank MT-800 will fill when Solenoid Valve SV-18 opens, and pump TP-600 turns on. Upon reaching the LSN-800 level switch, the water transfer sequence will shut down, closing solenoid valve SV-18 and turning off pump TP-600. Next the Mixing Motor MM-800 will initiate, and the Molasses Pump MP-700 will initiate. Flowmeter FE-701 will transmit flow totalization data to the MCP. If Molasses pump MP-700 will shut down when the requisite amount of molasses has been added to the MT-800 tank. This amount is operator adjustable from 1-40% molasses:water solution, (based on the tank capacity of 500 gallons between the LSL and LSH-800 switches) via the GUI. Once the molasses transfer process has concluded, transfer pump TP-600 will restart, SV-18 will remain closed, SV-20 will

open, and water will continue to fill the tank until the LSH-800 level has been reached and triggered. This action will rinse the molasses flowmeter FE-701 and associated piping and appurtenances.

The MM-800 mixing motor will continue to run for a time interval specified by the operator on the GUI. This interval will range from 1-100 minutes. Once completed, the MM-800 mixer will shut down, and the injection process will continue from where it was disengaged.

B. MOLASSES SOLUTION INJECTION SEQUENCE: the GUI will be equipped with the capability for the operator to adjust the time between injection cycles (in hours), with a minimum of .5 hours, and a maximum of 350 hours. Upon expiration of this timer, the molasses solution injection sequence will begin.

Upon expiration of the injection sequence timer, the SV-22 solenoid valve will be energized (opened). The feed solution transfer pump TP-900 will be energized, and solenoid valve SV-1 will energize (open), allowing molasses solution to be injected into the first injection well. Flow meter FE-901 will transmit, to the MCP, gallon totalization pumped through the TP-900 injection pump. The amount of injection solution to be injected into each well can be specified on the GUI by the operator, in amounts ranging from 1-99 gallons per injection event. When the operator-specified amount of injection solution has been added to the first injection well, valve SV-1 closes, and SV-2 opens, while injection pump TP-900 continues to run. The injection cycle described above for the SV-1 controlled well will then be repeated for injection valves SV-2 through SV-17. Once the injection sequence has been completed for valves SV-1 through SV-17, the rinse sequence will initiate. If, during an injection sequence, the level of injection solution in the MT-800 tank falls below level switch LSL-800, the injection sequence will stop (i.e., TP-900 will shut-down and SV-22 will close), the process paused with its position retained, and the Feed Solution Mixing Sequence, described in section A (above) initiated. Once the mixing sequence is completed (i.e., following shut-down of MM-800), the injection sequence will restart at the point where it was paused.

C. INJECTION SYSTEM RINSING SEQUENCE: Once the molasses injection step has been completed, the injection system rinsing process will initiate.

Following the closing of the SV-17 valve, valve SV-22 will de-energize (close), and valves SV-1 and SV-21 will open. Transfer pump TP-900 will initialize, and deliver an operator-specified amount of wash water through the SV-1 valve and associated piping. Flow meter FE-901 will again transmit the fluid totals to the MCP, which will be equipped with an operator adjustment on the GUI to specify the

wash water amount for each well, ranging from 1-99 gallons, from SV-1 through SV-17. Once the requisite amount of wash water for SV-1 has been completed, the wash down process is repeated for wells SV-2 through SV-17. Once this process has been completed, transfer pump TP-900 will shut down, and solenoid valve SV-21 will be de-energized (closed). The system will then wait until the cycle repeat timer (described in section A, above) has counted down the requisite number of hours (currently expected to be 72), and the injection process will restart. Once the rinsing sequence has concluded, solenoid valve SV-23 will energize (open), solenoid valve SV-24 will de-energize (close), and water from the airstripper will re-fill the water holding tank HT-500. Once the LSH-500 switch is triggered in the HT-500 tank, SV-23 will close, SV-24 will re-open, and process water from the airstripper will once again continue to discharge to its surface water discharge point.

Process parameters shall be continuously displayed on the GUI.

3.05 OPERATION – INSTRUMENTS AND ACTUATORS

A. FLOWMETER - FE-601: The FE-601 flowmeter shall be located on the treated water influent line to mixing tank MT-800, and shall transmit gallon totalization pumped to the MCP during each mixing cycle.

