NAME: Ciba Geigy
I.D. NO.: RID001194323
FILE LOC: R9
OTHER:

RCRA Facility Investigation

CIBA-GEIGY Facility
Cranston, Rhode Island

Draft Stabilization Design Documents
Technical Specifications

Submitted By
CIBA-GEIGY Corporation
444 Sawmill River Road
Ardsley, New York 10502

Volume 2 of 4

November 1993
Project No. 87X4660D

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SECTION 1A1

SUMMARY OF WORK

1.1 DESCRIPTION OF WORK

A. The following description is provided as a general scope of work for the construction of the Stabilization Action in Cranston, Rhode Island. The summary of work in this section is an overall summary of the CONTRACTOR'S responsibilities and does not supersede the requirements of any other specific related section.

1. Modify existing recovery wells to include pumps, piping, valves, instrument and a pre-engineered enclosure as shown and specified.
2. Provide and install the forcemain from the existing recovery wells to the pretreatment system.
3. Provide and install the forcemain from the Soil Vapor Extraction (SVE) system to the pretreatment system.
4. Provide and install (2) equalization tanks, transfer pumps and containment areas as shown and specified.
5. Demolish and remove selected areas of the Building No. 15 floor as shown and specified.
6. Provide and install the groundwater pretreatment system including all required electrical, structural equipment, instrumentation, piping/valves, plumbing and H&V work as shown and specified.
7. Relocate the existing sand filter in Building No. 15.
8. Provide and construct the SVE System including all required electrical, structural, instrumentation, piping, extraction wells and H&V work as shown and specified.
9. Provide and install a thermal/catalytic oxidizer for the SVE System vapors.
10. Provide and install a gravity sewer for the final pretreatment system effluent.

B. Permits and Regulations:

1. CONTRACTOR shall obtain and pay for all necessary and required permits for the work.
2. CONTRACTOR shall comply with all applicable regulations of OSHA in performance of the work and shall take all required precautions to insure the safety and health of personnel.

C. Submittals:
Prior to beginning the work, the CONTRACTOR shall submit to the OWNER for approval, all materials as required in other sections of this document.

D. Hours of Work:
1. Unless permitted by the OWNER, no work shall be performed between the hours of 6:00 pm and 7:00 am.
2. If it becomes absolutely necessary to perform the required work at either night or on weekends, the CONTRACTOR shall inform both the OWNER and the ENGINEER, 24-hours in advance of beginning such work.

1.2 CONTRACTS

A. The work for this project shall be performed under one prime contract.

1.3 CONTRACTOR'S USE OF THE PREMISES

A. CONTRACTOR shall coordinate use of the premises, for his storage and the operations of his workmen, with OWNERS and the existing utility service companies.

B. The CONTRACTOR shall operate only within the area allowed to him. The allowable construction area is presented in the contract Drawings.

C. The CONTRACTOR shall be solely responsible for obtaining and paying all costs in connection with any additional work area, storage sites, access to the site or temporary right-of-way which may be required for proper completion of the Work.

D. The CONTRACTOR shall be responsible for protection and safekeeping of equipment and materials on the site. No claim shall be made against the OWNER or his authorized representatives by reason of any act. Should access to the site occupied by stored materials or equipment be required, the OWNER shall direct the CONTRACTOR. No materials or equipment may be placed upon the property other than the designated areas on the Drawings unless the CONTRACTOR has agreed to the location contemplated by the OWNER to be used for storage.

END OF SECTION

SECTION 1A3

FIELD ENGINEERING

1.1 GENERAL

A. CONTRACTOR shall:

1. Provide civil, structural or other professional engineering services specified, or required to execute CONTRACTOR'S construction methods.
2. Keep a transit and leveling instrument on the site at all times and a skilled instrument man employed or obtained whenever necessary for layout of the Work.
3. Be solely responsible for all locations, dimensions and levels.

1.2 RECORDS

A. Maintain a complete, accurate log of all control and survey work as it progresses.

1.3 SUBMITTALS

A. On request of OWNER's Representative, submit documentation to verify accuracy of field engineering work.

END OF SECTION

SECTION 1A6

COORDINATION

1.1 GENERAL

A. As more fully set forth in the CIBA-GEIGY General Conditions, CONTRACTOR shall be solely responsible for coordination of all of the Work. He shall supervise, direct and cooperate fully with all Subcontractors, manufacturers, fabricators, suppliers, distributors, installers, testing agencies and all others whose services, materials or equipment are required to ensure completion of the Work within the Contract Time.

B. As more fully set forth in the General Conditions, CONTRACTOR shall cooperate with and coordinate his Work with utility service company or OWNER's employees performing additional work related to the Project at the site. CONTRACTOR shall cooperate with them in arrangements for storage of materials and in detailed execution of the Work, affording them without compensation, reasonable use of facilities under his control necessary for the performance of their work. CONTRACTOR shall have no claim against the OWNER for delay caused by conflict with another CONTRACTOR, utility service company or OWNER which may be operating at the site.

C. CONTRACTOR shall not be responsible for damage done by contractors not under his jurisdiction. He will not be liable for any such loss or damage unless it is through the negligence of CONTRACTOR.

D. CONTRACTOR shall maintain sufficient competent personnel, drafting equipment and supplies at the site for the purpose of preparing layout and coordination drawings. These drawings shall supplement the Contract Documents, and the working and Shop Drawings as necessary to correlate the work of various trades. Where such drawings are to be prepared by the mechanical, electrical, plumbing, or heating and ventilating

Subcontractors, CONTRACTOR will ensure that each Subcontractor maintains the required personnel and facilities at the site.

E. CONTRACTOR shall also coordinate his Work with the work of others to assure compliance with schedules.

F. CONTRACTOR shall attend and participate in all project coordination or progress meetings and report on the progress of all Work and compliance with schedules.

G. CONTRACTOR shall conduct Work to assure compliance with schedules, transmit written instructions to all concerned suppliers and Subcontractors and shall cooperate with the OWNER and ENGINEER. CONTRACTOR shall report all conflicts and discrepancies to the ENGINEER in writing.

END OF SECTION

SECTION 1A10

CUTTING AND PATCHING

1.1 GENERAL

A. This Section includes all cutting and patching of all Work under construction, completed Work and existing facilities in order to accommodate the coordination of work, install other work, uncover work for access, inspection or testing, or similar purposes. "Demolition Work" is specified elsewhere. Execute all cutting and patching, including excavation, backfill and fitting required to:

1. Remove and replace defective Work or Work not conforming to requirements of the Contract Documents.
2. Remove samples of installed Work as required for testing.
3. Remove all constructions required to provide for specified alteration or addition to existing Work.
4. Uncover Work to provide for ENGINEER'S inspection of covered Work or inspection by regulatory agencies having jurisdiction.
5. Connect to completed Work that was not accomplished int eh proper sequence.
6. Remove or relocate existing utilities and pipes which obstruct the Work to which connections must be made.
7. Make connections or alterations to existing or new facilities.

B. Restore all existing Work to a state equal to that which it was in prior to cutting and restore new Work to the standards of these Specifications.

C. Submittals:

1. Prior to cutting which may affect integrity and design function of Project, OWNER'S operations, or work of another contractor, submit written notice to ENGINEER, requesting consent to proceed with cutting, including:
   a. Identification of Project.

b. Description of affected Work of CONTRACTOR and work of others.

c. Necessity for cutting.

d. Effect on other work and on structural integrity of location.

e. Description of proposed Work. Designate:

1) Scope of cutting and patching.

2) CONTRACTOR, Subcontractor or trade to execute Work.

3) Products proposed to be used.

4) Extent of refinishing.

5) Schedule of operations.

f. Alternatives to cutting and patching, if any.

g. Designation of party responsible for cost of cutting and patching.

2. Should conditions of Work, or schedule, indicate change of materials or methods, submit written recommendation to ENGINEER, including:

a. Conditions indicating change.

b. Recommendations for alternative materials or methods.

c. Submittals as required for substitutions.

3. Submit written notice to ENGINEER, designating time Work will be uncovered, to provide for observation. Do not begin cutting or patching operations until authorized by ENGINEER.

D. Provide shoring, bracing and support as required to maintain structural integrity of Project and protect adjacent Work from damage during cutting and patching.

E. Conform to all applicable Specifications for application and installation of materials used for patching.

END OF SECTION

SECTION 1A11

CONNECTIONS TO EXISTING FACILITIES

1.1 GENERAL

A. Perform all construction necessary to complete connections and tie-ins to existing facilities including test pits to locate existing utilities and structures which may be encountered.

B. Keep existing facilities in operation unless otherwise specifically permitted in these Specifications or approved by OWNER.

C. CONTRACTOR shall perform all construction activities so as to avoid interference with operations of the facility and the work of others.

1.2 SEQUENCING AND OPERATIONS

A. All operations of existing equipment required for the Work shall be done by OWNER, unless specific permission is granted by OWNER to CONTRACTOR.

B CONTRACTOR shall carefully coordinate all work and schedules and shall provide OWNER written notice at least 48 hours before shut-downs or by-passes are required.

C. CONTRACTOR shall have completed all necessary preparatory Work and shall have adequate personnel available in order to keep each shutdown to a minimum.

D. If Work during any shutdown or interruption period is not done satisfactorily, or as planned, or within the maximum time allocated, OWNER may order CONTRACTOR to place the facilities back in service and reschedule the Work, or he may order the Work required to place the facilities back in service done with other forces. If the Work is done by

other forces, OWNER'S costs will be deducted from the amounts due CONTRACTOR.

E. No direct payment will be made for any labor, materials, tools, equipment or temporary facilities required for shutdowns. All costs, therefore, shall be considered to have been included in the prices bid for the Contract.

1.3 SUBMITTALS

A. Submit detailed schedule of proposed connections, including time estimate of shut-downs and tie-ins.

END OF SECTION

SECTION 1A12

REFERENCE STANDARDS

1.1 GENERAL

A. When a reference standard is specified, comply with requirements and recommendations stated in that standard, except when they are modified by the Contract Documents, or when applicable laws, ordinances, rules, regulations or codes establish stricter standards. The latest provisions of applicable standards shall apply to the Work, unless otherwise specified. Reference standards include, but are not necessarily limited to, the following:

AMCA	-	Air Moving and Conditioning Association, Inc.
ACI	-	American Concrete Institute.
ACIFS	-	American Cast Iron Flange Standards.
AFBMA	-	Anti-Friction Bearing Manufacturers Association.
AGA	-	American Gas Association.
AGMA	-	American Gear Manufacturers Association.
AIA	-	American Institute of Architects.
AISC	-	American Institute of Steel Construction.
AISI	-	American Iron and Steel Institute.
ANSI	-	American National Standards Institute.
ASCE	-	American Society of Civil Engineers.
ASHRAE	-	American Society of Heating, Refrigeration, and Air Conditioning Engineers.
ASME	-	American Society of Mechanical Engineers.
ASTM	-	American Society for Testing and Materials.
AWS	-	American Welding Society.
AWWA	-	American Water Works Association.
CGA	-	Compressed Gas Association.
CRSI	-	concrete Reinforcing Steel Institute.
DIPRA	-	Ductile Iron Pipe Research Association.
EEI	-	Edison Electric Institute.
EJMA	-	Expansion Joint Manufacturers' Association.

FM	-	Factory Mutual.
HMI	-	Hoist Manufacturers' Institute.
IEEE	-	Institute of Electrical and Electronic Engineers.
IPCEA	-	Insulated Power Cable Engineers Association.
NACE	-	National Association of Corrosion Engineers.
NBS	-	National Bureau of Standards.
NEC	-	National Electric Code.
NEMA	-	National Electrical Manufacturers Association.
NFPA	-	National Fire Protection Association.
OSHA	-	Occupational Safety and Health Act.
PCA	-	Portland Cement Association.
PCI	-	Prestressed Concrete Institute.
RMA	-	Rubber Manufacturers' Association.
SMACCNA	-	Sheet Metal and Air Conditioning Contractors National Association.
SPI	-	Society of the Plastics Industry.
SSPC	-	Steel Structures Painting Council.
STI	-	Steel Tank Institute.
UL	-	Underwriters' Laboratory.

B. CONTRACTOR shall, when required, furnish evidence satisfactory to the ENGINEER that materials and methods are in accordance with such standards where so specified.

C. In the event any questions arise as to the application of these standards or codes, copies shall be supplied on site by the CONTRACTOR.

END OF SECTION

SECTION 1A51

DECONTAMINATION OF PERSONNEL AND EQUIPMENT

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section covers the labor, materials, and equipment necessary for decontaminating all personnel, heavy equipment, drilling and driving equipment, sampling equipment, and miscellaneous equipment.

B. Decontamination equipment, facilities, and supplies shall be supplied by the CONTRACTOR.

C. All personnel shall be decontaminated before leaving the site, as specified in the Site Health and Safety Plan.

D. Equipment shall be cleaned and decontaminated prior to use onsite, and prior to leaving the site.

E. All equipment shall be washed and cleaned under requirements as specified by the Site Health and Safety Plan, and approved by the OWNER's representative prior to initiation of work at the site.

F. All decontamination water shall be placed in sealed approved 55-gallon drums and relocated to a location on-site for temporary storage as designated by the ENGINEER. All containers shall be labeled and dated. The CONTRACTOR shall provide all required 55-gallon drums.

1.2 TRANSPORTATION OF HAZARDOUS WASTE

A. All hazardous waste material shall be transported to an approved TSDF or other USEPA designated site in accordance with all applicable EPA, RCRA, Rhode Island DOT, Federal DOT, or other Federal, State, and local regulations.

PART 2 - PRODUCTS AND EQUIPMENT

A. The CONTRACTOR shall provide all equipment necessary for the decontamination process such as clean and distilled water, trisodium phosphate, acetone, methanol, a mobile hot-water high-pressure washer, buckets and brushes, etc.

PART 3 - EXECUTION

3.1 GENERAL

A. The CONTRACTOR shall follow the general decontamination plans, as specified in the Site Health and Safety Plan. Prior to mobilization, the CONTRACTOR will finalize all personnel-decontamination needs, equipment, and procedures with the ENGINEER.

3.2 EQUIPMENT DECONTAMINATION

A. Heavy equipment such as, but limited to, excavation equipment shall be decontaminated prior to arrival on-site and before leaving the project site. Decontamination will consist of combinations of:

1. Non-phosphate detergent plus tap water wash.
2. Tap water rinse.
3. 10% nitric acid rinse.
4. Tap water rinse.
5. Hexane (pesticide grade) rinse.
6. Deionized water rinse.
7. Total air dry.

B. All other drilling equipment and materials will be decontaminated prior to any drilling operations and between borings. All tools used for soil sampling and packaging, including split-spoon samplers, sample-cutting knives, etc., will be decontaminated prior to the collection of each sample. Well casing, screens, and fittings are to be delivered to the site in a clean condition and decontaminated onsite in the presence of the ENGINEER.

C. Decontamination of heavy equipment shall include the following:

1. Scrape and remove all earthen materials from the equipment.
2. Hose down equipment with a portable high-pressure, hot-water washer (steam cleaner).

D. At a minimum, all heavy equipment tires or support vehicles shall be cleaned with the steam cleaner prior to traveling on any public roads.

3.3 PERSONNEL DECONTAMINATION

A. Personnel decontamination shall be performed at the site prior to leaving the site. The CONTRACTOR will provide all protective clothing and the equipment necessary for its own personnel to comply with the decontamination procedures as specified in the Site Health and Safety Plan.

B. The following personnel decontamination procedures shall be followed:
1. Remove disposable booties and place in plastic bag for disposal.
2. Wash neoprene boots with detergent solution and rinse with clean water. Remove boots and retain for subsequent reuse.
3. Wash outer gloves in detergent solution and rinse in clean water. Remove outer gloves and place into plastic bag for disposal or retain for subsequent reuse.
4. Remove Tyvek or SARNEX coveralls (if used). Take care to prevent the release and dispersion of dusts which may have accumulated on the coveralls during onsite operations and place overalls into a disposable plastic bag.
5. Remove the respirator (if used) and place spent filters into the plastic bag destined for disposal. Place the respirator onto a reusable table or into a separate plastic bag for later cleaning and disinfection.
6. Remove disposable gloves.
7. Thoroughly wash hands and face.
8. If concentrations reach Level C, disposable items that were onsite will be placed in a 55-gallon drum with other solid wastes for eventual disposal.

END OF SECTION

SECTION 1C

MEASUREMENT AND PAYMENT

1.1 DESCRIPTION

A. The items listed below beginning with Article 1.4, refer to and are the same pay items listed in the Bid Form. They constitute all of the pay items for the completion of the Work. No direct or separate payment will be made for providing miscellaneous temporary or accessory works, plant, services, CONTRACTOR'S field offices, layout surveys, job signs, sanitary requirements, testing, safety devices, approval and record drawings, water supplies, power, maintaining traffic, removal of waste, watchmen, bonds, insurance, and all other requirements of the General Conditions, and other sections. Compensation for all such services, things and materials shall be included in the prices stipulated for the lump sum and unit pay items listed herein.

1.2 ESTIMATE OF QUANTITIES

A. The estimated quantities for unit bid prices, as listed in the Bid Schedule, are approximate only and are included solely for the purpose of comparison of Bids. The OWNER does not expressly or by implication agree that the nature of the materials encountered below the surface of the ground or the actual quantities of material encountered or required will correspond therewith and reserves the right to increase or decrease any quantity or to eliminate any quantity as OWNER may deem necessary. CONTRACTOR will not be entitled to any adjustment in a unit bid price as a result of any change in an estimated quantity and agrees to accept the aforesaid unit bid prices as complete and total compensation for any additions or deductions caused by a variation in quantities as a result of more accurate measurement, or by any changes or alterations in the Work approved by the OWNER, and for use in the computation of the value of the Work performed of progress payments.

1.3 RELATED PROVISIONS SPECIFIED ELSEWHERE

A. Payments to CONTRACTOR: Refer to General Conditions and Construction Contract.

B. Changes in Contract Price: General Conditions

C. Schedule of Valves: Section 1E8

1.4 STABILIZATION ACTION

A. Measurement and Payment: The lump sum payment for Item 1 will be full compensation for completing the Work as shown and specified under Divisions 1 through 16.

END OF SECTION

SECTION 1D1

PRECONSTRUCTION CONFERENCE

1.1 GENERAL

A. Date, Time and Location: Conference will be held after execution of the Contract and before construction is started at the site. ENGINEER will fix the date, time and location of the meeting.

B. ENGINEER shall prepare agenda, preside at meeting, prepare and distribute a transcript of proceedings to all parties.

C. CONTRACTOR shall provide data required, contribute appropriate items for discussion, and be prepared to discuss all items on agenda.

1.2 REQUIRED ATTENDANCE

A. OWNER.

B. ENGINEER.

C. CONTRACTOR and suppliers.

1.3 AGENDA

A. Agenda will include, but will not necessarily be limited to, the following:

1. Designation of responsible personnel.
2. Subcontractors.
3. Coordination with other contractors.
4. Construction schedule.
5. Processing of Shop Drawings and distribution of Submittals.
6. Processing of field decisions and Change Orders.
7. Requirements for copies of Contract Documents.
8. Insurance in force.

9. Schedule of Values.
10. Processing and Schedule of Payments.
11. Use of premises.
12. CONTRACTOR responsibility for Health & Safety and first aid procedures.
13. Security.
14. Housekeeping.
15. Field Offices.
16. Record Drawings.
17. Any other project related items.

END OF SECTION

SECTION 1D2

PROGRESS MEETINGS

1.1 GENERAL

A. Date and Time:

1. Regular Monthly Meetings: As mutually agreed upon by ENGINEER and CONTRACTOR.

B. Place: CONTRACTOR'S field office at Project site or other mutually agreed upon location.

C. ENGINEER shall prepare agenda, preside at meetings, and prepare and distribute a transcript of proceedings to all parties.

D. CONTRACTOR shall provide data required and be prepared to discuss all items on agenda.

1.2 MINIMUM ATTENDANCE

A. CONTRACTOR, other contractors, and suppliers. Representatives present for each party shall be authorized to act on their behalf.

B. ENGINEER.

C. OWNER's Representative.

D. Others as appropriate.

1.3 AGENDA

A. Agenda will include, but will not necessarily be limited to, the following:

1. Transcript of previous meeting.
2. Progress since last meeting.

3. Planned progress for next period.
4. Shop Drawings.
5. Problems, conflicts and observations.
6. Change Orders.
7. Applications for payment.
8. Quality standards and control.
9. Schedules, including off-site fabrication and delivery schedules. Corrective measures required.
10. Coordination between parties.
11. Health and Safety Issues.
12. Other business.

END OF SECTION

SECTION 1E1

CONSTRUCTION SCHEDULES

1.1 GENERAL

A. Provide construction schedule which conforms to the requirements below, unless otherwise approved by ENGINEER.

B. Update schedules every month unless otherwise specified or directed by ENGINEER.

1.2 CONTENT

A. Shop Drawing submittal dates and required approval dates.

B. Product delivery dates.

C. Field testing dates.

D. Dates for beginning and completing each phase of the Work by activity and by trades.

1.3 FORMAT

A. Type: Horizontal bar chart.

B. Sheet Size: 24-inches by 36-inches.

C. Time Scale: Indicate first date in each work week.

D. Organization:
   1. Group Shop drawing submittals and reviews into a separate subschedule.
   2. Group product deliveries into a separate subschedule.