1. Process Devices:

a. FT-601: This transmitter, will transmit, via analog signal, flow totalization to the to the MCP.

b. FQI-601: The total gallons pumped through the FE-601 flowmeter shall be displayed on the Graphical User Interface (GUI) located on the MCP. The value displayed on the GUI will be the total gallons pumped for the current mixing sequence only.

B. FLOWMETER - FE-701: The FE-701 flowmeter shall be located on the pure molasses influent line to mixing tank MT-800 and shall transmit gallon totalization pumped to the MCP.

1. Process Devices:

a. FT-701: This transmitter, will transmit, via analog signal, flow totalization to the MCP.

b. FQI-701: The total gallons pumped through the FE-701 flowmeter shall be displayed continuously on the GUI located on the MCP.

The value displayed on the GUI will be the total gallons pumped for the current mixing sequence only.

C. FLOWMETER - FE-901: The FE-901 flowmeter shall be located on the molasses feed solution injection line.

1. Process Devices:

a. FT-901: This transmitter, will transmit, via analog signal, its flow rate and flow totalization to the MCP.

b. FI-901: The flow rate through the FE-901 flowmeter shall be displayed continuously on the GUI located on the MCP.

c. FQI-901: The total gallons pumped through the FE-901 flowmeter to each injection well for both the injection sequence and rinse sequence (displayed separately) shall be displayed continuously on the GUI located on the MCP. The values displayed will be the gallons pumped for the current injection and rinsing sequence.

D. INTERLOCKS AND ALARMS:

1. Mixing and Injection System Interlock: Main system interlock, results in Mixing/Injection System shutdown only and dialout alarm #1 on autodialer. This shall include shut-down of all transfer pumps, mixers, and timers associated with the Mixing/Injection System. Any alarm condition initiating this interlock shall be latched. The system operator must acknowledge the alarm prior to restarting the system. The following conditions shall generate a Main System Interlock:

a. PAL-701: In the event that the molasses pump MP-700 discharge pressure falls below the operator-specified switch setpoint during molasses transfer, the red PAL-701 Molasses Pump Pressure Low indicator will illuminate, and the Main System Interlock will engage. This pressure alarm shall only engage while MP-700 is initiated, and will not be utilized otherwise (i.e., its purpose is to detect when the pure molasses supply totes are empty).

b. LAHH-800: In the event that the level in the mixing tank MT-800 exceeds the level of the LSHH-800 level switch, the LAHH-800

Mixing Tank High Level Alarm indicator will illuminate, and the Main System Interlock will engage.

c. LALL-800: In the event that the level in the mixing tank MT-800 falls below the level of the LSLL-800 level switch, the LALL-800 Mixing Tank Low Level Alarm indicator will illuminate, and the Main System Interlock will engage.

d. HT-500 LEVEL NOT READY: In the event that the MCP attempts to initiate a mixing sequence, and the LSH-500 level switch in the HT-500 holding tank has not yet been reached by the water level inside the tank, the red HT-500 LEVEL NOT READY indicator will illuminate, and the main system interlock will engage and latch.

e. PAH-902: In the event that the pressure in the injection manifold exceeds the setpoint of pressure switch PSH-902, the PAH-902 alarm indicator will illuminate, and the main system interlock will engage and latch.

f. Motor Failure Alarms: In the event of a failure of any of the following motors detected by the MCP, the mixing/injection process shall be suspended, and the main system interlock engaged. All motors on the system are equipped with "Motor Fail" indicators in the event that a failure is detected. Motors which will trigger this alarm are: MM-800, TP-900, TP-500 and MP-700.

g. LALL-500: In the event that the level in the holding tank HT-500 falls below the level of the LSLL-500 level switch, the LALL-500 Holding Tank Low Level Alarm indicator will illuminate, and the Main System Interlock will engage.

2. Water System Interlocks: In the event of an alarm within the water system, the MCP shall initiate a dialout of alarm #2 of the autodialer, and initiate a shutdown of the water extraction system, including compressor AC-200 and blower B-300. In addition, three-way solenoid valve SV-25 will engage to the BYPASS position. Provided that the HT-500 holding tank has filled, a shutdown of the mixing/injection system will not occur, and a mixing or injection sequence will be permitted to start, however, the process will not be allowed to continue unless the HT-500 tank has re-filled at all required points in the process as described in section 3.04 (above).

a. PAH-402: In the event that the pressure exceeds the setpoint of the PSH-402 pressure switch, the red Bag Filter Pressure alarm High (PAH-402) alarm indicator will illuminate on the MCP, and the water system interlock will engage and latch.

b. PAL-301: In the event that the pressure at the PSL-301 pressure switch falls below the setpoint of the PSL-301 pressure switch, the red Airstripper Blower Pressure Low alarm indicator will illuminate on the MCP, and the water system interlock will engage and latch. This alarm is enabled only when the blower is being called by the MCP.

c. LAHH-100: In the event that the level in the airstripper sump rises above the level of the LSHH-100 level switch, the red Airstripper Sump Level High alarm (LAHH-100) indicator will illuminate on the MCP, and the water system interlock will engage and latch.

d. LALL-500: In the event that the level in the holding tank HT-500 falls below the level of the LSLL-500 level switch, the LALL-500 Holding Tank Low Level Alarm indicator will illuminate, and the Main System Interlock will engage.

e. LAHH-500: In the event that the level in the holding tank HT-500 rises above the level of the LSHH-500 level switch, the LAHH-500 Holding Tank High Level Alarm indicator will illuminate, and the Main System Interlock will engage.

In the event that a Mixing/Injection System alarm, Water System alarm, or power failure occurs, all solenoid valves will return to their "failsafe" positions as shown on Drawing 5, with the exception of three-way solenoid valve SV-25, which will be engaged to its' BYPASS position.

3. Miscellaneous Alarms:

a. TSL-001: In the event that the temperature at TSL-001 falls below the setpoint, the MCP shall initiate a dialout alarm of #3 on the autodialer.

3.05 TESTING

A. All equipment will subjected to simulated functional testing at the VENDOR's facility. The VENDOR shall provide all necessary equipment and personnel to perform the test. All system components shall be Y2K compliant. VENDOR shall provide the necessary support for any debugging during initial testing.

B. When VENDOR (as noted on page 16920-5) is preparing to test any equipment and/or panel furnished under sections 16900, 16910, or 16920 he shall notify the CONSULTANT/ENGINEER at least 5 working days prior to testing so that the CONSULTANT/ENGINEER may have one or more representatives present at the testing.

3.06 DOCUMENTATION

A. The contractor shall furnish a complete list and data for all electrical devices that are specified herein. This shall include instrument specifications in ISA format, calibrated ranges, product data sheets, spare parts list, MANUFACTURERs' name, location, telephone and fax numbers.

B. The contractor shall furnish a login diagram, a print out of final working code, and any other data needed to fully document the programming function of the PLC.

END OF SECTION

SECTION 16910
CONTROLS AND INSTRUMENTATION

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Flowmeters (Liquid).

B. Pressure Indicators.

C. Pressure Switches.

D. Temperature Switches.

E. Level Switches.

1.02 RELATED SECTIONS

A. Section 01300 - Submittals.

B. Section 16000 - Electrical - General Provisions.

C. Section 16900 - Process Control.

1.03 SUBMITTALS

A. The CONTRACTOR shall submit to the CONSULTANT/ENGINEER for review Shop Drawings for all flow meters, pressure indicators, pressure switches, and level switches in accordance with Section 01300 (Submittals).

PART 2 - MATERIALS

2.01 FLOWMETERS (LIQUID)

A. The flowmeters monitoring groundwater recovery, feed solution mix water, pure molasses, and feed solution injections shall be manufactured by Badger, or an approved equivalent, and shall have the following make and model numbers:

- FE-101, FE-102, FE-103, FE-401 and FE-402 – Badger Model Industrial RCDL M25, bronze casing, with totalizer.

- FE-601 – Badger Model Industrial RCDL M25, bronze casing with totalizer and transmitter Model PFT420.

- FE-701 and FE-901 – Badger Model Magnetoflow (1") with remote Magnetoflow Primo convertor.

2.02 PRESSURE INDICATORS

Pressure indicators shall be MANUFACTURED by Ashcroft, Dwyer Instruments, Inc., or an approved equivalent, and shall meet the requirements provided below.

A. Pressure indicators PI-401, PI-403, PI-601, PI-702 and PI-900 shall be liquid filled, with a 2 ½" dial, stainless steel casing, ¼" male NPT threaded connection, have a pressure range of 0-30 psi., and .5 psi graduation marks.