3. Group construction work into a separate subschedule by activity.
4. Group critical activities which dictate the rate of progress into a separate subschedule.

E. Activity Designations: Show title and related Specification Section number.

1.4 SUBMITTALS

A. Submit initial schedule at least 20 days prior to submitting first application for a progress payment but no later than 30 days after date of execution of Agreement.

B. Submit updated schedules at progress meetings. If a schedule remains unchanged from one period to the next, submit a written notice to that effect.

C. Make all submittals to ENGINEER.

D. Unless otherwise specified, submit two sepia copies of each schedule. One copy will be reviewed by the ENGINEER and returned. The other copy will be retained by the ENGINEER.

E. Attach a letter of transmittal to each submittal and include the following information in the letter:
1. A listing of items which have changes since the last submittal.
2. Discussion of problems causing delays, anticipated length of delays, and proposed countermeasures.

END OF SECTION

SECTION 1E4

SHOP DRAWING SUBMITTAL AND CORRESPONDENCE PROCEDURE

1.1 GENERAL

A. The submittal of Shop Drawings shall conform to requirements of General Conditions and procedures described in this Section.

1.2 PROCEDURE

A. Submittals of Shop Drawings shall be made to: _____
_____.

B. A letter of transmittal shall accompany each submission. If data for more than one Section of the Specifications is submitted, a separate transmittal letter shall accompany the data submitted for each Section.

C. All letters of transmittal shall be sent to _____ in duplicate.

D. At the beginning of each letter of transmittal and each letter of inquiry, provide a reference heading indicating the following:

1. CONTRACTOR'S NAME _____
2. Project Name _____
3. Project No. _____
4. Transmittal No. _____

E. If Shop Drawing submittals show variation from the requirements of the Contract Documents, the CONTRACTOR shall make specific mention of such variation in his letter of transmittal.

F. All Shop Drawings submitted for approval shall have a title block with complete identifying information satisfactory to ENGINEER.

G. All Shop Drawings submitted shall bear the stamp of approval and signature of the CONTRACTOR as evidence that they have been reviewed by the CONTRACTOR. Submittals without this stamp of approval will not be reviewed by the ENGINEER and will be returned to the CONTRACTOR. The stamp shall contain the following minimum information:

Project Name: _____

CONTRACTOR's Name: _____

Date: _____

----------Reference----------

Item: _____

H. A number shall be assigned to each submittal by the CONTRACTOR starting with No. 1 and thence numbered consecutively. Resubmittals shall be identified by the same number followed by the suffix "A" for the first resubmittal, the suffix "B" for the second resubmittal, etc.

I. The CONTRACTOR shall initially submit to the ENGINEER a minimum of 3 copies of all submittals.

J. After the ENGINEER completes his review, the Shop Drawings will be marked with one of the following notations:

1. No Exceptions Taken
2. Furnish as Noted
3. Revise and Resubmit

K. If a submittal is acceptable, it will be marked "No Exceptions Taken" or "Furnish as Noted". One copy of the submittal will be returned to the CONTRACTOR.

L. Upon return of a submittal marked "No Exceptions Taken" or "Furnish as Noted", the CONTRACTOR may order, ship or fabricate the materials included on the submittal, provided it is in accordance with the corrections indicated.

M. If a Shop Drawing marked "Furnish as Noted" has extensive corrections or corrections affecting other drawings or Work the ENGINEER may require that the CONTRACTOR make the corrections indicated thereon and resubmit the Shop Drawings for record purposes.

N. If a submittal is unacceptable, one copy will be returned to the CONTRACTOR with the following notation:

1. "Revise and Resubmit"

O. Upon return of a submittal marked "Revise and Resubmit", the CONTRACTOR shall make the corrections indicated and repeat the initial approval procedure.

P. Shop Drawings or other submittals not bearing the ENGINEER's "No Exceptions Taken" or "Furnish as Noted" notation shall not be issued to Subcontractors nor utilized for construction purposes. No work shall be performed or equipment installed without a "No Exceptions Taken" or "Furnish as Noted" drawing or submittal.

Q. Shop Drawings shall be submitted well in advance of the need for the material or equipment for construction and with ample allowance for time required to make delivery of material or equipment after data covering such is approved. The CONTRACTOR shall assume the risk for all materials or equipment which are fabricated or delivered prior to the approval of Shop Drawings. No materials or equipment shall be incorporated into the Work nor will such be included in periodic progress payments until approval thereof has been obtained in the specified manner.

R. The ENGINEER will review and process all submittals promptly, but a reasonable time should be allowed for this, for the Shop Drawings being revised and resubmitted, and for time required to return the approved Shop Drawings to the CONTRACTOR.

S. It is the CONTRACTOR'S responsibility to review submittals made by his suppliers and subcontractors before transmitting them to the ENGINEER

to assure proper coordination of the Work and to determine that each submittal is in accordance with his desires and that there is sufficient information about materials and equipment for the ENGINEER to determine compliance with the Drawings and Specifications. Incomplete or inadequate submittals will be returned for revision without review.

END OF SECTION

SECTION 1E6

INSTALLATION DATA

1.1 GENERAL

A. Installation data are defined as written instructions; drawings; illustrative, wiring and schematic diagrams; diagrams identifying external connections, terminal block numbers and internal wiring; and all other such information pertaining to installation of materials and equipment that is not furnished with Shop Drawings. Included are all printed manufacturers installation instructions, including those that may be attached to equipment and for which approval by the ENGINEER is not required.

1.2 SUBMITTAL

A. CONTRACTOR shall submit two copies of all such data to the ENGINEER for each piece of equipment which he furnishes and for all other construction products for which such information is available from manufacturer. Data shall be acceptably identified and accompanied with a letter of transmittal.

END OF SECTION

SECTION 1E8

SCHEDULE OF VALUES

1.1 GENERAL

A. The Schedule of Values is an itemized list that establishes the value or cost of each part of the Work. It shall be used as the basis for preparing progress payments and may be used as a basis for negotiations concerning additional work or credits which may arise during the construction. Quantities and unit prices may be included in the schedule when approved by or required by the ENGINEER.

1.2 PREPARATION

A. Schedule shall show breakdown of labor, materials equipment and other costs used in preparation of the Bid.

B. Costs shall be in sufficient detail to indicate separate amounts for each Section of the Specifications.

C. CONTRACTOR may include an item for insurance, temporary facilities and job mobilization. This item will be included for payment at a rate spread equally over the length of the project.

D. Schedule of Values shall be prepared on a standard AIA Form.

E. Use Table of Contents of the Specifications as basis for Schedule format and identify each item with number and title in the Table of Contents. List sub-items of major products or systems as appropriate or when requested by ENGINEER.

F. When requested by ENGINEER, support values with data that will substantiate their correctness.

G. The sum of the individual values shown on the Schedule of Values must equal the total Contract Price.

H. Each item shall include a directly proportional amount of the CONTRACTOR'S overhead and profit.

I. Schedule shall show the purchase and delivery costs for materials and equipment that the CONTRACTOR anticipates he shall request payment for prior to their installation.

1.3 SUBMITTAL

A. Submit two copies of Schedule to ENGINEER for approval at least 20 days prior to submitting first application for a progress payment. After review by ENGINEER, revise and resubmit Schedule as required until it is approved.

END OF SECTION

SECTION 1E9

CONSTRUCTION PHOTOGRAPHS

1.1 GENERAL

A. CONTRACTOR shall retain a qualified photographer to perform the services specified in this Section.

B. The CONTRACTOR shall pay for photographer's services and supplies for the duration of the Project.

C. The CONTRACTOR shall provide access, health, and safety equipment and supplies as required to the photographer for the duration of the Project.

1.2 PROJECT PHOTOGRAPHS

A. The CONTRACTOR shall record the important features of the site prior to the commencement of work, during construction, and after the work has been completed.

B. Before work begins the CONTRACTOR shall take a minimum of 50 exposures including but not limited to views of the general site showing the locations of the future pretreatment plant, and areas of excavation. The locations will be designated by the ENGINEER.

C. CONTRACTOR shall take progress photographs throughout the project.

D. The progress photographs shall be 4 x 6 inches.

E. The progress photographs shall include, but not be limited to coverage of the following:

1. Initial and completed views of the general site conditions.
2. Future and existing recovery well locations.

3. Temporary/final fencing.
4. Easements, staging area and access roads.
5. Temporary construction facilities.
6. Decontamination of personnel and equipment.
7. Groundwater Capture System.
8. Pretreatment System.
9. Soil Vapor Extraction System Construction.
10. Utility trench.
11. Civil, electrical, structural, instrumentation and HVAC progress intervals.
12. Final site clean-up and restoration.
13. Unanticipated events.

F. After completion of the work, the shall take a minimum of 50 exposures and 60 minutes of video film including but not limited to views of the completed site. The locations will be designated by the ENGINEER.

1.3 VIEWS REQUIRED

A. Prints will illustrate condition and location of work and the state of progress.

B. At successive periods of photography, the CONTRACTOR shall take at least one photograph from the same overall view as previously required. These prints will be 8 x 10 inches.

C. Consult with the ENGINEER at each period of photography for recommendations concerning views required.

1.4 DELIVERY OF PRINTS AND VIDEO FILM

A. The CONTRACTOR shall submit to the ENGINEER two prints (8 x 10 inches) of each photograph taken prior to the commencement of work and after the completion of work, along with the negatives within ten (10) calendar days after taking the photographs, or as approved by the ENGINEER.

B. The CONTRACTOR shall submit to the ENGINEER two prints (4 x 6 inches) of each progress photograph along with the negatives within ten (10) calendar days after taking the photographs or as approved by the ENGINEER.

C. All photographs are OWNER's property and will not be released to the public or news media by the CONTRACTOR, SUB-CONTRACTOR or any others. The photographs should be enclosed back-to-back in a double-face plastic sleeve punched to fit standard three-ring binders.

1.5 PRINTS

A. All prints shall be color, of standard quality and sized as previously described. Weight shall be single weight glossy paper.

END OF SECTION

SECTION 1G1

TEMPORARY CONSTRUCTION FACILITIES

1.1 GENERAL

A. CONTRACTOR shall be responsible for all temporary construction facilities required for the Work. CONTRACTOR shall make all arrangements with utility service companies, except for electricity, for temporary services and shall pay all costs associated therewith.

B. Temporary construction facilities that are CONTRACTOR'S responsibility include:

1. Water.
2. Telephone.
3. Heat, Weather Protection and Ventilation.
4. Fire Protection.
5. Sanitary and First Aid Facilities.
6. Lighting.

C. CONTRACTOR shall abide by all rules and regulations of the utility service company or authority having jurisdiction.

D. Sufficient temporary heat and ventilation shall be provided to assure safe working conditions and that no damage will occur to any of the Work. In addition, all enclosed areas of the building in which the Work is performed shall be maintained at a minimum of 55°F, unless otherwise specifically excepted in the Specifications.

E. Provide all materials and equipment required for distribution of temporary electricity and lighting. Include continuous power for construction site offices. Provide all outlets with circuit breaker protection and comply with ground fault protection requirements of OSHA and NEC. Minimum lighting shall be 5 foot candles for open areas, 10 foot candles for stairs and shops. Provide minimum of one 300 watt lamp for each 400 square

feet on 20 foot centers in Work areas. OWNER'S electrical services will be made available for temporary power and lighting as follows:

1. 100 ampere, 480 volt, 3 phase service terminated at a disconnect switch in the vicinity of the pretreatment system construction area.

F. Suitably enclosed chemical or self-contained toilets shall be provided for the use of the persons employed on the Work. Toilets shall be located near the Work site and secluded from observation insofar as possible. Toilets shall be serviced at regular intervals, kept clean and supplied throughout the course of the Work.

G. CONTRACTOR shall furnish and maintain a safe drinking water supply readily available to all workers.

H. CONTRACTOR shall be responsible for all utility service costs until the Work is substantially complete. Included are all fuel, heat and other utility services necessary for execution, completion, testing and initial operation of the Work.

I. CONTRACTOR shall:

1. Comply with applicable requirements specified in Divisions 15 and 16.
2. Maintain and operate systems to assure continuous service.
3. Modify and extend systems as Work progress requires.
4. Completely remove temporary materials and equipment when their use is no longer required.
5. Clean and repair damage caused by temporary installations or use of temporary facilities.
6. Restore existing facilities used for temporary services to specified or to original condition. This includes restoration of lawns to areas where staging was performed.

END OF SECTION

SECTION 1G8

USE OF OWNER'S FACILITIES

1.1 GENERAL

A. CONTRACTOR may use existing facilities in Building No. 15 for construction purposes only if OWNER'S written permission is obtained.

B. Restore existing facilities used for temporary purposes to original condition in a manner satisfactory to OWNER.

C. CONTRACTOR and construction personnel shall not have access to lavatory and drinking water facilities inside of Building No. 15.

END OF SECTION

SECTION 1G9

PROTECTION OF THE WORK AND PROPERTY

1.1 GENERAL

A. CONTRACTOR shall be responsible for taking all precautions, providing all programs, and taking all actions necessary to protect the Work and all public and private property and facilities from damage as specified in the General Conditions and herein.

B. In order to prevent damage, injury or loss, CONTRACTOR'S actions shall include, but not be limited to, the following:

1. Store apparatus, materials, supplies, and equipment in an orderly, safe manner that will not unduly interfere with the progress of the Work or the Work of any other contractor or utility service company.
2. Provide suitable storage facilities for all materials which are subject to injury by exposure to weather, theft, breakage, or otherwise.
3. Place upon the Work or any part thereof only such loads as are consistent with the safety of that portion of the Work.
4. Clean up frequently all refuse, rubbish, scrap materials, and debris caused by his operations, to the end that at all times the site of the Work shall present a safe, orderly and workmanlike appearance.
5. Provide barricades and guard rails around openings, for scaffolding, for temporary stairs and ramps, around excavations, elevated walkways and other hazardous areas.

C. CONTRACTOR shall not, except after written consent from proper parties, enter or occupy with people, tools, materials or equipment, privately-owned land except on easements approved by ENGINEER.

D. CONTRACTOR shall assume full responsibility for the preservation of all public and private property or facility on or adjacent to the site. If any direct or indirect damage is done by or on account of any act, omission,

neglect or misconduct in the execution of the Work by the CONTRACTOR, it shall be restored by the CONTRACTOR, at his expense, to a condition equal to that existing before the damage was done.

E. Following completion of the Work, damages to curbs, sidewalks, driveways, lawns, shrubbery, monuments or other property caused by CONTRACTOR, shall be repaired at the CONTRACTOR'S expense in a manner acceptable to ENGINEER. CONTRACTOR may take photographs to document damage which existed prior to construction.

F. CONTRACTOR shall submit to ENGINEER lists of damages to property that exist prior to construction or construction related activity. The lists shall be submitted in the sequence with the construction progress and shall be submitted sufficiently in advance for ENGINEER to verify the damages. The lists shall include the following information:

1. Location of damage.
2. Nature of damage.
3. Extent of damage.

G. CONTRACTOR shall expeditiously and satisfactorily resolve all claims and complaints arising as a result of Work under this Contract. CONTRACTOR shall provide the services of an authorized representative during normal working hours for the purpose of handling all such claims and complaints. A file shall be maintained to log all claims and complaints and shall include the date and time, name of person filing the claim or complaint, nature and extent of the claim or complaint and its resolution. CONTRACTOR must advise ENGINEER monthly in writing of all such claims and complaints received by him including the status of each, and for each claim or complaint that has been secured by his insurance company, proof that such has been done.

H. CONTRACTOR shall pay for all costs to handle and resolve any claims or complaints. If, within 90 days of receipt of a complaint, CONTRACTOR fails to settle or secure any claim or complaint, as determined by ENGINEER, OWNER may retain such amounts of money from payments that would otherwise be due CONTRACTOR as, in the

opinion of OWNER, may be required to settle all claims filed with OWNER.

1.2 BARRICADES AND WARNING SIGNALS

A. Where Work is performed on or adjacent to any roadway, right-of-way, or public place, CONTRACTOR shall furnish and erect barricades, fences, lights, warning signs, and danger signals, and shall take other precautionary measures for the protection of persons or property and of the Work. Barricades shall be painted to be visible at night.

1.3 PROTECTION OF EXISTING STRUCTURES

A. Underground Structures:

1. Underground structures are defined to include, but not be limited to, all sewer, water, gas, and other piping, and manholes, chambers, electrical conduits, tunnels and other existing subsurface work located within or adjacent to the Contract limits.
2. Underground structures known to ENGINEER except water, sewer, electric and telephone service connections are shown on the Drawings. This information is shown for the assistance of CONTRACTOR in accordance with the best information available, but is not guaranteed to be correct or complete.
3. CONTRACTOR shall explore ahead of his trenching and excavation Work and shall uncover all obstructing underground structures sufficiently to determine their location, to prevent damage to them and to prevent interruption to the services which such structures provide. If CONTRACTOR damages an underground structure, he shall restore it to original condition at his expense.
4. Necessary changes in the location of the work may be made by ENGINEER, to avoid unanticipated underground structures.
5. If permanent relocation of an underground structure or other sub-surface facility is required and is not otherwise provided for in the Contract Documents, ENGINEER will direct CONTRACTOR in

writing to perform the Work, which shall be paid for under the provisions of the General Conditions.

B. Surface Structures:

1. Surface structures are defined as all existing buildings, structures and other facilities above the ground surface. Included with such structures are their foundations or any extension below the surface. Surface structures include, but are not limited to, buildings, tanks, walls, bridges, roads, dams, channels, open drainage, piping, poles, wires, posts, signs, markers, curbs, walks and all other facilities that are visible above the ground surface.

C. Protection of Underground and Surface Structures:

1. CONTRACTOR shall sustain in their places and protect from direct or indirect injury all underground and surface structures located within or adjacent to the limits of the Work. Such sustaining and supporting shall be done carefully and as required by the party owning or controlling such structure. Before proceeding with the work of sustaining and supporting such structure, CONTRACTOR shall satisfy ENGINEER that the methods and procedures to be used have been approved by the party owning same.

2. CONTRACTOR shall assume all risks attending the presence or proximity of all underground and surface structures within or adjacent to the limits to the Work. CONTRACTOR shall be responsible for all damage and expense for direct or indirect injury caused by his Work to any structure. CONTRACTOR shall repair immediately all damage caused by his work, to the satisfaction of the owner of the damaged structure.

D. All other existing surface facilities, including but not limited to, guard rails, posts, guard cables, signs, poles, markers, and curbs which are temporarily removed to facilitate installation of the Work shall be replaced and restored to their original condition at CONTRACTOR'S expense.

1.4 PROTECTION OF FLOORS AND ROOFS

A. CONTRACTOR shall protect floors and roofs during entire construction period.

B. Proper protective covering shall be used when moving heavy equipment, handling materials or other loads, when painting, handling mortar and grout and when cleaning walls and ceilings.

C. Use metal plans to collect all oil and cuttings from pipe, conduit, or rod threading machines and under all metal cutting machines.

D. Concrete less than 28 days old shall not be loaded without written permission of the ENGINEER. No floor, roof or slab shall be loaded in excess of its design loading.

E. Roofs shall not be loaded without written permission of the ENGINEER.

F. CONTRACTOR shall restrict access to roofs and keep clear of existing roofs except as required by the new Work.

G. If access to roofs is required, roofing, parapets, openings and all other construction on or adjacent to roof shall be protected with suitable plywood or other approved means.

1.5 PROTECTION OF INSTALLED PRODUCTS AND LANDSCAPING

A. Provide protection of installed products to prevent damage from subsequent operations. Remove protection facilities when no longer needed, prior to completion of Work.

B. Control traffic to prevent damage to equipment, materials and surfaces.

C. Provide coverings to protect equipment and materials from damage.

1. Cover projections, wall corners, and jambs, sills and soffits of openings, in areas used for traffic and passage of products in subsequent work.

END OF SECTION

SECTION 1G10

SECURITY

1.1 GENERAL

A. CONTRACTOR shall safely guard all Work, materials, equipment and property from loss, theft, damage and vandalism. CONTRACTOR'S duty to safely guard property shall include the OWNER'S property and other private property from injury or loss in connection with the performance of the Contract.

B. He shall employ watchmen as needed to provide the required security and prevent unauthorized entry.

C. CONTRACTOR may make no claim against the OWNER for damage resulting from trespass.

D. Party responsible for security shall make good all damage to property of OWNER and others arising from failure to provide adequate security.

E. If existing fencing or barriers are breached or removed for purposes of construction, CONTRACTOR shall provide and maintain temporary security fencing equal to the existing in a manner satisfactory to the ENGINEER and OWNER.