B. Pressure indicators PI-901 and PI-903 through PI-919, shall be liquid filled, with a 2 ½" dial, stainless steel casing, ¼" male NPT threaded connection, have a pressure range of 0-60 psi, and 1 psi graduation marks.

C. Pressure indicator PI-301 shall be supplied by the low profile air stripper VENDOR.

D. Pressure indicator PI-302 shall be a low pressure gauge manufactured by Ashcroft, or equivalent, with a 2 ½" dial, aluminum case, ¼" male NPT threaded connection have a pressure range from 0-60 iwc, and 1 iwc graduation marks.

E. Pressure indicators PI-101, PI-102, and PI-103, shall be liquid filled, with a 2 ½" dial, stainless steel casing, ¼" male NPT threaded connection, have a pressure range of 0-160 psi, and 2 psi graduation marks.

2.03 PRESSURE SWITCHES

A. All pressure switches shall be manufactured by Mercoid, Inc., or an approved equivalent. A schedule of pressure switch operating pressures is provided below.

PSL-201 – 40 psi.
PSL-301 – Provided by low profile air stripper vendor.
PSH-402 – 40 psi.
PSL-701 – 7 iwc.
PSH-902 – 60 psi.

All operating pressures listed above are estimated operating pressures. Pressure switches utilized shall contain a range of operating pressures, of which, the above operating pressure lies within.

2.04 TEMPERATURE SWITCHES

A. Temperature switch TSL-001 shall be manufactured by Mercoid, Inc., or an approved equivalent. TSL-001 shall be the bulb and capillary type, have an adjustable range of 0-100 degrees F and be suitable for use in ambient air.

2.05 LEVEL SWITCHES

Level switches shall be manufactured by Flotech, Inc., or an approved equivalent, and shall meet the specifications described below.

A. Level switches located on the feed solution mixing tank shall supported along a 1" diameter Sch. 40 carbon steel pipe mounted on the outside of the mixing tank as shown on the Construction Drawings. Level switches shall be made for mounting in a vertical run of pipe, contain a stainless steel housing, polypropylene float, have a maximum pressure rating of 250 psi, have a maximum resistive full load amps at 120 Vac of .5, and be UL and CSA certified.

B. Level switches located on the treated water holding tank shall be installed via bulkhead fittings installed in the holding tank. Levels switches shall be made for installing in tank sidewalls, contain stainless steel housing, polypropylene float, have a maximum pressure rating of 250 psi, have a maximum resistive full load amps at 120 Vac of .5, and be UL and CSA certified.

C. Level switches located on the low profile air stripper shall be supplied by the low profile air stripper VENDOR.

PART 3 - EXECUTION

3.01 GENERAL

A. The CONTRACTOR shall install control devices and instrumentation in full conformance with the instructions of the respective manufacturers.

B. All control conduit and conductors shall be installed at the locations shown on the drawings.

C. All control devices and instruments shall be installed at the locations and in the orientations shown on the drawings.

D. CONTRACTOR shall provide all required wiring. Hardware shall be stainless steel. Wiring installation shall be watertight and corrosion resistant.

END OF SECTION

SECTION 16920
CONTROL PANELS

PART 1 - GENERAL

1.01 WORK INCLUDED

A. The work covered by this Specification consists of furnishing all labor, equipment, supplies, and materials to provide a completely integrated operable control system for the Groundwater Remediation System. The system shall be constructed and programmed as shown on the Construction Drawings and specified herein. All controls and associated equipment shall be included.

1.02 QUALITY ASSURANCE

A. The Control System SUPPLIER shall have in his direct employ a staff of capable personnel for detail engineering, coordination, drafting, procurement, expediting, scheduling, construction inspection, installation start-up service for calibration and commissioning, and service for guarantee compliance.

1.03 REFERENCES

A. All Work shall conform to applicable standards of ANSI, IEEE, JSA, NEMA, UL, and NEC.

B. All work shall comply with applicable New York State and Colesville Local electrical codes.

C. All control components shall be UL Listed.

D. All assembled control panels shall be UL Listed, and be equipped with a label indicating UL Listing.

1.04 CONTROL LOOP DESCRIPTIONS

A. The Groundwater Extraction and Treatment Control System shall consist of the Main Control Panel (MCP) and associated motor controllers as depicted on Drawing 10.

1. Main Control Panel (MCP): The MCP shall house the PLC, all alarm indicators, all treatment building local control and instrumentation inputs and outputs, hand switches and push-buttons, power for local analog instrumentation and the operator interface terminal. The MCP shall

operate on a 15A, 120 volt power feed. No 240 volt power shall be used in, or routed through the MCP.

B. All control loop alarms that shut down equipment shall latch, unless noted otherwise, to prevent automatic system restart. Control loops shall be designed such that alarms must be manually reset prior to equipment restart. All alarm lights on the control panels shall be unique to one alarm condition and be clearly and permanently marked to identity the alarm condition. The program of the MCP should be configured such that only the "first in" alarm is displayed prior to acknowledgment. Following acknowledgment/reset, any existing alarms will then be displayed by illuminating the appropriate indicator light.

1.05 SUBMITTALS

A. The following items shall be submitted for each system as a complete package. NEMA Standard symbols and identification designations shall be used on Shop Drawings. Format for Shop Drawings shall be as follows:

1. Schematic or Elementary Diagrams

a. Diagrams shall be drawn between vertical lines which represent the source of power. All coils shall have one side connected to the right line. The diagram shall be complete with all control devices of the system indicated. Devices remote from the control panel shall be indicated by appropriate symbols.

b. A cross-reference system shall be used in conjunction with each relay or timer coil to readily locate all contacts on the diagram. Each line shall be identified with a line number to facilitate identification and explanation. All wires shall be identified with a wire number.

c. Where color coded cable is used, the color code shall be included in the diagram.

d. Limit, pressure, temperature, floats and similar devices shall be indicated in the turned-off, disconnected or shelf position.

e. Selector and other multi-contact switches shall have their contact closure sequence shown on the diagram.

f. Descriptions of the functions of valves, starters and indicating lights shall be indicated on the diagram and shall completely describe the sequence of operation, both automatic and manual.

2. Interconnection Diagrams: Interconnection diagrams shall indicate all field mounted devices external to panels and cabinets. These devices need not be shown in their relative locations. All field device and control panel terminal numbers shall be indicated. Interconnection diagrams may be incorporated on schematic or elementary diagrams.

3. Dimensions: Shop Drawings shall be drawn to scale and indicate all outline, mounting and clearance dimensions. Relative location and size of panel mounted components shall be indicated. Nameplate legends with exact engraving shall be indicated. Useable spare panel space shall be indicated, identified and dimensioned. The panel space layout drawn to scale together with a complete nameplate schedule including wording shall be submitted for review to the CONSULTANT/ENGINEER prior to fabrication.

4. Operator Interface Layout: The CONTRACTOR shall submit to the CONSULTANT/ENGINEER, printouts or drawings depicting the various screens proposed for the operator interface units. Prior to acceptance of the completed system, the layout requires acceptance by the CONSULTANT/ENGINEER.

5. Data: A bill of materials shall be provided, listing the make, model, type and rating of all components.

6. As-built documentation: The following documentation will be submitted within 30 calendar days of acceptance of the completed control system:

   a. All wiring, schematic and interconnecting diagrams originally submitted for CONSULTANT/ENGINEER approval shall be updated to incorporate modifications made to the controls during fabrication, installation and/or startup and shakedown. These updated diagrams shall then be submitted, along with AutoCad files, Version 14, for the project record and operation manual.

   b. A disk copy of the PLC program.

   c. A disk copy of the operator interface terminal program/setup.

1.06 PROTECTION OF EQUIPMENT

A. The CONTRACTOR shall be responsible for all damage to equipment in the factory or during shipment. It shall be the CONTRACTOR's responsibility to protect the equipment fully until it is accepted by the CONSULTANT/ENGINEER.

B. All damage to the equipment shall be repaired to the satisfaction of the CONSULTANT/ENGINEER. The CONTRACTOR shall pay for all costs of repairing the equipment.

1.07 INSPECTION AND TESTING

A. The CONTRACTOR shall guarantee that any component or equipment furnished by him which shall fail due to defects in materials or workmanship, within 1 year after acceptance by the CONSULTANT/ENGINEER, shall be replaced or repaired without further cost to the CONSULTANT/ENGINEER for labor, parts or transportation.