F. Security measures taken by the CONTRACTOR shall be at least equal to those usually provided by OWNER to protect his existing facilities during normal operation.

G. Maintain security program throughout construction and occupancy precludes need for CONTRACTOR'S security program.

1.2 CONTRACTOR'S ACCESS TO THE SITE

B. The CONTRACTOR shall provide a uniformed guard to control movement to and from the site. The guard shall be provided continuously between the hours of 5:00 p.m. and 7:00 a.m., Monday through Friday, for the duration of this Contract. No separate payment shall be made for the services of the uniformed guard. It is the responsibility of the CONTRACTOR to insure that the Gate not be left unguarded at any time during the hours stated above. If access is required by the CONTRACTOR at times other than that specified above, the CONTRACTOR shall furnish a uniformed guard as required. The cost of this extra uniformed guard service shall be borne by the CONTRACTOR.

C. Access to the site for CONTRACTOR'S employees, material, tools and equipment shall be only through the Main Gate.

END OF SECTION

SECTION 1G11

ACCESS ROADS AND PARKING AREAS

1.1 GENERAL

A. CONTRACTOR shall provide all temporary construction roads, walks and parking areas required beyond the designated available space during the construction and for use of emergency vehicles. Temporary roads and parking areas shall be designed and maintained by CONTRACTOR so as to be fully usable in all weather conditions.

B. CONTRACTOR shall prevent interference with traffic and OWNER'S operations on existing roads. He shall indemnify and save harmless OWNER from any expenses caused by CONTRACTOR'S operations over these roads.

C. Roadways damaged by CONTRACTOR shall be restored to their original condition by CONTRACTOR subject to approval of the OWNER or ENGINEER.

d. Temporary roads, walks and parking areas shall be removed by CONTRACTOR prior to final acceptance and the ground returned to its original condition, unless otherwise required by the Contract Documents.

END OF SECTION

SECTION 1G12

ENVIRONMENTAL CONTROLS

1.1 GENERAL

A. Provide and maintain methods, equipment, and temporary construction, as necessary to provide controls over environmental conditions at the construction site and adjacent areas. Remove physical evidence of temporary facilities at completion of Work.

1.2 NOISE CONTROL

A. CONTRACTOR'S vehicles and equipment shall be such as to minimize noise to the greatest degree practicable. Noise levels shall conform to the latest OSHA standards and in no case will noise levels be permitted which interfere with the Work.

1.3 DUST CONTROL

A. CONTRACTOR shall be responsible for controlling objectionable dust caused by his operation of vehicles and equipment, clearing or for any reason whatever. Dust control methods shall be approved by the ENGINEER.

1.4 PEST AND RODENT CONTROL

A. Provide rodent and pest control as necessary to prevent infestation of construction or storage area.

1. Employ methods and use materials which will not adversely affect conditions at the Site or on adjoining properties.

1.5 WATER CONTROL

A. Provide methods to control surface water and water from excavations and structures to prevent damage to the Work, the Site, or adjoining properties.

1. Control fill, grading and ditching to direct water away from excavations, pits, tunnels and other construction areas; and to direct drainage to proper runoff courses so as to prevent any erosion, damage or nuisance.

B. Provide, operate and maintain equipment and facilities of adequate size to control surface water.

C. Dispose of drainage water in a manner to prevent flooding, erosion, or other damage to any portion of the Site or to adjoining areas and in conformance with all environmental requirements.

1.6 POLLUTION CONTROL

A. Provide methods, means and facilities required to prevent contamination of soil, water or atmosphere by the discharge of noxious substances from construction operations.

B. Provide equipment and personnel, perform emergency measures required to contain any spillages, and to remove contaminated soils or liquids.

1. Excavate and dispose of any contaminated earth off-site, and replace with suitable compacted fill and topsoil.

C. Take special measures to prevent harmful substances from entering public waters.

1. Prevent disposal of wastes, effluents, chemicals, or other such substances adjacent to streams, rivers, or in sanitary or storm sewers.

D. Provide systems for control of atmospheric pollutants.

1. Prevent toxic concentrations of chemicals.

2. Prevent harmful dispersal of pollutants into the atmosphere.

E. CONTRACTOR'S equipment used during construction shall conform to all current federal, state and local laws and regulations.

1.7 EROSION CONTROL

A. Plan and execute construction work and earthwork by methods to control surface drainage from cuts and fills, and from borrow and waste disposal areas, to prevent erosion and sedimentation.

1. Hold the areas of bare soil exposed at one time to a minimum.
2. Provide temporary control measures such as berms, dikes and drains.

B. Construct fills and waste areas by selective placement to eliminate surface silts or clays which will erode.

C. Periodically inspect earthwork to detect any evidence of the start of erosion, apply corrective measures as required to control erosion.

END OF SECTION

SECTION 1G17

STORAGE OF MATERIALS

1.1 GENERAL

A. Store and protect materials in accordance with manufacturer's recommendations and requirements of Specifications.

B. CONTRACTOR shall make all arrangements and provisions necessary for the storage of materials and equipment. All excavated materials, 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 had at all times to all parts of the Work 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 and occupants. Arrange storage in a manner to provide easy access for inspection.

C. Areas available on the construction site for storage of material and equipment shall be as shown or approved by the ENGINEER.

D. The ENGINEER reserves the option to require the CONTRACTOR to vacate an assigned storage area within 60 days after notice by the ENGINEER. The ENGINEER shall designate another storage area of equivalent size for use of the CONTRACTOR.

E. Materials and equipment which are to become the property of the CONTRACTOR shall be stored to facilitate their inspection and insure preservation of the quality and fitness of the Work, including proper protection against damage by freezing and moisture. They shall be placed in inside storage areas unless otherwise acceptable to ENGINEER.

F. Lawns, grass plots or other private property shall not be used for storage purposes without written permission of the ENGINEER or other person in possession or control of such premises.

G. CONTRACTOR shall be fully responsible for loss or damage to stored materials and equipment.

H. Do not open manufacturers' containers until time of installation unless recommended by the manufacturer or otherwise specified.

I. Do not store products in the structures being constructed unless approved in writing by the ENGINEER.

1.2 UNCOVERED STORAGE

A. The following types of materials may be stored out-of-doors without cover:
   1. Masonry units.
   2. Reinforcing steel.
   3. Structural steel.
   4. Piping.
   5. Castings.

B. Store the above materials on wood blocking so there is no contact with the ground.

1.3 COVERED STORAGE

A. Rough lumber may be stored out-of-doors if covered with material impervious to water.

B. Tie down covers with rope and slope to prevent accumulation of water on covers.

C. Store materials on wood blocking.

1.4 FULLY PROTECTED STORAGE

A. Store all products not listed above in buildings or trailers which have a concrete or wooden floor, a roof, and fully closed walls on all sides.

B. Provide heated storage space for materials that would be damaged by freezing.

C. Protect mechanical and electrical equipment from contamination by dust, dirt and moisture.

D. Maintain humidity at levels recommended by manufacturers for electrical and electronic equipment.

1.5 PANEL AND INSTRUMENTATION STORAGE

A. All panels, microprocessor based equipment and all other devices subject to damage or useful life decrease because of temperatures below 40°F or above 120°F, relative humidity above 90 percent, or exposure to rain shall not be stored on site.

B. Storage shall be in an insured climate controlled warehouse. The CONTRACTOR shall have the right to inspect the equipment during normal working hours. Placed inside each panel or device shall be desiccant, volatile corrosion inhibitor blocks (VCI), a moisture indicator and maximum-minimum indicating thermometer. The panels and equipment shall be checked once per month. The desiccant, VCI and moisture indicator shall be replaced as often as required or every six months whichever occurs first. A certified record of the daily maximum and minimum temperature and humidity in the warehouse shall be available for inspection by the CONTRACTOR. A certified record of the monthly inspection noting maximum and minimum temperature for the month, condition of desiccant, VCI and moisture indicator shall also be available for inspection by the CONTRACTOR.

C. All costs for the storage shall be included in the Contract Price. Any panel or device which has been damaged by any cause or for which the storage temperatures or humidity range has been exceeded shall be replaced at no cost to the CONTRACTOR and shall not be cause for a delay in Contract completion.

D. The panels and equipment shall not be shipped to the plant site until field conditions are ready for installation including all slabs, walls, roofs, and environmental controls. The failure to have the plant site ready for installation shall not relieve the CONTRACTOR from meeting all Contract conditions.

1.6 MAINTENANCE OF STORAGE

A. Maintain periodic system of inspection of stored products on scheduled basis to assure that:
   1. State of storage facilities is adequate to provide required conditions.
   2. Required environmental conditions are maintained on continuous basis.
   3. Products exposed to elements are not adversely affected.

B. Mechanical and electrical equipment which requires long term storage shall have complete manufacturer's instructions for servicing accompanying each item, with notice of enclosed instructions shown on exterior of package.
   1. Comply with manufacturer's instructions on scheduled basis.
   2. Space heaters which are part of electrical equipment shall be connected and operated continuously until equipment is placed in service.

END OF SECTION

SECTION 1H2

SUBSTITUTIONS

1.1 GENERAL

A. Requests for review of a substitution shall conform to the requirements of the General Conditions and shall contain complete data substantiating compliance of proposed substitution with Contract Documents.

1.2 CONTRACTOR'S OPTIONS

A. For materials or equipment (hereinafter products) specified only by reference standard, select product meeting that standard, by any manufacturer, fabricator, supplier or distributor (hereinafter manufacturer). To the maximum extent possible, provide products of the same generic kind from a single source.

B. For products specified by naming several products or manufacturers, select any one of the products or manufacturers named which complies with Specifications.

C. For products specified by naming only one product or manufacturer and followed by words indicating that no substitution is permitted, there is no option and no substitution will be allowed.

D. Where more than one choice is available as a CONTRACTOR'S option, select product which is compatible with other products already selected or specified.

1.3 SUBSTITUTIONS

A. During a period of 60 days after date of commencement of Contract Time, ENGINEER will consider written requests from CONTRACTOR for substitution of products or manufacturers, and construction methods only

in case of unavailability of products or other conditions beyond control of CONTRACTOR.

B. Submit 5 copies of request for substitution. Submit separate request for each substitution. In addition to requirements set forth in the General Conditions, include in request the following:

1. For products or manufacturers:
   a. Product identification, including manufacturer's name and address.
   b. Manufacturer's literature with product description, performance and test data, and reference standards.
   c. Samples, if appropriate.
   d. Name and address of similar projects on which product was used, and date of installation.
2. For construction methods (if specified):
   a. Detailed description of proposed method.
   b. Drawings illustrating method.
3. Such other data as the ENGINEER may require to establish that the proposed substitution is equal to the product, manufacturer or method specified.

C. In making request for substitution, CONTRACTOR represents that:

1. CONTRACTOR has investigated proposed substitution, and determined that it is equal to or superior in all respects to the product, manufacturer or method specified.
2. CONTRACTOR will provide the same or better guarantees or warranties for proposed substitution as for product, manufacturer or method specified.
3. CONTRACTOR waives all claims for additional costs or extension of time related to proposed substitution that subsequently may become apparent.

D. A proposed substitution will not be accepted if:

1. Acceptance will require changes in the design concept or a substantial revision of the Contract Documents.

2. It will delay completion of the Work, or the work of other contractors.

3. It is indicated or implied on a Shop Drawing and is not accompanied by a formal request for substitution from CONTRACTOR.

E. If the ENGINEER determines that a proposed substitute is not equal to that specified, CONTRACTOR shall furnish the product, manufacturer or method specified at no additional cost to OWNER.

F. Approval of a substitution will not relieve CONTRACTOR from the requirement for submission of Shop Drawings as set forth in the Contract Documents.

END OF SECTION

SECTION 1H5

INSTRUCTION OF OPERATING PERSONNEL

1.1 GENERAL

A. CONTRACTOR shall provide the services of factory-trained operating specialists to supervise initial operations and to instruct OWNER'S operating personnel on the care, maintenance and proper operation of the equipment. The qualifications of the specialist shall be subject to approval by ENGINEER.

B. CONTRACTOR shall be responsible for coordinating these services at a time acceptable to OWNER.

C. CONTRACTOR shall notify ENGINEER 48 hours in advance of each scheduled instruction session. CONTRACTOR'S notification shall include an alternate date for the instructions if the OWNER'S personnel are not available for the primary date. CONTRACTOR'S notification will include an agenda of the topics to be covered during the session.

D. The duration of the operations and maintenance instructional sessions and any special requirements relation to individual systems or equipment shall be as specified.

E. Instructional sessions shall be held at the plant site, and only one session shall be scheduled per day.

F. Refer also to each equipment Specification Section for additional requirements for instruction of operating personnel.

END OF SECTION

SECTION 1H6

INSTALLATION OF EQUIPMENT

1.1 GENERAL

A. This Section describes Work necessary to install equipment and materials to be incorporated into this project. It supplements the Specification requirements in Divisions 2 through 16.

B. Shop Drawings, installation drawings and instructions furnished by the manufacturers shall be used by the CONTRACTOR in the installation of the equipment and materials.

1.2 ANCHOR BOLTS AND GROUT

A. Anchor and expansion bolts shall be furnished by the CONTRACTOR, as specified and required. Use expansion bolts only where shown or approved by ENGINEER. Anchor and expansion bolts shall be of specified materials with heavy hexhead nuts. Anchorage items shall conform to the applicable requirements of Section 5G.

B. Grouting shall be in accordance with Section 3K.

1.3 TRANSPORTING, HANDLING AND INSTALLING EQUIPMENT AND MATERIALS

A. CONTRACTOR shall conform to requirements of the 1H Sections of Division 1.

B. CONTRACTOR shall employ competent mechanics experienced in the installation of the types of equipment and materials to be furnished, and shall ensure that all equipment and materials are installed in accordance with the recommendations of the manufacturer.

C. All bolts, nuts and other fastenings shall be furnished by CONTRACTOR, and shall comply with the applicable requirements of Section 5G.

1.4 EQUIPMENT ERECTION

A. General: Conform to the following as a minimum.

1. Use only mechanics skilled in the handling, setting, aligning, leveling and adjusting of the type of equipment and materials furnished.
2. Use only an oil bath heater to expand couplings, gears, etc. Do not force or drive them on equipment shafts, nor subject them to an open flame or torch.
3. Wedging will not be permitted. Use least number of flat shims possible in leveling equipment. Shims shall be clean and free of slags. All shims, filling pieces, keys, packing red or white lead grout, or other materials necessary to properly align, level and secure apparatus in place shall be provided. When requested by ENGINEER, CONTRACTOR shall demonstrate that all elements so required are level and plumb. Grind as necessary to bring parts to proper bearing after erection.
4. Use proper tools in the assembly of equipment and materials to prevent deforming or marring the surface of shafts, nuts or other parts.
5. Connections requiring gaskets shall be tightened evenly all around to ensure uniform stress over the entire gasket area.
6. No equipment and materials shall be altered or repaired, and no burning or welding will be permitted on any parts having machined surfaces, except by written permission of the ENGINEER.
7. No rigging shall be done from any structure without the permission of ENGINEER, and CONTRACTOR shall be completely responsible for damage to the structure resulting from his operations.
8. Use tools, equipment and materials that will not damage the structure or equipment.
9. CONTRACTOR shall furnish and install plugs in lubrication holes to prevent entry of foreign material.

10. Electrical work, testing, lubricating and painting shall all comply with requirements of the applicable Section.

B. Setting and Erection:

1. All units shall be carefully set and aligned on their foundations by qualified millwrights after their sole plates have been shimmed to true alignment at the anchor bolts. The anchor bolts shall be set in place and the nuts tightened against the shims. After the foundation alignments have been approved by the ENGINEER, the bedplates or wing feet of the equipment shall be further checked after securing to the foundations and, after confirmation of all alignments, the sole plates shall be finally grouted in place. CONTRACTOR shall be responsible for the correct alignment of equipment with its associated piping. "Pipe springing" will not be allowed.
2. Misaligned holes shall be reamed. "Driving" of bolts or keys will not be permitted.

C. Alignment and Leveling:

1. All shafts, couplings and sheaves shall be field checked for alignment and adjusted to manufacturer's specifications where necessary.
2. Couplings shall be aligned while the equipment is free from all external loads.
3. Angular and parallel alignment shall be checked, and the actual alignment shall be recorded and submitted to the ENGINEER. Alignment shall be within manufacturer's recommended tolerance.
4. Dial indicators shall be used for the checking of angular and parallel alignment. During rotation of the half couplings in performance of this test, they shall be maintained in the same relative position, and the dial indicator readings shall be taken at the same place on the circumference of the coupling.

D. Threaded Connections:

1. A molybdenum disulfide anti-seize compound shall be applied to all threads in mechanical connections such as bolts, studs, cap screws, tubing, etc. unless otherwise indicated.

1.5 SERVICES OF MANUFACTURERS' REPRESENTATIVE

A. Equipment furnished under Division's 11 and 13 shall include the cost of competent, qualified representatives of manufacturers of all equipment to supervise the installation, adjustment and testing of the equipment and to instruct the operating personnel on operation and maintenance. The training time and additional requirements for furnishing services of manufacturers' representatives are detailed in the appropriate Sections of the Specifications.

B. A certificate from the manufacturer stating that the installation of the equipment is satisfactory, that the unit has been satisfactorily tested and is ready for operation, and that the operating personnel have been suitably instructed in the operation, lubrication and care of the unit shall be submitted within thirty days of completion of the performance test.

END OF SECTION

SECTION 1I1

CLEANING

1.1 GENERAL

A. Execute cleaning, during progress of the Work, at completion of the Work, and as required by General Conditions.

B. Requirements of Regulatory Agencies:
   1. In addition to the requirements herein, maintain the cleanliness of the Work and surrounding premises within the Work limits so as to comply with federal, state, and local fire and safety laws, ordinances, codes and regulations.
   2. Comply with all federal, state and local anti-pollution laws, ordinances, codes and regulations when disposing of waste materials, debris and rubbish.

C. Scheduling of Cleaning and Disposal Operations:
   1. So that dust, wash water or other contaminants generated during such operations do not damage or mar painted or finished surfaces.
   2. To prevent accumulation of dust, dirt, debris, rubbish and waste materials on or within the Work or on the premises surrounding the Work.

D. Waste Disposal:
   1. Dispose of all non-hazardous waste materials, surplus materials, debris and rubbish in dumpsters. All non-hazardous waste materials shall be disposed of off-site by the CONTRACTOR in accordance with all applicable federal, state and local laws.
   2. Do not burn or bury rubbish and waste materials on the plant site.
   3. Do not dispose of volatile or hazardous wastes such as mineral spirits, oil, or paint thinner in storm or sanitary drains.
   4. Do not discharge wastes into only streams or waterways.

E. Cleaning Materials:

1. Use only cleaning materials recommended by manufacturer of surface to be cleaned.
2. Use each type of cleaning material on only those surfaces recommended by the cleaning material manufacturer.
3. Use only materials which will not create hazards to health or property.

F. During Construction:

1. Keep the Work and surrounding premises within work limits free of accumulations of dirt, dust, waste materials, debris and rubbish.
2. Keep dust generating areas wetted down.
3. Provide suitable containers for storage of non-hazardous waste materials, debris and rubbish until time of disposal.
4. Provide approved 55-gallon drums for storage of hazardous waste materials including but not limited to drill cuttings and personnel protection equipment.
5. Store sealed 55-gallon drums containing hazardous waste materials on-site until an approved TSDF or designated facility will accept the sealed drums in accordance with all RECRA, USEPA, federal, state and local regulations.

G. When Project is Completed:

1. Remove and dispose of all excess or waste materials, debris, rubbish, and temporary facilities from the site, structures and all facilities.
2. Repair pavement, roads, sod, and all other areas affected by construction operations and restore them to original condition or to a minimum condition specified.
3. Remove spatter, grease, stains, fingerprints, dirt, dust, labels, tags, packing materials and other foreign items or substances from interior and exterior surfaces, equipment, signs and lettering.
4. Repair, patch and touch up chipped, scratched, dented or otherwise marred surfaces to match specified finish.
5. Remove paint, clean and restore all equipment and material nameplates, labels and other identification markings.

6. Clean all floors, slabs, pavements and ground surfaces.
7. Maintain cleaning until final acceptance by ENGINEER.

END OF SECTION

SECTION 1I2

RECORD DOCUMENTS

1.1 GENERAL

A. CONTRACTOR shall maintain and provide ENGINEER with record documents as specified below, except where otherwise specified or modified in Divisions 2-16.

B. Maintenance of Documents:

1. Maintain in CONTRACTOR'S field office in clean, dry, legible condition complete sets of the following: Drawings, Specifications, Addenda, approved Shop Drawings, Samples, photographs, Change Orders, other modifications of Contract Documents, test records, survey data, Field Orders, and all other documents pertinent to CONTRACTOR'S Work.
2. Provide files and racks for proper storage and easy access. File in accordance with filing format of Construction Specification Institute (CSI), unless otherwise approved by ENGINEER.
3. Make documents available at all times for inspection by ENGINEER and OWNER.
4. Record documents shall not be used for any other purpose and shall not be removed from the CONTRACTOR'S office without ENGINEER'S approval.