PART 2 - PRODUCTS

2.01 SUPPLIERS

A. All control panels and components shall be provided and programmed by the following SUPPLIER:

Enterprise Automation, Inc.
P.O. Box 2784
Clifton, New Jersey 07015
Phone: 732-271-1745
Atten: Brian Hawkins

or and approved equivalent.

2.02 GENERAL

A. The Main Control Panel (MCP) shall contain indicator all lights, indicators, control switches, terminals and wiring as shown on the drawings and described herein.

B. All wiring shall be minimum AWG #16, run in wireways, clearly marked at all terminations with Brady or equal markers. Field wiring shall terminate on 600V,

barrier terminals. All terminals shall be clearly marked. All interior devices and terminals shall be mounted on sub-panels.

C. Field wiring shall enter the panel through conduit and be attached to specified wiring terminals located on the bottom or sides of the MCP.

2.03 SPECIFIC COMPONENTS

A. Refer to Drawings and Section 16910 - "Controls and Instrumentation" for additional information pertaining to specific components, in order to obtain the desired operation and monitoring requirements.

B. Programmable Logic Controller: Programmable controller shall be an Allen-Bradley SLC-500 modular type with I/O provided to meet the requirements of the system as described in the Drawings and Specifications. Provide a minimum of 20 percent spare discrete I/O, and a minimum of 2 unused slots in the SLC modular chassis for future upgrade or expansion. The processor shall be an Allen-Bradley type SLC-5/03 (8K Memory Model, A-B Part # 1747-L533). No substitutions are permitted.

C. Control Relays: Logic control relays shall be 2-pole double-throw plug-in type with contacts rated 10 amps. They shall be of the track mounted socket type and have a transparent dust cover. They shall have a visual means of indication when the relay is energized.

D. Nameplates: Nameplates shall be 1/16-inch laminated plastic. Exterior nameplates shall be white with black core (letters). Interior nameplates shall be black with white core (letters). The lettering shall be arranged in two or three rows. The overall size shall be 1 by 3 1/2 inches, unless mounting space or legend content dictate otherwise.

E. Fuse Blocks: Fuse blocks and fuses shall be provided for the protection of the instruments. Control fuses shall be rail mounted, with LED "blown" indicator. They shall use 1 1/4" x 1/4" fuses of the type appropriate for the application.

F. Panel Control Switches: Unless otherwise indicated. control and selector switches shall be of the heavy duty, oil-tight, NEMA-rated rotary type with enclosed contacts. The switches shall have positive, quick acting contacts with contact operation not dependent on springs. Each switch shall be equipped with pistol grip handles and rectangular escutcheon with legends as show on the drawings. Switches shall be manufactured by Allen-Bradley, Square-D, General Electric or approved equal.

G. Push-Buttons: Push-buttons shall be heavy-duty, oil-tight and NEMA-rated. MANUFACTURER shall be General Electric, Allen-Bradley, Square D or approved equal.

H. Indicating Lights: Indicating lamps shall be of the transformer type for 120 volt AC service. The lamp assemblies shall be equipped with lenses of the required color as shown in the P&ID and described herein, and readily removable from the front of the panel. Indicating lights shall be oil-tight, and NEMA rated. Allowable MANUFACTURERs include Allen-Bradley, General Electric, Square D or approved equal.

I. Control Panel Enclosures:

1. Main Control Panel enclosure shall be NEMA-12, and shall be provided with windows, subpanels, dead front kits, and other accessories as required. Control panel door shall be provided with a 3 point latching system with a lockable handle. Main Control Panel Enclosure shall be Hoffman or equal, and be of sufficient size to provide at least 30 percent available unused volume for future expansion or upgrade.

2. Smaller Wall or pedestal mounted control panels shall be carbon steel NEMA 12, and shall be provided with windows, subpanels, dead front kits, and other accessories as required. Wall mounted enclosures shall be manufactured by Hoffman Engineering or approved equal.

J. Operator Interface Terminal: The MCP shall be equipped with an Operator Interface Terminal (GUI) enabling the operator to access process parameters and performance data, as well as imput digital and numeric process variables into the PLC controller. The terminal shall consist of a PanelView 600, as manufactured by Allen-Bradley, and be configured for RS-485 communication. No substitutions shall be permitted.