C. Marking System: Provide colored pencils or felt tipped pens for marking changes, revisions, additions and deletions, to the record set of Drawings. Use following color code unless otherwise approved by the ENGINEER:

1. Process and Mechanical: Red
2. Architectural: Blue
3. Structural: Purple
4. Plumbing: Brown
5. HVAC: Green
6. Other Printed Notations: Black

D. Recordings:

1. Label each document "PROJECT RECORDS" in 2-inch high printed letters.
2. Keep record documents current.
3. Do not permanently conceal any Work until required information has been recorded.
4. Drawings: Legibly mark to record actual construction including:
   a. Depths of various elements of foundation in relation to datum.
   b. Horizontal and vertical location of underground utilities and appurtenances referenced to permanent surface improvements.
   c. Location of internal utilities and appurtenances concealed in construction referenced to visible and accessible features of structure.
   d. Field changes of dimensions and details.
   e. Changes made by Change Order or Field Order.
   f. Details not on original Drawings.
5. Specifications and Addenda: Legibly mark up each Section to record:
   a. Manufacturer, trade name, catalog number, and supplier of each product and item of equipment actually installed.
   b. Changes made by Change Order or Field Order.
   c. Other matters not originally specified.

E. Submittal:

1. Upon Substantial Completion of the Work, deliver record documents to ENGINEER. Final payment will not be made until satisfactory record documents are received by ENGINEER.
2. Accompany submittal with transmittal letter containing:
   a. Date.
   b. Project title and number.
   c. CONTRACTOR'S name and address.
   d. Title and number of each record document.
   e. Certification that each document as submitted is complete and accurate.

f. Signature of CONTRACTOR, or his authorized representative.

END OF SECTION

SECTION 1I3

OPERATION AND MAINTENANCE DATA

1.1 GENERAL

A. Provide operation and maintenance data in the form of instructional manuals for use by the operation personnel for:
   1. All equipment and systems.
   2. All valves and related accessories.
   3. All instruments and control devices.

B. Definitions:
   1. Operation and Maintenance Data:
      a. The term "operation and maintenance data" includes all product related information and documents which are required for preparation of the plant operation and maintenance manual.
      b. Required operation and maintenance data include, but are not limited to, the following:
         1) Complete, detailed written operating instructions for each product or piece of equipment including: equipment function; operating characteristics; limiting conditions; operating instructions for startup, normal and emergency conditions; regulation and control; and shutdown.
         2) Complete, detailed written preventive maintenance instructions as defined below.
         3) Recommended spare parts lists and local sources of supply for parts.
         4) Written explanations of all safety considerations relating to operation and maintenance procedures.
         5) Name, address and phone number of manufacturer, manufacturer's local service representative, and Subcontractor or installer.

6) Copy of all approved Shop Drawings, and copy of warranty bond and service contract as applicable.

2. Preventive Maintenance Instructions:

a. The term "preventive maintenance instructions" includes all information and instructions required to keep a product or piece of equipment properly lubricated, adjusted and maintained so that the item functions economically throughout its full design life.

b. Preventive maintenance instructions include, but are not limited to, the following:

1) A written explanation with illustrations for each preventive maintenance task.

2) Recommended schedule for execution of preventive maintenance tasks.

3) Lubrication charts.

4) Table of alternative lubricants.

5) Trouble shooting instructions.

6) List of required maintenance tools and equipment.

C. Submittals:

1. General: Submit operations and maintenance data to the ENGINEER within 90 days after approval of Shop Drawings unless noted otherwise.

2. Number of Copies: Three (3) of each item.

3. Letter of Transmittal: Provide a letter of transmittal with each submittal and include the following in the letter:

a. Date of submittal.

b. CONTRACTOR'S name and address.

c. A list of the attachments and the Specification Sections to which they relate.

d. Reference to or explanation of related submittals already made or to be made at a future date.

4. Format Requirements:

a. Use 8-1/2 inch by 11 inch paper of high rag content and equality. Larger drawings of illustrations are acceptable if neatly folded to the specified size in a manner which will

permit easy unfolding without removal from the binder. Provide reinforced punched binder tab. Or provide fly-leaf for each product.

b. All text must be legible typewritten or machine printed originals of high quality copies of same.

c. Each page shall have a binding margin of approximately 1-1/2 inches and be punched for placement in a three ring looseleaf or triple post binder. Provide binders. Identify each binder with the following:

   1) Title "OPERATING AND MAINTENANCE INSTRUCTIONS".
   2) Title of Project/Project No.
   3) Contract No.
   4) Identity of general subject matter covered.

d. Use dividers and indexed tabs between major categories of information such as operating instructions, preventive maintenance instructions, or other. When necessary, place each major category in a separate binder.

e. Provide a table of contents for each binder.

f. Identify products by their functional names in the table of contents and at least once in each chapter or Section. Thereafter, abbreviations and acronyms may be used if their meaning is explained in a table in the back of each binder. Use of model or catalog numbers or letters for identification is not acceptable.

END OF SECTION

SECTION 1I4

SPARE PARTS AND MAINTENANCE MATERIALS

1.1 GENERAL

A. CONTRACTOR shall furnish spare parts and maintenance materials as specified in the individual Sections.

B. Parts and materials shall be furnished in manufacturer's unopened cartons, boxes, crates or other protective covering suitable for preventing corrosion or deterioration for the maximum length of storage which may be normally anticipated. They shall be clearly marked and identified.

C. During construction, store parts in accordance with manufacturers' recommendations. Protect from weather, condensation and humidity.

D. Parts and materials shall be delivered to the OWNER upon completion of the Work. CONTRACTOR shall then place them in permanent storage rooms or areas approved by the ENGINEER.

E. CONTRACTOR shall be fully responsible for loss or damage to parts and materials until they are transmitted to the OWNER.

END OF SECTION

SECTION 2C

DEMOLITION AND REMOVALS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified, and required to complete the Work of demolition, removal, and disposal.
2. CONTRACTOR shall furnish all labor, materials and equipment to demolish the existing areas of Building No. 15.
3. The CONTRACTOR shall de-energize and remove all transformers, switchgear, panelboards, lighting fixtures, switches, circuit breakers, electrical conduits, motors, limit switches, pressure switches, instrumentation wiring and power equipment as designated to be removed on the Drawings. All electrical equipment to be retained shall be relocated or isolated by the CONTRACTOR prior to the removal of the equipment specified herein and shown.
4. The removal of all materials form the demolition of buildings and structures shall become CONTRACTOR's property, unless otherwise noted. The debris shall be disposed of off site in a manner not contrary to the Contract requirements.

B. Related Sections:

1. Section 2D1, Excavation and Backfill.

1.2 SUBMITTALS

A. Schedule: Submit for approval the following:

1. CONTRACTOR shall submit detailed description of methods, equipment and sequence for demolition and removal for ENGINEER's review.

1.3 PROTECTION

A. General:

1. Demolition and removal Work shall be performed by competent workmen experienced in the various types of demolition and removal work required and shall be carried through to completion with due regard to the safety of all OWNERS employees, workmen on the Site and the public. The Work shall be performed with as little nuisance as possible.
2. The Work shall comply with the applicable provisions and recommendation of ANSI A10.2, Safety Code for Building Construction, all governing codes and as hereinafter specified.
3. CONTRACTOR shall make such investigations, explorations and probes as are necessary to ascertain any required protective measures before proceeding with demolition and removal.
4. CONTRACTOR shall provide interior and exterior shoring, bracing and support to prevent movement, settlement, or collapse of existing structures or facilities. The OWNER assumes no responsibility for the actual condition of the structures or facilities adjacent to the Work or the structures or facilities designated for removal or modification.
5. Do not bring explosives on site. No explosives will be permitted for this Project.

B. Execution:

1. CONTRACTOR shall provide, erect and maintain catch platforms, lights, barriers, weather protection, warning signs and other items as required for proper protection of the public, occupants of the building, workmen engaged in demolition operations, and adjacent construction.
2. CONTRACTOR shall provide and maintain weather protection at exterior openings so as to fully protect the interior premises against

damage from the elements until such openings are closed by new construction.

3. CONTRACTOR shall provide and maintain temporary protection of the existing structure designated to remain where demolition, removal and new Work is being done, connections made, materials handled or equipment moved.
4. CONTRACTOR shall take necessary precautions to prevent dust from rising by wetting demolished masonry, concrete, plaster and similar debris. Unaltered portions of the existing buildings affected by the operations under this Section shall be protected by dustproof partitions and other adequate means.
5. CONTRACTOR shall provide adequate fire protection in accordance with local Fire Department requirements.
6. CONTRACTOR shall not close or obstruct walkways, passageways, or stairways and shall not store or place materials in passageways, stairs or other means of egress. CONTRACTOR shall conduct operations with minimum traffic interference.
7. CONTRACTOR shall be responsible for any damage to the existing structure or contents by reason of the insufficiency of protection provided.
8. CONTRACTOR shall carry out all operations so as to avoid interference with operations and work in the existing facilities and the work under other contracts.
9. CONTRACTOR shall be solely responsible for making all necessary arrangements and for performing all necessary work involving the discontinuance or interruption of all utilities or services.
10. Any equipment, piping and appurtenances removed without proper authorization, shall immediately be replaced to the satisfaction of ENGINEER a no cost to OWNER.

C. Notification:

1. At least 48 hours prior to commencement of a demolition or removal, CONTRACTOR shall notify ENGINEER in writing of this proposed schedule therefor. OWNER shall inspect the existing equipment and (review with CONTRACTOR) those items which

are to remain the property of OWNER. No removals shall be started without the permission of ENGINEER.

PART 2 - PRODUCTS

(Part 2 omitted this Section)

PART 3 - EXECUTION

3.1 GENERAL

A. The Work required shall be done with care, and shall include all required shoring, bracing, etc. CONTRACTOR shall be responsible for any damage which may be caused by demolition and removal Work to any part or parts of existing structures or items designated for reuse or to remain. CONTRACTOR shall perform patching, restoration and new Work in accordance with applicable technical sections of the Specification and in accordance with the details shown on the Drawings.

B. There is o guarantee by OWNER that the number of fixtures, amount of equipment or any other material of value existing in the buildings and structures to be demolished at the bidding time will be present i nthe structures when they are demolished. CONTRACTOR shall have no claim against the OWNER because of the absence of such fixtures and materials.

C. Surfaces of walls, floors, ceilings, or other areas which are exposed by any of the removals specified herein, and which will remain as architecturally finished surfaces, which have holes, scars, chipped or other damaged surfaces revealed by the removal shall be repaired by CONTRACTOR with the same or matching materials as the existing surface or as may be otherwise approved by ENGINEER.

D. Pollution Controls: Use water sprinkling, temporary enclosures, and other suitable methods to limit the amount of dust and dirt rising and scattering

in the air to the lowest practical level. Comply with governing regulations pertaining to environmental protection.

1. Do not use water when it may create hazardous or objectionable conditions such as ice, flooding, and pollution.
2. Clean adjacent structures, facilities, and improvements of dust, dirt, and debris caused by demolition operations. Return adjacent areas to conditions existing prior to the start of the Work.

E. All supports, pedestals and anchors shall be removed with the equipment and piping unless otherwise specified or required. Concrete bases, anchor bolts and other supports shall be removed to approximately one inch below the surrounding finished area and the recesses shall be patched to match the adjacent areas. Superstructure wall and roof openings shall be closed, and damaged surfaces shall be patched to match the adjacent areas, as specified under applicable sections of the Specifications, as shown, or as directed by ENGINEER. Wall sleeves and castings shall be plugged or blanked off, all openings in concrete shall be closed in a manner meeting the requirements of the appropriate sections of the Specifications, as shown or as directed and approved by ENGINEER.

F. Where equipment is shown or specified to be removed and relocated, CONTRACTOR shall not proceed with removal of this equipment without specific prior approval of ENGINEER. Upon approval, and prior to commencing removal operations, the equipment shall be operated in the presence of representatives of CONTRACTOR, OWNER and ENGINEER. Such items shall be removed with care, under the supervision of the trade responsible for reinstallation and protected and stored until required. Material or items damaged during removal shall be replaced with similar new material or items. Any equipment that is removed without proper authorization and is required for plant operation shall be replaced at no cost to the OWNER.

G. Wherever piping is to be removed for disposition, the piping shall be drained by CONTRACTOR and adjacent pipe and headers that are to remain in service shall be blanked off or plugged and then anchored in an approved manner.

H. Where alterations occur, or new and old Work join, CONTRACTOR shall cut, remove , patch, repair or refinish the adjacent surfaces to the extent required by the construction conditions, so as to leave the altered Work in as good a condition as existed prior to the start of the Work. The materials and workmanship employed in the alternations, unless otherwise shown on the Drawings or specified, shall comply with that of the various respective trades which normally perform the particular items of work.

I. CONTRACTOR shall confine the cutting of the existing Building Floor to the limits of the new Work.

J. CONTRACTOR shall remove all temporary work, such as enclosures, signs, guards, and the like when such temporary work is no longer required or when directed at the completion of the Work.

3.2 STRUCTURAL REMOVALS

A. CONTRACTOR shall remove concrete and structures to the lines and grades shown unless otherwise directed by ENGINEER. Where no limits are shown, the limits shall be 4 inches outside the item to be installed. The removal of masonry beyond these limits shall be at CONTRACTOR's expense and these excess removals shall be reconstructed to the satisfaction of ENGINEER with no additional compensation to the CONTRACTOR.

B. Determine the thickness of existing concrete to be removed and the extent to which it is reinforced. No additional compensation will be made because of variations from the thickness shown or for variations in the amount of reinforcement.

C. All concrete, brick, tile, concrete block, roofing materials, reinforcement, structural or miscellaneous metals, plaster, wire mesh and other items contained in or upon the structure shall be removed and taken from the site, unless otherwise approved by ENGINEER. Demolished items shall not be used in backfill.

D. After removal of parts or all of masonry walls, slabs and like work which tie into new Work or existing work, the point of junction shall be neatly repaired so as to leave only finished edges and finished surfaces exposed.

3.3 PAVEMENT, CURB AND SIDEWALK REMOVALS

A. Remove existing pavement, including base and surface courses, stabilized sub-bases, curbs, and gutters as required to construct new facilities or as shown. Before removing, saw a straight joint at least 1-1/2-inches deep between sidewalk and pavement designated for removal and that left in place. Curbs and gutters shall be removed to the nearest construction joint beyond the end of demolition symbol shown on the Drawings.

B. Provide for satisfactory transition between replaced pavement and sidewalks and the portions remaining in place.

3.4 EQUIPMENT REMOVALS

A. Equipment removals shall consist of dismantling and removing of existing piping, pumps, motors, equipment, and other appurtenances as specified, shown, or required for the completion of the Work. It shall include cutting, capping, draining, and plugging as required, except that the cutting of existing piping for the purpose of making connections thereto will be included under Division 15.

B. When underground piping is to be altered or removed, the remaining piping shall be properly capped. Abandoned underground piping may be left in place unless it interferes with new Work or is shown or specified to be removed.

D. Water and vent piping shall be removed to points shown or required. Pipe shall be plugged with cleanouts and plugs. Where piping or ducts pass through existing roof the hole in the roof shall be properly patched and made the watertight.

E. Any demolition or changes to potable water piping and other plumbing and heating system work shall be made in conformance with all applicable codes. Portions of the potable water system that may have been altered or opened shall be pressure tested and disinfected in accordance with Division 15 and local codes. Other plumbing piping and heating piping shall be pressure tested only.

F. Provide all caps, plugs, blind flanges, shut-off valves and other work and materials required to remove from service existing piping and necessary to keep existing piping in service where shown or required.

3.5 ELECTRICAL REMOVALS

A. Electrical removals shall consist of the removal of existing transformers, distribution switchboards, control panels, motors, conduits and wires, panelboards, lighting fixtures, and miscellaneous electrical equipment all as required to perform the Work.

B. All existing electrical equipment and fixtures to be removed shall be removed by the CONTRACTOR with such care as may be required to prevent unnecessary damage, to keep existing systems in operation and to keep the integrity of the grounding systems.

1. The Electrical CONTRACTOR shall, in conjunction with OWNER, de-energize panelboards, lighting switches, pressure switches, instrumentation, wiring and similar power equipment prior to removal.

C. Where shown or otherwise required, wiring shall be removed. The CONTRACTOR shall verify the function of all wiring before disconnecting and removing it. Ducts which are not to be reused shall be plugged and made watertight. All openings in buildings for entrance of abandoned conduit or direct-burial cable shall be patched and made watertight.

D. Panelboards where shown shall be removed and disposed of off the site. All cutting and patching necessary for the removal and replacement of panelboards shall be performed.

E. Lighting fixtures shall be relocated as shown or required to install the new Work or perform the demolition work.

F. Switches, receptacles, starters and other miscellaneous electrical equipment, shall be removed and disposed of off the site. Care shall be taken in removing all equipment so as to minimize damage to architectural and structural members. Any damage incurred shall be repaired.

3.6 MISCELLANEOUS REMOVALS

A. CONTRACTOR shall remove miscellaneous concrete walls, slabs, pipe supports, equipment pads, and curbs where shown on the Drawings or where necessary for the construction of new structures or modification of existing structures. Anchor bolts shall be cut back one inch below the concrete surface and the hole patched.

3.7 MODIFICATIONS AND CLOSURES

A. Modifications shall conform with all applicable Specifications, the Drawings, and the directions and approvals of ENGINEER.

B. Where alterations require cutting or drilling into existing floors, walls, and roofs the holes shall be repaired in an approved manner. CONTRACTOR shall repair such openings with the same or matching materials as the existing floor, wall, or roof or as otherwise approved by ENGINEER. All repairs shall be smoothly finished unless otherwise approved by ENGINEER.

1. CONTRACTOR shall confine cutting of existing roof areas designated to remain to the limits required for the proper installation of the new Work. CONTRACTOR shall cut and remove insulation, etc. and provide temporary weathertight

in neat joints with new construction or be satisfactory for the purpose intended. Where existing reinforcing rods are to extend into new construction, remove the concrete so that the reinforcing is clean undamaged. Cut off other reinforcing flush with the surface.

E. All new Work shall be keyed into the existing in an acceptable manner. New reinforcing steel shall be welded to the existing reinforcing. Welding shall conform to AWS D12.1, Reinforcing Steel Welding Code. In general, the same or matching materials as the existing adjacent surface shall be used. The finished closure shall be a smooth, tight, sealed, permanent closure with all exposed surfaces smooth finished and acceptable to ENGINEER.

3.8. TITLE TO EQUIPMENT AND MATERIALS

A. CONTRACTOR shall have no right or title to any of the equipment, materials or other items removed from the existing buildings or structures unless otherwise directed by the ENGINEER. CONTRACTOR shall not sell or assign or attempt to sell or assign any interest in the said equipment, materials or other items until the said equipment, materials or other items have been removed.

B. CONTRACTOR shall have no claim against OWNER because of the absence of such fixtures and materials.

3.9 CONDITION OF BUILDINGS, STRUCTURES AND EQUIPMENT

A. OWNER does not assume responsibility for the actual condition of buildings, structures and equipment to be demolished and removed.

B. Conditions existing at the time of inspection for bidding purposes will be maintained by OWNER so far as practicable.

C. The information regarding the existing structures and equipment shown on the Drawings is based on visual inspection and a walk-through survey only. Neither the ENGINEER nor OWNER will be responsible for interpretations or conclusions drawn therefrom by CONTRACTOR.

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B. Conditions existing at the time of inspection for bidding purposes will be maintained by OWNER so far as practicable.

C. The information regarding the existing structures and equipment shown on the Drawings is based on visual inspection and a walk-through survey only. Neither the ENGINEER nor OWNER will be responsible for interpretations or conclusions drawn therefrom by CONTRACTOR.

3.10 MAINTENANCE AND CLEAN UP

A. CONTRACTOR shall maintain the buildings, structures and public properties free from accumulations of waste, debris and rubbish, caused by the demolition and removal operations.

B. CONTRACTOR shall provide on-site dump containers for collection of waste materials, debris and rubbish, and he shall wet down dry materials to lay down and prevent blowing dust.

C. At reasonable intervals during the progress of the demolition and removal Work or as directed by ENGINEER, CONTRACTOR shall clean the Site and properties, and dispose of waste materials, debris and rubbish.

END OF SECTION

SECTION 2D1

EXCAVATION AND BACKFILL

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. Furnish all labor, materials, equipment and incidentals required to perform all excavating, backfilling and disposing of earth materials as specified, and required for the purpose of constructing structures, conduits, pipelines and other facilities required to complete the Work in every respect.
2. All necessary preparation of subgrade for footings, foundations, and slabs is included.
3. All temporary means needed to prevent discharge of sediment to water courses because of dewatering systems or erosion are included.
4. Testing of all excess material and all fill and backfill materials.

1.2 QUALITY ASSURANCE

A. Tests:

1. Source Quality Control: CONTRACTOR shall be responsible for the payment of all testing required to determine the acceptability of proposed fill and backfill material.

B. Permits and Regulations:

1. CONTRACTOR shall be responsible for obtaining all building and construction permits.
2. Perform excavation work in compliance with applicable requirements of governing authorities having jurisdiction.

C. Reference Standards: Comply with applicable provisions and recommendations of the following except as otherwise shown or specified.

1. ASTM A 36, Structural Steel.
2. ASTM A 328, Steel Sheet Piling.
3. ASTM D 422, Particle-Size Analysis of Soils.
4. ASTM D 423, Liquid Limit of Soils.
5. ASTM D 424, Plastic Limit and Plasticity Index of Soils.
6. ASTM D 1556, Density of Soil in Place by the Sand-Cone Method.
7. ASTM D 2487, Classification of Soils for Engineering Purposes.
8. AISC Specifications for the Design, Fabrication, and Erection of Structural Steel for Buildings.

1.3 SUBMITTALS

A. Shop Drawings:

1. Submit for review for the following items:
   a. Sheeting and bracing.
   b. Protection methods anticipated.
   c. Underpinning.
2. The Drawings shall be prepared by a professional engineer registered in the State of Rhode Island and recognized as expert in the specialty involved. The Drawings shall be submitted to the ENGINEER for purposes of establishing that the terms of the Specifications are complied with. Submit calculations and all other pertinent information. Drawing submissions will not be checked and will not imply approval by the CONTRACTOR of the work involved.
3. CONTRACTOR shall be wholly responsible for designing, installing and operating whatever system is necessary to accomplish satisfactory sheeting, bracing, protection, underpinning and dewatering.

1.4 JOB CONDITIONS

A. Subsurface Information:

1. Two (2) additional test borings shall be performed by the CONTRACTOR as shown and specified.

B. Existing Structures and Utilities:

1. Shown on the Drawings are certain surface and underground structures adjacent to the Work. This information has been obtained from existing records. It is not guaranteed to be correct or complete and is shown for the convenience of the CONTRACTOR. CONTRACTOR shall explore ahead of the required excavation to determine the exact location of all structures. They shall be supported and protected from injury by the CONTRACTOR. If they are broken or otherwise damaged, they shall be restored immediately by the CONTRACTOR at his expense.
2. Locate existing underground utilities in the areas of Work. If utilities are to remain in place, provide adequate means of protection during earthwork operations.
   a. Should uncharted or incorrectly charted piping or other utilities be encountered during excavation, consult the OWNER and ENGINEER immediately for directions as to procedures to be taken. Cooperate with OWNER and utility companies in keeping respective services and facilities in operation. Repair damaged utilities to satisfaction of utility owner.
3. Do not interrupt existing utilities serving facilities occupied and used by others, except when permitted in writing by OWNER and then only after acceptable temporary utility services have been provided.

C. Use of Explosives: Not permitted on the job site.

D. Protection of Persons and Property:

1. Barricade open excavations occurring as part of this Work and post with warning lights.
2. Operate warning lights during hours from dusk to dawn each day and as otherwise required.

3. Protect structures, utilities, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout and other hazards created by earthwork operations.

E. Dust Control: Conduct all operations and maintain the area of activities, including sweeping and sprinkling of roadways, so as to minimize creation and dispersion of dust.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. Select Fill and Backfill Materials:

1. Place below footings, foundations, slabs and against structure walls.
2. Fill shall be well-graded, granular material or bank run gravel, free from organic matter. All fill shall be from a virgin source, and not subject to previous industrial activity. Not more than 50 percent by weight shall pass through a No. 40 sieve; not more than 10 percent by weight shall pass through a No. 200 sieve; and 100 percent shall pass a 6-inch square sieve.

PART 3 - EXECUTION

3.1 INSPECTION

A. CONTRACTOR will examine the areas and conditions under which excavating are to be performed and notify the ENGINEER of conditions he may find that are detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected in an acceptable manner.

3.2 TEST PITS

A. Where ordered by the ENGINEER, excavate and backfill, in advance of construction, test pits to determine conditions or location of existing facilities.

B. Test pits made by the CONTRACTOR for his own use at his option shall not be at no additional cost to the OWNER.

3.3 EXCAVATION

A. General:

1. Scope: Perform all excavation required to complete the Work as shown and specified.
2. Excavated Materials: Earth, sand, clay, gravel, hardpan, boulders not requiring drilling or jackhammering to remove, decomposed rock, sediment, rubbish and all other materials within the excavation limits, except rock.

B. Structures and Pipelines:

1. Excavations: Open excavations, shored and braced where necessary to prevent possible injury to workmen and to new and existing structures or pipelines.
2. Sheeting and Bracing: Install in accordance with drawings submitted under Article 1.3 above.

C. Footings:

1. Consider the elevation of the bottom of footings shown as approximate only and the ENGINEER may order such changes in dimensions and elevations as may be required to secure a satisfactory footing.
2. Hand trim all structure excavations to permit the placing of full widths, and lengths of footings on horizontal beds. Rounded and undercut edges will not be permitted.
3. When excavations are made below the required grades, without the written order of the ENGINEER, backfill with well graded granular material to be compacted to the specified density or

concrete as directed by the ENGINEER at expense of CONTRACTOR.

D. Size of Excavations: Extend excavation sufficiently on each side of structures, footings, etc., to permit setting of forms, installation of sheeting or the safe sloping of banks.

E. Subgrades:

1. General Requirements: The compaction of backfill shall be maintained at +2 percent from optimum moisture content. The compacted fill shall remain firm and in tact under all construction operations. Mud, muck and other soft or unsuitable materials shall be removed.
2. Subgrade Requirements for Pipeline Trench Bottoms and Floor Slabs: Compact to at least 90% of the maximum modified Proctor dry unit weight.
3. Subgrade Requirements for Footing Foundations: Compact to at least 95 percent of the maximum modified Proctor dry unit weight.
4. Soft Subgrades: For subgrades which are otherwise solid, but which become soft or mucky on top due to construction operations, follow these procedures:
   a. Remove the soft and mucky material and replace with suitable backfill and recompacted to the specified density. The soft surface can also be stabilized with crushed stone, crushed slag or lime.
   b. Overlay with geotextile fabric prior to placement of crushed stone or gravel.
5. Finished Elevation of Stabilized Subgrades: Do not place above subgrade elevations shown.

F. Stability of Excavations:

1. Sides of Excavations: Slope to comply with codes and ordinances of agencies having jurisdiction.
2. Shoring and Bracing: Where sloping is not possible either because of space restrictions or stability of material excavated.

3. Safety: Maintain sides and slopes of excavations in a safe condition until completion of backfilling.
4. Caving: If caving occurs outside the excavation area, backfill the resulting hole in accordance with the requirements of this section after removing the loose material.

G. Material Storage:
1. Stockpile excavated materials in approved areas, until required for backfill or fill.
2. Place, grade and shape stockpiles for proper drainage.
3. Locate and retain soil materials away from edge of excavations.
4. Excess soil and waste materials shall be stored on-site and tested to determine heavy metal concentrations.

H. Unsuitable Material:
1. Where the existing material beneath the bedding material is considered unsuitable by the ENGINEER, remove and replace it with select backfill.
2. The selected backfill shall be compacted in accordance with the specified density criteria in subsection 3.7.

3.4 UNAUTHORIZED EXCAVATION

A. Limits: All excavation outside the lines and grades shown.

B. Responsibility: All unauthorized excavation together with the removal, testing, required treatment and disposal of the associated materials is at the CONTRACTOR'S expense.

C. Backfill: Fill and compact the unauthorized excavation with select backfill and at CONTRACTOR'S expense.

3.5 DRAINAGE AND DEWATERING

A. General:

1. Prevent surface and subsurface water from ponding in the excavations and from flooding adjacent areas.
2. Remove water from excavation as fast as it collects.
3. Maintain the ground water level at least 3 feet below the bottom of the excavation to provide a stable surface for construction operations, a stable subgrade for the permanent work, and to prevent damage to the Work during all stages of construction.
4. Provide and maintain pumps, sumps, suction and discharge lines and other dewatering system components necessary to convey water away from excavations.
5. Obtain ENGINEER's approval before shutting down dewatering system for any reason.

B. Standby Requirements for Dewatering: Provide standby equipment to ensure continuity of dewatering operations.

C. Disposal of Water Removed by Dewatering System:

1. Dispose of all water removed from the excavation to the local sanitary sewer.
2. Dispose of water in such a manner as to cause no inconvenience to the OWNER, ENGINEER, or others involved in work about the site.
3. Convey water from the construction site in a closed conduit. Do not use trench excavations as temporary drainage ditches.

3.6 SHEETING, SHORING AND BRACING

A. General:

1. Excavations for Structures and Pipe Lines: Open excavation, sheeted, shored and braced where necessary to prevent injury to workmen, structures, or pipe lines.

2. Observe all municipal, county, state and federal ordinances, codes, regulations and laws.
3. Used material shall be in good condition, not damaged or excessively pitted. All steel or wood sheeting designated to remain in place shall be new. New or used sheeting may be used for temporary work.
4. Timber Used for Breast Boards (lagging): New or used, meeting the requirements for Douglas Fir Dense Construction grade or Southern Pine No. 2 Dense S3.
5. Design in accordance with the provisions of the "Specifications for the Design, Fabrication and Erection of Structural Steel for Buildings(m), of the AISC all steel work for sheeting, shoring, bracing, cofferdams, etc. except that field welding will be permitted.
6. Steel Sheet Piling: Manufactured from steel conforming to ASTM A 328. Steel for soldier piles, wales and braces shall be new or used and shall conform to ASTM A 36. Furnish mill test reports on new piling but not used ones.
7. Maintain shoring and bracing in excavations regardless of time period excavations will be open. Carry down shoring and bracing as excavation progresses.
8. Unless otherwise shown, specified, or ordered, remove all materials used for temporary construction when work is completed. Make this removal in a manner not injurious to the structure or its appearance or to adjacent Work.
9. **Safe and satisfactory sheeting shall be the entire responsibility of the CONTRACTOR.**

B. Removal of Sheeting and Bracing:
1. Remove sheeting and bracing from excavation unless otherwise directed in writing by the ENGINEER.
2. Conduct removal so as to not cause injury to the Work.
3. Removal shall be equal on both sides of excavation to ensure no unequal loads on pipe or structure.

4. Defer removal of sheeting and bracing, where removal may cause soil to come into contact with concrete until the following conditions are satisfied:
   a. Concrete has cured a minimum of 7 days.
   b. Wall and floor framing up to and including grade level floors are in place.

3.7 GENERAL BACKFILL

A. General:
   1. Furnish, place and compact all general backfill and fill required to provide the finished grades shown and described herein.

B. Restrictions: Backfill excavations as promptly as Work permits, but not until completion of the following:

   1. Reviewed by ENGINEER of construction below finish grade.
   2. Inspection, testing, approval, and recording of locations of underground utilities.
   3. Removal of concrete formwork.
   4. Removal of shoring and bracing, and backfilling of voids with satisfactory materials. Cut off temporary sheet piling driven below bottom of structures and remove in manner to prevent settlement of the structure or utilities, or leave in place if required.
   5. Removal of trash and debris.
   6. Permanent or temporary horizontal bracing is in place on horizontally supported walls.
   7. Placement of settlement plates.

C. Placement:
   1. Keep excavation dry during backfilling operations.
   2. Bring up backfill evenly on all sides around structures.
   3. Compact fill to the degree and within the moisture content specified in Paragraph 3.7.I of this Section.

D. Backfill Against Concrete:

1. Do not differ the levels of backfill against concrete walls by more than 2 feet on either side of walls unless walls are adequately braced.

E. Thickness of Lifts: Unless otherwise specified or required, place fill in horizontal loose lifts not exceeding 9 inches in thickness and mix and spread in a manner assuring uniform lift thickness after placing.

F. Moisture:

1. Control the water content of fill material during placement within the range necessary to obtain the compaction specified.
2. In general, maintain the moisture content of the fill within 2 percent of the optimum moisture content for compaction as determined by laboratory tests.
3. Perform all necessary work to adjust the water content of the material to within the range necessary to permit the compaction specified.
4. Do not place fill material when free water is standing on the surface of the area where the fill is to be placed.
5. No compaction of fill will be permitted with free water on any portion of the fill to be compacted.

G. Unacceptable Material:

1. Do not place or compact fill in a frozen condition or on top of frozen material.
2. Remove fill containing organic materials or other unacceptable material and replace with approved fill material.

H. Equipment:

1. Compact fill with equipment suitable for the type of material placed and which is capable of providing the densities required.
2. Select compaction equipment and submit it and proposed procedure to the ENGINEER for approval.

I. Compaction Criteria:

1. General backfill shall be compacted to at least 90 percent of the maximum modified Proctor dry unit weight as achieved by ASTM D 1557.
2. The backfill shall be compacted with a moisture content within +2 percent of the optimum moisture content.

J. Tests:

1. Test the effectiveness of the equipment at the commencement of compacted fill Work by construction of a small section of fill within the area where fill is to be placed.
2. If tests on this section of fill show that the specified compaction is not obtained, increase the amount of coverages, decrease the lift thickness or obtain a different type of compactor.
3. No additional cost to the OWNER shall be incurred.

K. Backfill around Structures:

1. Follow the specified procedures for backfill around structures except that within 2 feet of foundations and underground structures, use light compaction equipment with the gross weight of the equipment not exceeding 7,000 pounds.
2. Provide equipment that is capable of the required compaction within restricted areas next to structures and around piping.

L. Inadequate Compaction:

1. If the specified densities are not obtained because of improper control of placement or compaction procedures, or because of inadequate or improperly functioning compaction equipment, perform whatever work is required to provide the required densities.
2. This work includes complete removal of unacceptable fill areas and replacement and recompaction until acceptable fill is provided.

M. Settlement:

1. Repair any settlement that occurs, at CONTRACTOR'S expense.

2. Make all repairs and replacements necessary within 30 days after notice from the ENGINEER or OWNER.

3.8 SELECT BACKFILL

A. General: Furnish, place and compact all select backfill and fill required as shown and described herein.

B. Restrictions:
   1. Make subgrade surface level, dry, firm and subject to CONTRACTOR'S approval.
   2. Do not place fill if any water is on the surface of area to receive fill.
   3. Do not place or compact fill in a frozen condition or on top of frozen material.

C. Thickness of Lifts:
   1. Place fill in horizontal loose lifts of 9 inches maximum thickness.
   2. Mix and spread in a manner to assure uniform lift thickness after placing.
   3. Compact each layer of fill before placement of the next lift.

D. Unacceptable Material:
   1. Do not place fill containing lumps or pockets of soil. Fill material containing rubble, debris, wood or other organic matter is not acceptable.
   2. Remove and dispose of fill containing unacceptable material.

E. Moisture:
   1. The water content of the fill being compacted shall be within the range of plus or minus 2 percentage points from the optimum moisture content of the material.
   2. Wet the fill materials during placement to achieve water contents needed for effective compaction.

F. Equipment:

1. Perform compaction of fill with equipment suitable for the type of fill material being placed.
2. Select equipment which is capable of providing the densities required and submit the equipment to the ENGINEER for review.
3. Vibratory rollers or vibratory plate compactors are suitable for compaction of select fill.

G. Coverage:

1. Compact each layer of fill material by at least two complete coverages of all portions of the surface of each lift using suitable compaction equipment.
2. One coverage is defined as the condition reached when all portions of the fill lift have been subjected to the direct contact of the compacting surface of the compactor.

H. Compaction:

1. The minimum density to be obtained in compacting the selected backfill or fill below the footing foundation shall be 95 percent of the maximum modified Proctor dry unit weight obtained in the laboratory in accordance with ASTM D 1557, Method C.
2. If the field and laboratory tests indicate unsatisfactory compaction, provide the additional compaction necessary to obtain the specified degree of compaction.

I. Disturbed Materials:

1. Provide, place and compact select fill necessary to replace subgrade materials disturbed and softened as a result of the CONTRACTOR'S operations or to backfill unauthorized excavation.
2. Furnish additional fill at CONTRACTOR'S expense.

3.9 GRADING

A. General:

1. Uniformly grade areas within limits of grading under this Section, including adjacent transition areas.
2. Smooth subgrade surfaces within specified tolerances.
3. Compact with uniform levels or slopes between points where elevations are shown, or between such points and existing grades.

3.10 DISPOSAL OF EXCAVATED MATERIALS

A. Excess Material:

1. Following testing, all excess material removed from the excavations will be disposed of off the site in accordance with EPA, state and local regulations.

END OF SECTION

SECTION 2H6

PRE-CAST MANHOLES

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope: CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish and install all precast.

B. General:

1. Manholes shall conform in shape, size, dimensions, material, and other respects to the details shown or as ordered by ENGINEER.
2. Cast-iron frames, grates and covers shall be the standard frame and grate or cover.

C. Related Sections:

1. Division 2 Sections on Earthwork.
2. Section 3K, Concrete.
3. Division 15 Sections on Piping.

1.2 QUALITY ASSURANCE

A. Reference Standards:

1. ASTM C 478, Specification for Precast Reinforced Concrete Manhole Sections.

1.3 SUBMITTALS

A. Shop Drawings: Submit for approval the following:

1. Drawings showing design and construction details of all precast concrete including details of joints between the manhole bases and riser sections and stubs or openings for the connection of sewers.

PART 2 - PRODUCTS

2.1 PRECAST CONCRETE MANHOLES

A. Precast manholes shall conform to the details shown. Provide cast in-place concrete bases where shown.

B. Except where otherwise specified precast manhole components shall consist of reinforced concrete pipe sections especially designed for manhole construction and manufactured in accordance with ASTM C 478 except as modified herein.

C. Precast reinforced concrete manhole bases, riser sections, flat slabs and other components shall be manufactured by wet cast methods only, using forms which will provide smooth surfaces free from irregularities, honeycombing or other imperfections.

D. Joints between manhole components shall be the tongue and groove type employing a single, continuous rubber O-ring gasket and shall conform to AWWA C 302. The circumferential and longitudinal steel reinforcement shall extend into the bell and spigot ends of the joint without breaking the continuity of the steel. Joints between the base sections, riser sections and top slabs of manholes 72 inches in diameter and less shall be rubber and concrete joints. Joints for manhole components greater than 72 inches in diameter shall be provided with steel bell and spigot rings.

E. All precast manhole components shall be of approved design and of sufficient strength to withstand the loads-imposed upon them. They shall be designed for a minimum earth cover loading of 130 pounds per cubic foot, an H-20 wheel loading, and an allowance of 30 percent in roadways and 15 percent in rights-of-way for impact. Manhole bases shall have two

cages of reinforcing steel in their walls, each of the area equal to that required in the riser sections. Wall thickness shall not be less than S inches. Concrete top slabs shall not be less than 8-inches thick.

F. Lifting holes, if used in manhole components, shall be tapered, and no ore than two shall be cast in each section. Tapered, solid rubber plugs shall be furnished to seal the lifting holes. The lifting holes shall be made to be sealed by plugs driven from the outside face of the section only.

G. The point of intersection (P.I.) of the sewer pipe centerlines shall be marked with 1/4-inch diameter steel pin firmly enclosed in the floor of each manhole base and protruding approximately 1-inch above the finished floor of the base.

H. Mark date of manufacture and name or trademark of manufacturer on inside of barrel.

I. The barrel of the manhole shall be constructed of various lengths of riser pipe manufactured in increments of one foot to provide the correct height with the fewest joints. Openings in the barrel of the manholes for sewers or drop connections will not be permitted closer than one foot from the nearest joint. Special manhole base or riser sections shall be furnished as necessary to meet this requirement.

J. A precast or cast-in-place slab or precast eccentric cone, as shown or approved, shall be provided at the top of the manhole barrel to receive the cast iron frame and cover.

K. Manhole sections shall contain manhole steps, 12 inches on centers, accurately positioned and embedded in the concrete.

2.3 MISCELLANEOUS METALS

A. Metal frames, covers, steps, toe pockets and similar required items shall be provided as shown and in accordance with Division 5 Sections on Metal Fabrications.

2.4 DROP CONNECTIONS

A. Drop connections for manholes shall be constructed where shown and shall conform to the design and details shown. Pipe and fittings shall be ductile iron as shown or otherwise approved.

PART 3 - EXECUTION

3.1 MANHOLE BASES

A. Precast bases shall be set on a crushed stone or crushed gravel foundation as shown. Precast bases shall be set at the proper grade and carefully leveled and aligned.

3.2 PRECAST MANHOLE SECTIONS

A. Set sections vertical with steps and sections in true alignment. The base of the bell or groove end at joints between components shall be buttered with 1:2 cement-sand mortar to provide a uniform bearing between components. All joints shall be sealed with cement mortar inside and out and troweled smooth to the contour of the wall surface. Raised or rough joint finishes will not be accepted.

B. Install sections, joints and gaskets in accordance with manufacturers recommendations.

C. Lifting holes shall be sealed tight with a solid rubber plug driven into hole from the outside of the barrel and the remaining void filled with 1 to 2 cement-sand mortar.