K. Terminal Blocks and Accessories

1. Terminal Blocks: ANSI/NEMA ICS 4, UL Listed.

2. Power Terminals: Unit construction type, closed-back type, with tubular pressure screw connectors, rated 600 volts.

3. Signal and Control Terminals: Modular construction type, channel mounted; tubular pressure screw connectors, rated 600 volts.

4. 30 percent spare signal and control terminal block points shall be provided for modification or future upgrade.

2.04 CONTROL PANEL FEATURES

A. Light Test Push-button: The MCP shall be equipped with a momentary push-button which, when pressed, lights all indicator lights for a bulb test.

B. Emergency Stop Pushbutton(s): The MCP will be equipped with a red, mushroom-type "Emergency Stop" switch, which, once depressed, disconnects power to all MCP components and control outputs. The switch used must require manual reset. The MCP shall be equipped with terminals for the use of up to five (5) external or remote Emergency Stop Pushbuttons.

C. Main Power "On" Indicator: The MCP shall be equipped with a green indicator which will illuminate whenever power is applied to the MCP. The indicator will not illuminate if : (1) Power is interrupted to the MCP, or; (2) The main control fuse (F1) has blown.

D. External Programming Port: The MCP shall be equipped with an external programming port for access to serial communication with the PLC and GUI without necessitating the opening of the MCP door. This port shall be clearly marked: "Programming Port".

E. Autodialer: The MCP shall be equipped with an autodialer, as manufactured by RACO, model # "Chatterbox". Substitutions: approved equivalent.

F. The MCP shall be equipped with an isolated section with terminal block and surge suppressors for telephone service and field terminations.

PART 3 - EXECUTION

3.01 INSTALLATION

A. All electrical control equipment shall be installed in a neat and workmanlike manner in complete accordance with the Drawings, approved shop drawings and MANUFACTURERs' printed installation instructions.

B. All raceways and panel connections shall conform to the guidelines established in Section 16110 - "Raceways".

C. Ground all devices and shields according to MANUFACTURERs' directions.

D. All terminations shall be accessible from the front of the panel.

3.02 FABRICATION/LAYOUT

A. Input/Output Layout

1. All field instrumentation, field control switches, control panel push-buttons and hand switches shall be assigned unique inputs into the PLC. No field devices, instruments or switches shall be permitted to drive indicators, alarms, motor controllers or controls without entering the PLC.

2. All control panel indicators, motor controllers, field devices (ex: solenoids) external alarms or relays shall be driven directly from the PLC output(s).

3.03 PROGRAMMING

A. The CONTRACTOR shall provide all programming of the PLC as described on the Drawings and described herein. The CONTRACTOR will be responsible for any program modification necessary to reach an acceptable level of system performance, as determined during system startup.

B. Operator Interface Terminal: The operator interface terminal, or MUI, shall be programmed to provide operator adjustable access to all timers and operator-settable process parameters shown on the Drawings, as well as provide the following capabilities:

1. Status of mixing/molasses injection system, including, but not limited to: description of process parameter underway, alarms or alerts, and flow totalizations as described in Section 16900.

2. Settings of which injection wells are to be considered on-line for the injection sequence (i.e. capability of turning individual wells off for maintenance, while maintaining the capability of running the injection cycle).

3. Settings (in gallons) of injection amounts of mixed molasses solution for each well as described in Section 16900.

4. Settings (in gallons) of injection amounts of rinse water for each well as described in Section 16900.

5. Injection molasses solution concentration, as described in Section 16900.

6. Settings (in minutes) of the mixing time for molasses mixer MM-800 as described in Section 16900.

7. Settings (in hours) of the frequency of the injection sequence as described in Section 16900.

8. Manual override switches (H-O-A, O-A, etc...) for all process equipment and solenoid valves as described on Drawing 5, and Section 16900. These switches shall be of the "virtual" (computer screen touch) type.

The default screen shall contain the real-time values for all of the parameters listed above, and shall return to a general process description/status display when the keypad has been inactive for 120 seconds.

END OF SECTION

File on eDOCs X Yes ____ No
Site Name Colesville
Site No. 704010
County Broome
Town Colesville
Foilable X Yes ____ No
File Name 2000-07-01, Tech-spec. GW Remediation
Scanned & eDOC ____