3.3 MANHOLE CHANNELS

A. All invert channels through manholes shall be constructed of Class A concrete. Channels shall be properly formed to the sizes, cross sections,

grades and shapes shown on the drawings or as ordered. Benches shall be built up to the heights shown or as ordered and given a uniform wood float finish. Care shall be taken to slope all benches for proper drainage to the invert channel.

3.4 GRADING RINGS

A. Grading rings or brick stacks shall be used for all precast manholes where required. Stacks or grade rings shall be a maximum of 12 inches in height, constructed on the roof slab or cone section on which the manhole frame and cover shall be placed. he height of the stack shall be such as is necessary to bring the manhole frame to the proper grade.

3.5 GRADING AT MANHOLES

A. Manholes in paved areas shall be constructed to meet the final surface grade. Manholes shall not project above finished roadway pavements to prevent damage from snowplows.

B. CONTRACTOR shall be solely responsible for the proper height of all manholes necessary to reach the final grade at all locations. CONTRACTOR is cautioned that ENGINEER's review of Shop Drawings for manhole components will be general in nature and CONTRACTOR shall provide an adequate supply of random length precast manhole riser sections to adjust any manhole height to meet fields conditions for final grading.

3.6 MANHOLE WATERTIGHTNESS

A. All manholes shall be free of visible leakage. Each manhole shall be tested for leaks and inspected, and all leaks shall be repaired in a manner subject to ENGINEER's approval.

3.7 FLEXIBLE PIPE JOINT AT MANHOLE BASE

A. An approved flexible joint shall be provided between each pipe entering and exiting manhole. This may be accomplished by the installation in the manhole base of the bell end of a pipe or by other means subject to approval of ENGINEERs. Joints shall be similar to the approved pipe joints. The joint into the manhole base shall be completely watertight.

END OF SECTION

SECTION 2I2

PAVEMENT

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown,- specified, and required to furnish and install hot mix-hot laid bituminous paving. For all existing pavement damaged by CONTRACTOR.
2. The Work includes permanent and temporary pavements comprised of one or more of the following:
   a. Aggregate base course.
   b. Tack coats.
   c. Binder course.
   d. Top course.
   e. Pavement marking.
3. Temporary pavement shall be placed as necessary to maintain continuous access to the parking lot and other locations on-site.
4. In order to prevent damage to the permanent pavement by CONTRACTOR's operations, all permanent pavement materials, including the aggregate base course, shall not be installed until approved in writing by ENGINEER. The finished course of paving shall not be installed until all structures, equipment, piping and outside facilities are substantially completed and at a time approved by ENGINEER.

B. Related Sections:

1. Section 2C, Demolition and Removals.
2. Section 2D1, Excavation and Backfill.

1.2 QUALITY ASSURANCE

A. Laboratory Approval: Laboratory approval of the sources of supply of the fine aggregates, coarse aggregates, mineral filler, bituminous materials, liquefiers and any other materials used in the mix shall be obtained and submitted by CONTRACTOR. No delivery or mixed materials shall be made from any bituminous mixing plant until the source of supply are approved.

1.3 SUBMITTALS

A. Shop Drawings: Submit for approval the following:

1. Job mix formula proposed, giving complete data on materials, including source, location, percentages, temperatures, date of last testing, and all other pertinent data.

1.4 JOB CONDITIONS

A. Weather Limitations:

1. Permanent paving materials, including the aggregate base course, shall be placed only when the air temperature is 40 degrees Fahrenheit and rising or warmer and the surface on which the paving is to be laid is 40 degrees Fahrenheit or higher. All temperatures are to be measured in the shade.
2. Bituminous pavement for temporary uses, that are not and will not become part of a permanent pavement, will not be subject to the above regulations in regard to weather limitations. No pavement, however, shall be laid on a frozen subgrade.

B. Grade Control: Establish and maintain the required lines and grades, including crown and cross-slope for each course during construction operations.

PART 2 - PRODUCTS

2.1 PAVEMENT THICKNESS

A. In-place compacted material thickness shall not be less than 6 inches.

2.2 MATERIALS

A. Materials shall conform to the following:

1. Subgrade shall be virgin material or select fill conforming to the requirements of Section 2D1, Excavation and Backfill.
2. Base Courses:
   a. Aggregate for permanent pavement base course shall consist of crushed stone conforming to the following gradation:

Screen Size	% Passing
1-1/2-in	100
1-in	100
1/2-in	65-85
3/8-in	55-75
#4	40-55
#8	30-45
#16	22-36
#30	16-27
#50	12-19
#100	7-13
#200	3-8

3. Pavement:

a. Permanent: Provide a two course wearing surface for permanent pavement, consisting of a binder course and a top course.

b. Temporary: Provide a one course wearing surface for temporary pavement, consisting of a top course as specified above.

4. Tack Coat: Tack coat shall be an asphalt emulsion.

PART 3 - INSPECTION

3.1 GENERAL

A. Installation of all pavement materials and pavement markings shall be performed by experienced personnel.

B. Preparing the mixtures, paving equipment, placing the mixes, and compacting the mixes shall be in accordance with below.

1. Preparing the mixtures includes the plant equipment, stockpiling, heating, aggregate processing, mixing of aggregate and bituminous material, and transportation to job site.
2. Paving equipment includes bituminous pavers, rolling equipment and hand tools.
3. Placing the mixes includes paver placing, hand placing, spreading, tamping and jointing.
4. Compacting the mixes includes breakdown rolling, second rolling and finish rolling.

C. Regardless of the type of temporary or permanent restoration involved, CONTRACTOR shall insure that all castings are set flush with the road surface. CONTRACTOR is advised that there shall be no placement of bituminous concrete top course until:

1. Manholes have been constructed to their final elevation.
2. Defective areas of the binder course have been repaired.

D. Provide final surfaces of uniform texture, conforming to required grades and cross sections.

3.2 SUBGRADE PREPARATION

A. Permanent Pavement: Preparation of the permanent pavement subgrade including compaction shall be completed for the full width of the surface.

1. Fine grade earth subgrade and compact with self-powered rollers of sufficient size to provide a firm, unyielding surface to receive the aggregate base course. Remove and replace all unsuitable subgrade material as directed by ENGINEER.
2. Where the subgrade is constructed by excavation of the existing grade, the top 6-inches of the subgrade shall be compacted to at least 95 percent of maximum density at optimum moisture content as determined in ASTM D 698.
3. When the subgrade is constructed on fill:
   a. Existing grade shall be made smooth and compacted per Section 3.2.A.2.
   b. Subgrade shall be brought to the appropriate lines and grades utilizing select backfill placed in accordance with the applicable requirements of Section 2D1, Excavation and Backfill.
4. Existing grades prior to placement of subbase or backfill shall be established such that when materials for construction are placed no rutting or displacement will occur.

B. Temporary Pavement: Subgrade shall be compacted with a ten ton roller or other approved method.

C. No materials, temporary or permanent, shall be placed on subgrades which are muddy or have water thereon.

3.3 PERMANENT PAVEMENT BASE COURSE INSTALLATION

A. Construct base course to thickness specified in equal layers not more than three inches (compacted) thick. If subgrade material is worked into the base material during compaction or finishing operations, remove the aggregate over this area and replace with new aggregate.

B. Compact each layer with a power driven roller weighing not less than ten tons in an approved manner with the aid of water. Before mixing and spreading the base material, the moisture content shall be both sufficient to prevent segregation into pockets of fine and coarse material, and to permit satisfactory compaction. Add water as required.

C. After compaction, the top surface of this course shall not extend above, nor more than 1/2-inch below true grade and surface at any location. Depressions shall be filled with additional aggregate material and the surface rerolled. Base course shall be maintained by CONTRACTOR within the 1/2-inch tolerance until the pavement course is installed.

3.4 PAVEMENT INSTALLATION

A. Contact surfaces of all curbings, gutters, castings and adjacent pavement edges shall be painted with a layer of tack coat before placing or repairing the pavement course.

B. Bituminous concrete shall be constructed to thicknesses specified and rolled with 12 ton self powered two axle or three axle tandem or three wheel roller to a density of 94 percent of maximum.

C. Pavement shall be uniform in appearance, free of bumps and hollows, worked to drain, and free of bleeding.

D. Trim the existing pavement with pneumatic chisels of all loose edges and broom and tack coat all edges prior to placing the transition pavement.

E. In placing and compacting abutting courses of bituminous concrete pavements, joint heating devices shall be used on all joints (transverse, longitudinal and existing).

F. Bituminous pavement shall match in thickness the existing pavement and shall butt with the pavement in a smooth, even transition.

G. Test bituminous pavement for conformity with the specified crown and grade immediately after initial compression. Correct variations by the removal or additional of materials and by continuous rolling.

H. The finished surface shall not vary more than 1/4-inch when tested with a 16-ft straightedge applied parallel with, or at right angles to, the centerline.

I. After final rolling, again test the smoothness of the course. Correct humps or depressions exceeding the specified tolerances or that retain water on the surface by removing the defective work and replacing with new material.

3.6 TEMPORARY PAVEMENT OVER TRENCHES

A. Bituminous concrete plant mix to be utilized for temporary pavement over trenches, as required, shall conform to the requirements for the top course Type La plant mix.

B. Trenches for utility work within existing paved areas-shall receive temporary pavement. Temporary pavement shall be furnished, installed and maintained by each CONTRACTOR performing such trench work. The ENGINEER shall determine the limits of temporary pavement to be installed over these trenches.

C. After the trench has been properly backfilled, excavation shall be made over the trench area and the sub-grade compacted by rolling with a ten ton roller or other approved methods, so as to permit the placing of a one and one-half inch (1-1/2") compacted thickness of bituminous concrete. The sub-grade shall not be in a muddy or frozen condition and shall be smooth and parallel to the desired surface of the finished pavement. Compaction of this 1-1/2" minimum thickness bituminous concrete shall be as specified herein.

3.7 PATCHING

A. Remove and replace all defective areas in temporary and permanent pavements. Cut-out such areas and fill with fresh Type La bituminous concrete top course as specified. Compact to the required density.

3.8 CLEANING AND PROTECTION

A. After completion of paving operations, clean surfaces of excess or spilled bituminous materials and all foreign matter.

B. Protect newly finished pavement until it has become properly hardened by cooling.

C. During the paving operation cover openings of drainage structures in the area of paving.

3.9 MAINTENANCE AND ACCEPTANCE

A. CONTRACTOR shall maintain all paved surfaces until the roads and parking areas have been accepted. Paved areas will not be accepted until after CONTRACTOR has completed all phases of the work, including all necessary transportation, hauling and severe usage of the paved areas. ENGINEER shall be the sole judge in this matter.

END OF SECTION

SECTION 02225

TRENCHING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Excavating trenches for utilities.

B. Compacted fill from top of utility bedding to subgrade elevations.

C. Backfilling and compaction.

1.2 RELATED SECTIONS

A. Document [_____-_____]: Geotechnical report; bore hole locations and findings of subsurface materials.

B. Section 01025 - Measurement and Payment: Requirements applicable to unit prices for the work of this section.

C. Section 01400 - Quality Control Testing: fill compaction.

D. Section 01560 - Temporary Controls: Water control in excavations.

E. Section 02510 - Asphaltic Concrete Paving.

F. Section 15410 - Plumbing Piping.

G. Section 16111 - Conduit.

1.3 UNIT PRICE - MEASUREMENT AND PAYMENT

A. Excavating Subsoil Materials: By the cubic foot. Includes excavating to required elevations, loading and placing materials in stockpile. Over Excavating: Payment is not made for over excavated work nor for replacement materials.

B. Aggregate Bedding Materials: By the cubic foot. Includes supplying fill material, stockpiling, placing where required, and compacting.

1.4 REFERENCES

A. AASHTO M147 - Materials for Aggregate and Soil-Aggregate.

B. AASHTO T180 - Moisture-Density Relations of Soils Using a 10-lb (4.54 kg) Rammer and an 18-in. (457 mm) Drop.

C. ASTM C136 - Method for Sieve Analysis of Fine and Coarse Aggregates.

D. ASTM D698 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures, Using 5.5 lb (2.49 Kg) Rammer and 12 inch (304.8 mm) Drop.

E. ASTM D1557 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10 lb (4.54 Kg) Rammer and 18 inch (457 mm) Drop.

F. ASTM D2167 - Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.

G. ASTM D2922 - Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

H. ASTM D3017 - Test Methods for Moisture Content of Soil and Soil-Aggregate Mixtures.

1.5 DEFINITIONS

A. Utility: Any buried pipe, duct, conduit, or cable.

1.6 FIELD MEASUREMENTS

A. Verify that survey bench mark, control point, and intended elevations for the Work are as shown on drawings.

1.7 COORDINATION

A. Coordinate work under provisions of Section 01041.

B. Verify work associated with lower elevation utilities is complete before placing higher elevation utilities.

1.8 SUBMITTALS FOR REVIEW

A. Section 01300 - Submittals: Procedures for submittals.

B. Samples: Submit, in air-tight containers, 10 lb (4.5 kg) sample of each type of fill to testing laboratory.

1.9 SUBMITTALS FOR INFORMATION

A. Section 01300 - Submittals: Procedures for submittals.

B. Materials Source: Submit name of imported materials suppliers.

1.10 QUALITY ASSURANCE

A. Perform Work in accordance with State of Rhode Island Public Works' standards. Maintain one copy on site.

PART 2 PRODUCTS

2.1 AGGREGATE BEDDING MATERIALS

A. Aggregate (Pea Gravel): Natural stone; free of clay, shale, organic matter; graded in accordance with ASTM C136 to the following limits:
   1. Minimum Size: 1/4 inch (6 mm)
   2. Maximum Size: 5/8 inch (16 mm)

B. Fine Aggregate (Sand): Natural river or bank sand; free of silt, clay, loam, friable or soluble materials, and organic matter; graded in accordance with ASTM C136; within the following limits:

Sieve Size	Percent Passing
No. 4 (4.75 mm)	100
No. 14 (1.40 mm)	10 to 100
No. 50 (300 micro m)	5 to 90
No. 100 (150 micro m)	4 to 30
No. 200 (75 micro m)	0

2.2 ACCESSORIES

A. Geotextile Fabric: Non-biodegradable non-woven, manufactured by [_____].

2.3 SOURCE QUALITY CONTROL

A. Section 01400 - Quality Control: Source testing and analysis of aggregate material.

B. Coarse Aggregate Material - Testing and Analysis: Perform in accordance with ASTM C136.

C. Fine Aggregate Material - Testing and Analysis: Perform in accordance with ASTM C136.

C. If tests indicate materials do not meet specified requirements, change material or material source and retest.

D. Provide materials of each type from same source throughout the Work.

PART 3 EXECUTION

3.1 PREPARATION

A. Identify required lines, levels, contours, and datum locations.

B. Protect plant life and other features remaining as a portion of final landscaping.

C. Protect bench marks, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.

D. Maintain and protect above and below grade utilities which are to remain.

3.2 EXCAVATING

A. Excavate subsoil required for utilities.

B. Cut trenches sufficiently wide to enable installation and allow inspection. Remove water or materials that interfere with Work.

C. Do not interfere with 45 degree bearing splay of foundations.

D. Hand trim excavation. Remove loose matter.

E. Remove lumped subsoil, boulders, and rock up to 1/3 cu yd (0.25 cu m), measured by volume.

F. Correct areas over excavated.

3.3 STOCKPILING

A. Stockpile materials on site at locations designated by the Engineer.

B. Stockpile in sufficient quantities to meet Project schedule and requirements.

C. Separate differing materials with dividers or stockpile apart to prevent mixing.

D. Direct surface water away from stockpile site so as to prevent erosion or deterioration of materials.

E. Stockpile excavated material in area designated on site and remove excess material not being used from site.

3.4 STOCKPILE CLEANUP

A. Remove stockpile, leave area in a clean and neat condition. Grade site surface to prevent free standing surface water.

3.5 BACKFILLING

A. Backfill trenches to contours and elevations with unfrozen fill materials.

B. Systematically backfill to allow maximum time for natural settlement. Do not backfill over porous, wet, frozen, or spongy subgrade surfaces.

C. Place geotextile fabric prior to placing fill.

D. Aggregate Bedding Material: Place and compact materials per Contract Drawings in equal continuous layers not exceeding 8 inches (200 mm) compacted depth.

E. Asphaltic Concrete: Place as specified in Section 02510.

F. Employ a placement method that does not disturb or damage foundation perimeter drainage, and utilities in trench.

G. Maintain optimum moisture content of fill materials to attain required compaction density.

H. Remove surplus fill materials from site.

I. Leave fill material stockpile areas completely free of excess fill materials.

3.6 TOLERANCES

A. Top Surface of Backfilling Under Paved Areas: Plus or minus 1 inch (25 mm) from required elevations.

B. Top Surface of General Backfilling: Plus or minus 1 inch (25 mm) from required elevations.

3.7 FIELD QUALITY CONTROL

A. Section 01400 - Quality Assurance: Field inspection and testing.

B. Compaction testing will be performed in accordance with ASTM D2922.

C. If tests indicate Work does not meet specified requirements, remove Work, replace, compact, and retest.

D. Frequency of Tests: One per 25 linear feet of trench.

3.8 PROTECTION OF FINISHED WORK

A. Protect finished Work under provisions of Section 01560.

B. Reshape and re-compact fills subjected to vehicular traffic during construction.

3.9 SCHEDULE

A. Water Extraction and Water Service.
   1. Cover pipe and bedding with excavated materials, in 8-inch (200 mm) lifts, compacted to 90 percent.

B. Conduit:
   1. Cover conduit and bedding with excavated materials to subgrade elevation compacted to 90 percent.

END OF SECTION

SECTION 02851

STEEL GUARDRAIL

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Steel guardrail and steel posts for protection of aboveground Thermal Oxidation Unit and gas service appurtenances as indicated on the Drawings.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

A. Guardrail:
   1. Basis of Measurement: By the linear foot (meter).
   2. Basis of Payment: Includes rail, accessories, end closures, finished.

B. Intermediate Posts:
   1. Basis of Measurement: By the unit.
   2. Basis of Payment: Includes posts and driving posts.

C. Terminal Anchor Posts:
   1. Basis of Measurement: By the unit.
   2. Basis of Payment: Includes driving posts, anchors, and posts.

1.3 REFERENCES

A. AASHTO M180 - Corrugated Sheet Steel Beams for Highway Guardrail.

B. ANSI/ASTM A123 - Zinc (Hot Dip Galvanized) Coatings on Iron and Steel Products.

C. ASTM A36 - Structural Steel.

D. ASTM A153 - Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

E. ASTM A428 - Weight of Coating on Aluminum-Coated Iron or Steel Articles.

F. ASTM A500 - Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Round and Shapes.

G. ASTM A501 - Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.

1.4 SYSTEM DESCRIPTION

A. Guardrail Height: As indicated.

B. Post Spacing: As indicated.

C. Post Depth: As indicated.

1.5 SUBMITTALS

A. Shop Drawings: Indicate plan layout, spacing of components, anchorage, and schedule of components.

B. Product Data: Provide data on rail, posts, accessories, hardware and structural capabilities of rail section.

C. Manufacturer's Installation Instructions: Indicate installation requirements.

1.6 REGULATORY REQUIREMENTS

A. Conform to applicable code for rail height or location restrictions.

1.7 FIELD MEASUREMENTS

A. Verify that field measurements are as indicated on drawings.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. [_____] Product [_____].

B. [_____] Product [_____].

C. [_____] Product [_____].

2.2 MATERIALS

A. Guardrail Beam: ASTM A36 rolled steel sections, "W" profile, [____] inch ([____] mm) thick, [____] inch ([____] mm) high, die punched bolt holes for site assembly and attachment to posts, formed steel curved and flared termination sections.

B. Steel Posts: ASTM A36 structural steel sections, [__x__] inch ([__x__] mm) [size] [diameter], [____] inch ([____] mm) wall thickness.

2.3 ACCESSORIES

A. Hardware: Steel, bolts, nuts and washers to suit rail profile.

2.4 FINISHES

A. Components: Galvanized to ANSI/ASTM A123; 2.0 oz/sq ft (600 g/sq m) coating.

B. Hardware: Galvanized to ASTM A153, 2.0 oz/sq ft (600 g/sq m) coating.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install rails and posts and accessories in accordance with manufacturer's instructions.

B. Drive posts plumb to correct elevations.

C. Attach rails securely to posts with anchoring hardware.

3.2 ERECTION TOLERANCES

A. Posts - Maximum Variation From Plumb: 1/2 inch (12 mm).

B. Rail - Maximum Offset From True Position: 1 inch (25 mm).

C. Rail - Maximum Variation From True Height: 1/2 inch (12 mm).

D. Components shall not infringe on adjacent property lines.

END OF SECTION

SECTION 02671

EXTRACTION WELLS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Drilling and casing water well.

B. Pump and controller.

C. Water and system testing and certification.

1.2 RELATED SECTIONS

A. Section 02225 - Trenching: Excavating for conduit and pipe from well head to building.

B. Section 02225 - Trenching: Backfilling for conduit and pipe from well head to building.

C. Section 11210 - Pumps.

D. Section 15410 - Plumbing Piping.

E. Section 16111 - Conduit.

1.3 REFERENCES

A. ASME SEC. VIII - Pressure Vessels.

B. ASTM A53 - Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless.

C. ASTM A120 - Pipe, Steel, Black and Hot-Dipped, Zinc Coated (Galvanized) Welded and Seamless, for Ordinary Uses.

D. AWWA C900 - Standard for Polyvinyl Chloride (PVC) Pressure Pipe, 4 inch through 12 inch, for Water.

1.4 SYSTEM DESCRIPTION

A. Four existing extraction wells (VE-1, VE-2, VE-3 and MW-14S) will be used. The wells will be constructed or modified to have a pipe, as specified by the Contract

Drawings, connected directly onto the well riser (casing) which will be used to extract soil gases by applying vacuum, generated in an air vacuum tank, to the unsaturated zone soils. Each well riser will be fitted with a vacuum gauge for measurement of the vacuum level applied to the well.

B. Each well will have a coaxial water extraction straw, as specified by the Contract Drawings, adjusted to the desired water level in the well and connected to a water vacuum tank, via a water extraction manifold, for groundwater extraction. An intrinsically-safe water level sensor/switch will be installed into each well to provide a control signal to the water vacuum manifold solenoid valve, to control the water extraction rate and water level in the well.

C. The extraction wells are screened through the unsaturated zone into the saturated zone. These wells will be able to extract contaminated groundwater and soil gas. Free-phase toluene product is not anticipated to be recovered.

1.5 PERFORMANCE REQUIREMENTS

A. Capable of producing a minimum 5 gallons per minute (gpm) of contaminated groundwater.

B. Capable of extracting a minimum 250 actual cubic feet per minute (ACFM) (188 standard (CFM)) of soil vapor at 8 inches Hg vacuum.

1.6 SUBMITTALS

A. Product Data: Include data indicating rated capacities, accessories, electrical nameplate data, and wiring diagrams.

B. Manufacturer's Installation Instructions: Assembly, and installation instructions.

1.7 QUALITY ASSURANCE

A. Perform Work in accordance with [_____.]

B. Submit proof of state license to perform this work.

1.8 SEQUENCING

C. Sequence Work to occur before placement of water and vapor extraction piping to building.

PART 2 PRODUCTS

2.1 MATERIALS

A. Well Cap: (*material*): requirements and dimensions.

B. Water Extraction Straw ( ):

C. Water Level Sensor/Switch:

D. Soil Gas Extraction Pipe ( ):

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify site conditions under provisions of Section 01041.

3.2 PREPARATION

A. Protect structures near the well from damage.

3.3 INSTALLATION

A. Well Cap Installation

B. Water Straw Installation

C. Install level sensor/switch in accordance with manufacturer's instructions.

D. Soil Gas Pipe Installation.

E. Electrical Connections: Refer to Section 16111.

3.4 TOLERANCES

A. Maximum Variation From Plumb: not to exceed 2/3 of casing diameter per 100 feet (30 m) of well depth.

B. Maximum Offset From True Position: 1 inch (25 mm).

3.5 PERFORMANCE TESTING

A. Notify Engineer 3 days prior to flow rate testing.

B. Test flow rate and certify.

END OF SECTION

SECTION 3I

GROUT

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified and required to furnish and install grout.
2. Grout shall be placed at the following locations:
   a. Column and beam bearing.
   b. Equipment bases.
   c. Handrails and railings.
   d. Construction joints.
3. The types of grout include the following:
   a. Non-shrink, epoxy type.
   b. Non-shrink, non-metallic type.
   c. Ordinary cement-sand.

B. Classes of Ordinary Cement Type Grout:

1. Class "A" ordinary cement type grout shall have a compression strength of 4000 PSI and include the following:
   a. Foundation grout.
   b. Construction joint grout.
2. Class "B" ordinary cement type grout shall have a compression strength of 3000 PSI and include the following:
   a. Masonry lintels, bond beams, and pilasters grout fill.

C. Related Sections:

1. Section 3B, Concrete Joints.
2. Section D, Cast-in-Place Concrete.
3. Section 4A, Mortar (grout for masonry work).

4. Section 5A1, Structural Steel.
5. Section 5E10, Aluminum Handrails and Railings.

1.2 QUALITY ASSURANCE

A. Reference Standards: Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.
   1. ASTM C 144, Aggregate for Masonry Mortar.
   2. ASTM C 150, Portland Cement.
   3. ASTM C 109, Compressive Strength of Hydraulic Cement Mortars (using 2-in. or 50 mm. Cube Specimens)
   4. ASTM C 191, Time of Setting of Hydraulic Cement by Vicar Needle.
   5. CRD-C-588, Specifications for Non-Shrink Grout.
   6. CRD-C-619, Specification for Grout Fluidifier.

1.3 SUBMITTALS

A. Shop Drawings: Submit for approval the following:
   1. Manufacturer's specifications and installation instructions for all proprietary materials.
   2. For ordinary cement grout, submit copies of grout design mix and laboratory test reports for grout strength tests.

B. Reports and Certificates:
   1. For proprietary materials, submit copies of reports on quality control tests.
   2. For nonproprietary materials, submit certification that materials meet specification requirements.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Delivery of Materials: Grout materials from manufacturers shall be delivered in unopened containers and shall bear intact manufacturer's labels.

B. Storage of Materials: Grout materials shall be stored in a dry shelter and shall be protected from moisture.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Non-metallic, 100 percent solids, high strength epoxy grout.
   1. Use clean well graded sand with epoxy resins suitable for use on dry or damp surfaces.
   2. Product and Manufacturer: Provide one of the following:
      a. Euco High Strength Grout by The Euclid Chemical Company.
      b. Sikadur 42 Grout by Sika Chemical Company.
      c. Five Star Epoxy Grout by U.S. Grout Corporation.

B. Non-Shrink, Non-Metallic Grout:
   1. Pre-mixed non-staining cementitious grout requiring only the addition of water at the jobsite.
   2. Product and Manufacturer: Provide one of the following:
      a. Euco N-S by The Euclid Chemical Company.
      b. Masterflow 713 by Master Builders Company.
      c. Sika Grout 212 by Sika Chemical Company.

C. Ordinary Cement-Sand Grout: Prepare design mixes of ordinary cement grout. Mixes subject to the following limitations:
   1. Cement:
      a. Portland cement, ASTM C150, Type II; or blended hydraulic cement, ASTM C595, Type 1P.
   2. Aggregates: ASTM C33 and as herein specified.
      a. Do not use aggregates containing soluble salts or other substances such as iron sulfides, pyrite, marcasite, ochre, or other materials that can cause stains on exposed concrete surfaces.
      b. Fine Aggregate: Clean, sharp, natural sand free from loam, clay, lumps or other deleterious substances.

1) Dune sand, bank run sand and manufactured sand are not acceptable.

c. Coarse Aggregate: Clean, uncoated, processed aggregate containing no clay, mud, loam, or foreign matter, as follows:

1) Crushed stone, processed from natural rock or stone.

2) Washed gravel, either natural or crushed. Use of slag and pit or bank run gravel is not permitted.

3) Coarse Aggregate Size: Size to be ASTM C33, Nos. 7 for Class "B" grout. Coarse aggregate <u>not</u> permitted in Class "A" grout.

3. Admixtures: Provide admixtures produced by established reputable manufacturers, and use in compliance with the manufacturer's printed instruction. Do not use admixtures, which have not been incorporated and tested in the accepted mixes, unless otherwise authorized in writing by ENGINEER. Refer to Section 3D for additional admixtures requirements.

4. Proportioning and Design of Mixes: Prepare design mixes for each glass of grout. Mixes subject to the following limitations:

a. Class "A" Grout:

1) Specified 28-day Compressive Strength: 4,000 psi.

2) Maximum Water-Cement Ratio by Weight: 0.45.

3) Fine Aggregate meeting ASTM C33.

4) Air Content Percentage: $9 \pm 1\%$.

5) Minimum Cement Content in Pounds per Cubic Yard: 658.

b. Class "B" Grout:

1) Specified 28-day Compressive Strength: 3,000 psi.

2) Maximum Water-Cement Ratio by Weight: 0.50.

3) Fine and Coarse Aggregate (No. 7) meeting ASTM C33.

4) Air Content Percentage: $7 \pm 1\%$.

5) Minimum Cement Content in Pounds per Cubic Yard: 611.

5. Use an independent testing company acceptable to the ENGINEER for preparing and reporting proposed mix designs.

a. The testing company shall not be the same as used for field quality control testing unless approved by the ENGINEER.

6. Proportion mixes by either laboratory trial batch or field experience methods, using materials to be employed on the Project for grout required. Comply with ACI 211.1 and report to the ENGINEER the following data:
   a. Complete identification of aggregate source of supply.
   b. Tests of aggregates for compliance with specified requirements.
   c. Scale weight of each aggregate.
   d. Absorbed water in each aggregate.
   e. Brand, type and composition of cement.
   f. Brand, type and amount of each admixture.
   g. Amounts of water used in trial mixes.
   h. Proportions of each material per cubic yard.
   i. Gross weight and yield per cubic yard of trial mixtures.
   j. Measured slump.
   k. Measured air content.
   l. Compressive strength developed at 7 days and 28 days, from not less than 3 test specimens cast for each 7-day and 28-day test, and for each design mix.
7. Submit written reports to the ENGINEER of proposed mix of grout at least 30 days prior to start of Work. Do not begin grout production until mixes have been approved by the ENGINEER.
8. Laboratory Trial Batches: When laboratory trial batches are used to select grout proportions, prepare test specimens and conduct strength tests as specified in ACI 301, Chapter 3 - Proportioning. However, 4,000 psi mixes need not be designed for greater than 3,400 psi, regardless of the production facilities standard deviation.
9. Field Experience Method: When field experience methods are used to select grout proportions, establish proportions as specified in ACI 301, Chapter 3.
10. Admixtures: Use air-entraining admixture in all grout. Provide not less than 4-1/2 percent nor more than 7-1/2 percent entrained air. Use amounts of admixtures as recommended by the manufacturer for climatic conditions prevailing at the time of placing. Adjust

quantities and types of admixtures as required to maintain quality control. Do not use admixtures which have not been incorporated and tested in the accepted design mix, unless otherwise authorized in writing by the ENGINEER.

11. Slump Limits: Proportion and design mixes to result in grout slump at the point of placement of not more than 5 inches.

D. Water:

1. Use clean, fresh, potable water free from injurious amounts of oils, acids, alkalies or organic matter.

PART 3 - EXECUTION

3.1 INSPECTION

A. CONTRACTOR and his installer shall examine the substrate and conditions under which grout is to be placed, and notify ENGINEER in writing of unsatisfactory conditions. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to ENGINEER.

3.2 INSTALLATION

A. General:

1. Place grout as shown and in accordance with manufacturer's instructions. If manufacturer's instructions conflict with the Specifications do not proceed until ENGINEER provides clarification.
2. Drypacking will not be permitted.
3. Manufacturers of proprietary products shall make available upon 72 hours notification the services of a qualified, full time employee to aid in assuring proper use of the product under job conditions.
4. Placing grout shall conform to temperature and weather limitations in Section 3D.

B. Columns, Beams and Equipment Bases:

1. After shimming equipment to proper grade, securely tighten anchor bolts. Properly form around the base plates, allowing sufficient room around the edges for placing the grout. Adequate depth between the bottom of the base plate and the top of concrete base must be provided to assure that the void is completely filled with the epoxy grout.
2. After shimming columns, beams and equipment to proper grade, securely tighten anchor bolts. Properly form around the base plates allowing sufficient room around the edges for placing the grout. Adequate depth between the bottom of the base plate and the top of concrete base must be provided to assure that the void is completely filled with the non-shrink, non-metallic grout.

C. Handrails and Railings:

1. After posts have been properly inserted into the holes or sleeves, fill the annular space between posts and sleeve with the non-shrink, non-metallic grout. Bevel grout at juncture with post so that moisture flows away from post.

D. Grout Fill Around Reinforcement in Masonry Work:

1. Provide ordinary Class "B" cement grout for grout fill in masonry lintels, bond beams and pilasters. Site mixing of grout is acceptable. Use of water-reducing admixture is not required.

END OF SECTION

SECTION 3K

CONCRETE

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish and install cast-in-place concrete reinforcement and related materials.

B. Coordination:

1. Review installation procedures under other Sections and coordinate the installation of items that must be installed in the concrete.

C. General:

1. Class "A" concrete shall be steel reinforced and includes the following:
   a. Cast-in-place manholes.
   b. Precast manholes.
   c. Other reinforced concrete structures.
2. Class "B" concrete shall be placed without forms or with simple forms, with little or no reinforcing, and includes the following:
   a. Concrete fill.
   b. Curbs and gutters.
   c. Sidewalks.
   d. Encasements, etc.
3. Steel Reinforcement: Includes bars, ties, supports and welded wire fabric.

1.2 QUALITY ASSURANCE

A. Source Quality Control:

1. Concrete Testing Service:
   a. CONTRACTOR shall employ acceptable testing laboratory to perform materials evaluation, testing and design of concrete mixes.
   b. CONTRACTOR's laboratory shall also evaluate concrete delivered to and placed at the site.
2. Certificates, signed by concrete producer and CONTRACTOR, may be submitted in lieu of material testing when acceptable to ENGINEER.
3. Quality Control: Perform sampling and testing during concrete placement, as follows:
4. Quality Control: CONTRACTOR's testing laboratory will perform sampling and testing during concrete placement, as follows:
   a. Sampling: ASTM C 172.
   b. Slump: ASTM 143, one test for each load at point of discharge.
   c. Air Content: ASTM C 31, one for each set of compressive strength specimens.
   d. Compressive Strength: ASTM C 39, one set for each 50 cubic yards or fraction thereof of each class of concrete; 1 specimen tested at 7 days, 2 specimens tested at 28 days.
      1) When the total quantity of concrete is less than 50 cubic yards, the strength tests may be waived by CONTRACTOR if field experience indicates evidence of satisfactory strength.
5. Report test results in writing to ENGINEER on same day tests are made.

B. Reference Standards: Comply with the applicable provisions and recommendations of the following, except as otherwise shown or specified.

1. ACI 301, Specifications for Structural Concrete for Building (includes ASTM Standards referred to herein except ASTM A 36).
2. ACI 347, Recommended Practice for Concrete Formwork.

3. ACI 304, Recommended Practice for Measuring, Mixing, Transporting, and Placing Concrete.
4. ACI 315, Manual of Standard Practice for Detailing Reinforced Concrete Structures.
5. ACI 305, Recommended Practice for Hot Weather Concreting.
6. ACI 306, Recommended Practice for Cold Weather Concreting.
7. ASTM A 36, Structural Steel.
8. Concrete Reinforcing Steel Institute, Manual of Standard Practice, include ASTM Standards referenced herein.

1.3 SUBMITTALS

A. Samples: Submit samples of materials as specified and may be requested by ENGINEER including names, sources and descriptions.

B. Shop Drawings: Submit for approval the following:

1. Copies of manufacturer's specifications with application and installation instructions for proprietary materials and items, including admixtures and bonding agents.
2. Drawings for fabrication, bending, and placement of concrete reinforcement. Comply with ACI 315, Chapters 1 thru 8. For walls, show elevations to a minimum scale of 1/4 inch to 1 foot. Show bar schedules, stirrup spacing, diagrams of bent bars, arrangements and assemblies, as required for the fabrication and placement of concrete reinforcement.
3. List of concrete materials and concrete mix designs proposed for use. Include the results of all tests performed to qualify the materials and to establish the mix designs in accordance with ACI 301, 3.9. Submit written report to ENGINEER for each proposed concrete mix at least 15 days prior to start of Work. Do not begin concrete production until mixes have been reviewed and are acceptable to ENGINEER. Mix designs may be readjusted when material characteristics, job conditions, weather, test results, or other circumstances warrant. Do not use revised concrete mixes until submitted to and accepted by ENGINEER.

C. Laboratory Test Reports: Submit copies of laboratory test reports for concrete cylinders, materials and mix design tests. ENGINEER'S review will be for general information only. Production of concrete to comply with specified requirements is the responsibility of SUBCONTRACTOR.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver concrete reinforcement materials to the site bundled, tagged and marked. Use metal tags indicating bar size, lengths, and other information corresponding to markings shown on placement diagrams.

B. All materials used for concrete must be kept clean and free from all foreign matter during transportation and handling and kept separate until measured and placed in the mixer. Bins or platforms having hard clean surfaces shall be provided for storage. Suitable means shall be taken during hauling, piling and handling to insure that segregation of the coarse and fine aggregate particles does not occur and the grading is not affected.

PART 2 - PRODUCTS

2.1 CONCRETE MATERIALS

A. Portland Cement: ASTM C 150, Type II.

B. Aggregates: ASTM C 33.
   1. Fine Aggregate: Clean, sharp, natural sand free from loam, clay, lumps or other deleterious substances. Dune sand, bank ran sand and manufactured sand are not acceptable.
   2. Coarse Aggregate: Clean, uncoated, processed aggregate containing no clay mud, loam or foreign matter, as follows:
      a. Crushed stone, processed from natural rock or stone.
      b. Washed gravel, either natural or crushed. Use of slag and pit or bank run gravel is not permitted.

C. Coarse Aggregate Size: Size to be ASTM C 33, Nos. 57 or 67, unless permitted otherwise by ENGINEER.

D. Water: Clean, drinkable.

E. Air-Entraining Admixture: AST C 260.

F. Water-Reducing Admixture: ASTM C 494. Only use admixtures which have been tested and accepted in mix designs.

2.2 FORM MATERIALS

A. Provide form materials with sufficient stability to withstand pressure of placed concrete without bow or deflection.

B. Exposed Concrete Surfaces: Acceptable panel-type to provide continuous, straight, smooth, as-cast surfaces. Use largest practical sizes to minimize form joints.

C. Unexposed Concrete Surfaces: Suitable material to suit project conditions.

D. Provide 3/4-inch chamfer at all exposed corners.

2.3 REINFORCING MATERIALS

A. Reinforcing Bars: ASTM A 615, Grade 60.

1. Bars noted on plans to be epoxy-coated shall be coated with Scotch-kote Brand Fusion Bonded Epoxy Coating 213 or 214 as manufactured by 3M, St. Paul Minnesota. Coating shall be applied to cleaned steel reinforcing bars by the electrostatic spray method and fully cured in accordance with the recommendations of the manufacturer of the coating material. Before coating, the bars shall be cleaned by abrasive blast cleaning to meet the requirements of near white metal in accordance with SSPC-SP10. The Coating shall be applied to the cleaned surface as soon as possible after cleaning, and before osication of the surface discernable to the unaided eye occurs. However, in no case shall application of the coating be delayed more than 8 hours after cleaning. The film thickness of the coating after curing shall be 5 to 20 mils, inclusive, as measured

using ASTM G 12 on the body of the reinforcing bar between the deformations and/or ribs on a straight length of bar. The coating shall be free from holes, voids, cracks, and damaged areas discernable to the unaided eye. Damaged or other unsatisfactory areas shall be patched with a coring material and by a method recommended by the coating manufacturer.

B. Welded Wire Fabric: ASTM A 185.

C. Steel Wire: ASTM A 82.

D. Supports for Reinforcement: Bolsters, chairs, spacers and other devices for spacing, supporting and fastening reinforcement in place.

1. Use wire bar type supports complying with CRSI recommendations, except as specified below. Do not use wood, brick, or other unacceptable materials.
2. For slabs on grade, use supports with sand plates or horizontal runners where base materials will not support chair legs.
3. For all concrete surfaces, where legs of supports are in contact with forms, provide supports complying with CRSI, Manual of Standard Practice as follows:
   a. Either hot-dip galvanized, plastic protected or stainless steel legs.
4. Over waterproof membranes, use precast concrete chairs.

2.4 RELATED MATERIALS

A. Waterstops:

1. Flat dumbbell or centerbulb type, size to suit joints, of Polyvinyl Chloride.
   a. Manufacturer: Provide waterstops of one of the following:
      1) W.R. Meadows, Incorporated.
      2) A.C. Horn, Incorporated.

B. Membrane-Forming Curing compounds: ASTM C 309, Type I.

C. Epoxy Bonding Agent:

1. Two-component epoxy resin bonding agent.

a. Product and Manufacturer: Provide one of the following:

1) Sikadur Hi-Mod by Sika Chemical Corporation.

2) Epoxtite Binder (Code No. 2390) by A.C. Horn, Incorporated.

D. Joint Fillers: See Section 7J.

2.5 GROUT

A. Nonshrink, Nonmetallic Grout:

1. Premixed nonstaining cementitious grout requiring only the addition of water at the job site.

2. Product and Manufacturer: Provide one of the following:

a. Euco N-S by the Euclid Chemical Company.

b. Masterflo 713 by Master Builder Company.

c. Five Star by U.S. Grout Corporation.

d. Or equal.

2.6 MOISTURE BARRIER

A. Moisture Barrier: ASTM E 154:

1. Provide moisture barrier cover over prepared base material where indicated. Use polyethylene membrane not less than 8 mils thick, lapping at least 9 inches at joints.

PART 3 - EXECUTION

3.1 INSPECTION

A. CONTRACTOR and his installer shall examine the substrate and the conditions under which Work is to be performed and notify ENGINEER

of unsatisfactory conditions. Do not proceed with the Work until unsatisfactory conditions have been corrected in a manner acceptable to ENGINEER.

3.2 FORMWORK

A. Formwork: Construction so that concrete members and structures are correct size, shape, alignment, elevation and position, complying with ACI 347.

B. Provide openings in formwork to accommodate Work of other trades. Accurately place and securely support items built into forms.

C. Tie holes shall be filled immediately after form removal. The cavities shall be cleaned, thoroughly dampened, and filled solid with mortar. Where appearance is essential, they shall be finished to match the surrounding surface. A bonding coat and curing is not required.

3.3 REINFORCEMENT, JOINTS, AND EMBEDDED ITEMS

A. Comply with the applicable recommendations of specified codes and standards, and CRSI, Manual of Standard Practice, for details and methods of reinforcement placement and supports.

B. Clean reinforcement to remove loose rust and mill scale, earth, ice, and other materials which reducer or destroy bond with concrete.

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

1. Place reinforcement to obtain the minimum concrete coverage as shown and as specified in ACI 318. Arrange, space, and securely tie bars and bar supports together with 61 gage wire to hold reinforcement accurately in position during concrete placement operations. Set with ties so that twisted ends are directed away

from exposed concrete surfaces.

2. Reinforcing steel shall not be secured to forms with wire, nails, or other ferrous metal. Metal supports subject to corrosion shall not touch formed or exposed concrete surfaces.

D. Provide sufficient numbers of supports of strength required to carry reinforcement. Do not place reinforcing bars more than 2 inches beyond the last leg of any continuous bar support. Do not use supports as bases for runways for concrete conveying equipment and similar construction loads.

E. Splices:

1. Provide standard reinforcement splices by lapping ends, placing bars in contact, and tying tightly with wire. Comply with requirements shown for minimum lap of spliced bars.

F. Install welded wire fabric in as long lengths as practical, lapping at least one mesh.

G. Concrete shall not be placed until the reinforcing steel is inspected and permission for placing concrete is granted by ENGINEER. All concrete placed in violation of this provision will be rejected.

H. Joints: Provide construction, isolation, and control joints as indicated on drawings or required. Locate construction joints so as to not impair the strength and appearance of the structure. Place isolation and control joints in slabs on ground to stabilize differential settlement and random cracking.

I. Installation of Embedded Items: Set and build into the Work anchorage devices and embedded items required for other Work that is attached to, or supported by cast-in-place concrete. Use setting diagrams, templates, and instruction provided under other Sections and other contracts for locating and setting. Refer also to Paragraph 1.1.B., Coordination, above.

3.4 CONCRETE AND PLACEMENT

A. Proportioning and Design of Mix:

1. Minimum compressive strength at 28 days: 4000 psi.
2. Maximum water cement ratio by weight: 0.45.
3. Minimum cement content: 564 pounds per cubic yard.
4. Normal weight: 145 pounds per cubic foot.
5. Use air-entraining admixture in all concrete: provide not less than 4 percent nor more than 8 percent entrained air for concrete exposed to freezing and thawing, and from 2 percent to 4 percent for other concrete.
6. Calcium Chloride: Do not use calcium chloride in concrete, unless otherwise authorized in writing by ENGINEER. Do not use admixtures containing calcium chloride.

B. Mob-Site Mixing: Use drum type batch machine mixer, mixing not less than 1-1/2 minutes for one cubic yard or smaller capacity. Increase mixing time at least 15 seconds for each additional cubic yard or fraction thereof.

C. Ready-Mixed Concrete: ASTM C 94.

D. Concrete Placement: Comply with ACI 304, placing concrete in a continuous operation within planned joints or sections. Do not begin placement until work of other trades affecting concrete is completed.

E. Consolidate placed concrete using mechanical vibrating equipment with hand ridding and tamping, so that concrete is worked around reinforcement and other embedded items and into all parts of forms.

F. Protect concrete from physical damage or reduced strength due to weather extremes during mixing, placement, and curing.

1. In cold weather comply with ACI 306.
2. In hot weather comply with ACI 305.

3.5 QUALITY OF CONCRETE WORK

A. Make all concrete solid, compact and smooth, and free of laitance, cracks and cold joints.

B. All concrete for liquid retaining structures, and all concrete in contact with earth, water, or exposed directly to the elements shall be watertight.

C. Cut out and properly replace to the extent ordered by ENGINEER, or repair to the satisfaction of ENGINEER surfaces which contain cracks or voids, ar unduly rough, or are in any way defective. Patches or plastering will not be acceptable.

D. Repair, removal, and replacement of defective concrete as ordered by ENGINEER shall be at no additional cost to OWNER.

3.6 CURING

A. Curing: Begin initial curing as soon as free water has disappeared from exposed surfaces. Where possible, keep continuously moist for not less than 72 hours. Continue curing use of moisture-retaining cover or membrance-forming curing compound. Cure formed surfaces by moist curing until forms are removed. Provide protection as required to prevent damage to exposed concrete surfaces.

3.7 FINISHES

A. Finish:

1. After placing concrete slabs, do not work the surface further until ready for floating. Begin floating when the surface water has disappeared or when the concrete has stiffened sufficiently. Use a wood float only. Check and level the surface plane to a tolerance not exceeding 1/4 inch in 10 feet when tested with a 10 foot straightedge placed on the surface at not less than 2 different angles. Cut down high spots and fill all low spots. Uniformly slope surfaces to drains. Immediately after leveling, refloat the surface

to a uniform, smooth, granular texture.

2. After floating, begin the first trowel finish operating using a power-driven trowel. Begin final troweling when the surface produces a ringing sound as the trowel is moved over the surface.
3. Consolidate the concrete surface by the final hand troweling operation. Finish shall be free of trowel marks, uniform in texture and appearance, and with a surface plane tolerance not exceeding 1/8 inch in 10 feet when tested with a 10-foot straight edge. Grind smooth surface defects which would telegraph through applied floor covering system.
4. Use trowel finish fore the following:
   a. Interior exposed slabs unless otherwise shown or specified.
5. Apply non-slip broom finish to the exterior concrete slab and elsewhere as shown on the Drawings.

B. Apply chemical floor hardener to exposed interior concrete floor areas when cured and dry, in accordance with manufacturer's instructions.

3.8 GROUT PLACEMENT

A. General:
   1. Place grout as shown and in accordance with manufacturer's instructions. If manufacturer's instructions conflict with the Specifications do not proceed until CONTRACTOR provides clarification.
   2. Drypacking will not be permitted.
   3. Manufacturers of proprietary products shall make available upon 72 hours notification the services of qualified, full-time employee to aid in assuring proper use of the product under job conditions.
   4. Placing grout shall conform to the temperature and weather limitations described in Article 3.4 above.

END OF SECTION

SECTION 03305

CAST-IN-PLACE PILES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Machine augered shaft, placement of pressure injected concrete and internal reinforcement.

1.2 RELATED SECTIONS

A. Section 13121 - Pre-Engineered Buildings

1.3 UNIT PRICES

A. Piles:
   1. Pile Quantity: Determined by the quantity of piles indicated in the Contract Documents.
   2. Pile Length: By the linear foot meter measured from point to cut-off elevation as indicated.

B. Adjustments in Contract Price will be made due to changes in number and length of piles, based on unit prices established in the Agreement as follows:
   1. Actual Pile Quantity, and
   2. Contract unit price per unit length, multiplied by the Actual Pile Length. Base measurement on total linear measurement of piling from point to cut-off elevation.

C. Determination of Unit Measurements: Identified by site measurements and verified by the Engineer.

1.4 REFERENCES

A. ACI 336.1 - Construction of End Bearing Drilled Piers.

B. ACI 304 - Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete.

C. ACI 305R - Hot Weather Concreting.

D. ACI 306R - Cold Weather Concreting.

E. ACI 308 - Standard Practice for Curing Concrete.

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

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

H. ASTM C33 - Concrete Aggregates.

I. ASTM C94 - Ready-Mixed Concrete.

J. ASTM C150 - Portland Cement.

K. CRSI - Concrete Reinforcing Steel Institute - Manual of Practice.

1.5 SUBMITTALS

A. Submit under provisions of Section 01300.

B. Shop Drawings: Indicate bar sizes, spacings, locations, and quantities of reinforcing steel bending and cutting schedules, supporting and spacing devices.

C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

D. Product Data: Provided data on attachment accessories.

1.6 QUALITY ASSURANCE

A. Perform Work in accordance with CRSI - Manual of Standard Practice.

B. Maintain one copy of each document on site.

C. Submit certified copies of mill test report of reinforcement materials analysis.

D. Acquire cement and aggregate from same source for all work.

E. Conform to ACI 305R when concreting during hot weather.

F. Conform to ACI 306R when concreting during cold weather.

1.7 QUALIFICATIONS

A. Installer: Company specializing in performing the work of this section with minimum 3 years documented experience.

B. Design pile under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State of Rhode Island.

1.8 PRE-INSTALLATION CONFERENCE

A. Convene one week prior to commencing work of this section, under provisions of Section 01041.

PART 2 PRODUCTS

2.1 CONCRETE MATERIALS

A. Cement: ASTM C150, Type I - Normal Portland type; manufactured by [_____].

B. Fine and Coarse Aggregates: ASTM C33.

C. Water: Potable and not detrimental to concrete.

2.2 CONCRETE MIX

A. Mix concrete in accordance with ACI 304. Deliver concrete in accordance with ASTM C94.

B. Select aggregate proportions for light weight concrete in accordance with ACI 318.

C. Provide concrete to the following criteria:

Unit	Measurement
Compressive Strength (7 day)	[____] psi ([____] MPa)
Compressive Strength (28 day)	4000 psi ([____] MPa)
Coarse Aggregate	[____] percent by volume
Fine Aggregate	[____] percent by volume
Water/Cement Ratio (maximum)	[____] by weight (mass)
Aggregate Size (maximum)	[____] inch ([____] mm)
Aggregate Size (minimum)	[____] inch ([____] mm)
Slump - Plus or minus 1 inch (50 mm)	[____] inches ([____] mm)

D. Use accelerating admixtures in cold weather only when approved by Engineer. Use of admixtures will not relax cold weather placement requirements.

E. Use calcium chloride only when approved by Engineer.

F. Use set retarding admixtures during hot weather only when approved by Engineer.

2.3 REINFORCEMENT

A. Reinforcing Steel: ASTM A615, 40 ksi (276 MPa) yield grade; billet steel bars, unfinished; spiral wound

2.4 FABRICATION

A. Fabricate concrete reinforcing in accordance with CRSI Manual of Practice.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify site conditions under provisions of Section 01041.

B. Verify that anchors, reinforcement and other items to be cast into concrete are accurately placed, positioned securely, and will not cause hardship in placing concrete.

3.2 PREPARATION

A. Use placement method which will not cause damage to nearby structures.

B. Protect structures near the Work from damage.

C. Prepare to place piles from existing site elevations.

3.3 INSTALLATION

A. Drill concentric and vertical pile shafts to diameters and depths indicated.

B. Maintain shafts free of water.

C. Progressively raise auger. Pressure inject concrete grout with equipment designed for such placement.

D. Place concrete in accordance with ACI 304.

E. Notify Engineer minimum 24 hours prior to commencement of operations.

F. Ensure reinforcement and inserts are not disturbed during concrete placement.

G. Maintain records of concrete placement. Record date, location, quantity, air temperature, and test samples taken.

H. Place, support, and secure reinforcement against displacement. Do not deviate from required position.

I. Conform to applicable code for concrete cover over reinforcement.

J. Set tops of piles to elevations indicated.

K. Prepare pile top to receive anchor.

L. Do not permit top of pile to deform to a mushroom shape.

M. Extend reinforcement for connection of anchor.

3.4 TOLERANCES

A. Maximum Variation From Vertical: 1 in 48.

B. Maximum Variation From Design Top Elevation: 4 inches (100 mm).

C. Maximum Out-of-Position: 2 inches (50 mm).

3.5 FIELD QUALITY CONTROL

A. Field inspection and testing will be performed under provisions of Section 01400.

B. Submit proposed mix design to inspection and testing firm for review prior to commencement of Work.

C. Tests of cement and aggregates may be performed to ensure conformance with specified requirements.

D. Three concrete test cylinders will be taken for every 75 or less cu yds (57 or less cu m) of concrete placed.

E. One additional test cylinder will be taken during cold weather concreting, cured on job site under same conditions as concrete it represents.

F. One slump test will be taken for each set of test cylinders taken.

3.6 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Section 01700.

B. Record actual locations of piles, pile diameter, and pile length.

C. Accurately record the following on project record documents:
   1. Sizes, lengths, and locations of piles.
   2. Sequence of placement.
   3. Final base and top elevations.
   4. Deviation from indicated locations.

3.7 UNACCEPTABLE PILES

A. Unacceptable Piles: Piles that are placed out of position, are below elevations, or are damaged.

B. Provide additional piles or replace piles failing to conform to specified requirements.

END OF SECTION

SECTION 03405

PRECAST CONCRETE PIERS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Piers and supporting devices.

1.2 RELATED SECTIONS

A. Section 13121 - Pre-Engineered Buildings.

1.3 UNIT PRICE - MEASUREMENT AND PAYMENT

A. Precast Pier:
   1. Basis of Measurement: By the unit.
   2. Basis of Payment: Includes unit member placed and anchored.

1.4 REFERENCES

A. ACI 301 - Structural Concrete for Buildings.

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

C. ANSI/AWS D1.1 - Structural Welding Code.

D. ANSI/AWS D1.4 - Structural Welding Code - Reinforcing Steel.

E. ANSI/ASTM A185 - Welded Steel Wire Fabric for Concrete Reinforcement.

F. ANSI/ASTM A416 - Uncoated Seven-Wire Stress-Relieved Strand for Prestressed Concrete.

G. ANSI/ASTM A497 - Welded Deformed Steel Wire Fabric for Concrete Reinforcement.

H. ASTM A36 - Structural Steel.

I. ASTM A153 - Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

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

K. ASTM A666 - Austenitic Stainless Steel, Sheet, Strip, Plate, and Flat Bar for Structural Applications.

L. ASTM C150 - Portland Cement.

M. PCI MNL-116 - Manual for Quality Control for Plants and Production of Precast and Prestressed Concrete Products.

N. PCI MNL-120 - Design Handbook - Precast and Prestressed Concrete.

O. PCI MNL-123 - Manual on Design of Connections for Precast Prestressed Concrete.

P. PCI MNL-124 - PCI Design for Fire Resistance of Precast Prestressed Concrete.

Q. UL - Underwriters Laboratories.

1.5 DESIGN REQUIREMENTS

A. Size components to withstand design loads in a [restrained] [unrestrained] condition as follows:
   1. Horizontal Assembly: [____] psf ([____] KPa) live [and dead] loads.
   2. Vertical Assembly: [____] psf ([____] KPa).

B. Design members exposed to the weather to provide for movement of components without damage, failure of joint seals, undue stress on fasteners or other detrimental effects, when subject to seasonal or cyclic day/night temperature ranges.

1.6 SUBMITTALS

A. Submit under provisions of Section 01300.

B. Shop Drawings: Indicate layout, unit locations, fabrication details, reinforcement, connection details, support items, dimensions, and relationship to adjacent materials, and sealed by a Professional Structural Engineer.

C. Indicate design loads, bearing requirements, and special conditions.

D. Product Data: Indicate standard component configurations, design loads, and bearing requirements.

1.7 QUALITY ASSURANCE

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

1.8 QUALIFICATIONS

A. Fabricator: Company specializing in manufacturing the work of this section with minimum 3 years documented experience.

B. Erector: Company specializing in erecting the work of this section with 3 years documented experience.

C. Design precast concrete members under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State of Rhode Island.

D. Welder: Qualified within previous 12 months in accordance with ANSI/AWS D1.1 and ANSI/AWS D1.4.

1.9 REGULATORY REQUIREMENTS

A. Conform to ACI 318 and applicable code for design load and construction requirements applicable to work of this Section.

1.10 PRE-INSTALLATION CONFERENCE

A. Convene a pre-installation conference 1 week prior to commencing work of this section, under provisions of Section 01041.

1.11 DELIVERY, STORAGE, AND HANDLING

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

B. Handle precast members in position consistent with their shape and design. Lift and support only from support points.

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

D. Protect members to prevent staining, chipping, or spalling of concrete.

E. Mark each member with date of production and final position in structure.

1.12 COORDINATION

A. Coordinate work under provisions of Section 01041.

PART 2 PRODUCTS

2.1 FABRICATORS

A. [_____] Product [_____].

B. [_____] Product [_____].

C. [_____] Product [_____].

D. Substitutions: Under provisions of Section 01030.

2.2 MATERIALS

A. Cement: White Portland, conforming to ASTM C150 Type III.

B. Aggregate, Sand, Water, Admixtures: Determined by precast fabricator as appropriate to design requirements and PCI MNL-116.

2.3 REINFORCEMENT

A. Tensioning Steel Tendons: ANSI/ASTM A416 Grade [250k] [270K] [____], of sufficient strength commensurate with member design.

B. Reinforcing Steel: ASTM A615 Grade [____], deformed steel bars.

C. Welded Steel Wire Fabric: ASTM A185 Plain Type in coiled rolls.

2.4 ACCESSORIES

A. Grout: Non-shrink, non-ferrous minimum yield strength of 10,000 psi 68.9 mPa) at 28 days.

B. Bearing Pads: Neoprene (Chloroprene).

2.5 FABRICATION

A. Fabrication procedure to conform to PCI MNL-116.

B. Maintain plant records and quality control program during production of

precast members. Make records available upon request.

C. Ensure reinforcing steel, anchors, inserts, and other cast-in items are embedded and located as indicated on Drawings.

D. Tension reinforcement tendons as required to achieve design load criteria.

E. Exposed Ends at Stressing Tendons: Fill recess with grout, trowel flush.

2.6 FINISHES

A. Ensure exposed-to-view finish surfaces of precast concrete members are uniform in color and appearance.

B. Cure members under identical conditions to develop required concrete quality, and minimize appearance blemishes such as non-uniformity, staining, or surface cracking.

C. Plant Finish (Finish A): Normal plant finish; surface may contain small surface holes caused by air bubbles, minor chips or spalling at edges or ends, without major discoloration.

2.7 FABRICATION TOLERANCES

A. Conform to PCI MNL-116.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that site conditions are ready to receive work and field measurements are as shown on Drawings.

3.2 PREPARATION

A. Prepare support equipment for the erection procedure.

3.3 ERECTION

A. Erect members without damage to structural capacity, shape, or finish. Replace or repair damaged members.

B. Install bearing pads.

C. Secure units in place. Perform welding in accordance with ANSI/AWS D1.1.

3.4 ERECTION TOLERANCES

A. Erect members level and plumb within allowable tolerances.

B. Conform to PCI MNL-116.

C. When members cannot be adjusted to conform to design or tolerance criteria, cease work and advise Engineer. Execute modifications as directed.

3.5 PROTECTION

A. Protect members from damage caused by field welding or erection operations.

B. Provide non-combustible shields during welding operations.

3.6 CLEANING

A. Clean weld marks, dirt, or blemishes from surface of exposed members.

END OF SECTION

SECTION 4A

MORTAR

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish all mortar Work.
2. This Section specifies the mortar for masonry materials specified in the following:
   a. Section 4C3, Concrete Unit Masonry.
   b. Section 4C7, Glass Unit Masonry.
3. The types of mortar Work required includes, but is not necessarily limited to, the following:
   a. Portland cement-lime mortars.
   b. Fire-resistant mortar.
   c. Grouts.
   d. Miscellaneous additives.

B. Related Sections:

1. Section 3I, Grout.

1.2 QUALITY ASSURANCE

A. Requirements of Regulatory Agencies: Wherever a fire-resistance classification is shown or scheduled for unit masonry construction (4-hour, 3-hour and similar designations), provide mortar and proportions complying with the requirements established by UL and other governing authorities.

B. Codes: Comply with the applicable requirements of the State of Rhode Island Official Compilation of Codes, Rules and Regulations for types of mortar Work specified.

C. Source Quality Control:

1. Do not change source or brands of mortar materials during the course of the Work.
2. Where question of compliance to the requirements of this Section arise the mortar properties specification shall take precedence over the mortar proportion specifications.
3. No change shall be made in the proportions established for mortar accepted under the property specifications nor shall materials with different physical characteristics be utilized in mortar used in the Work unless compliance with the requirements of the property specifications is re-established by Shop Drawing data submission to ENGINEER.
4. Two air-entraining materials shall not be combined in mortar.

D. Reference Standards: Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.

1. ASTM C 5, Quicklime for Structural Purposes.
2. ASTM C 91, Masonry Cement.
3. ASTM C 136, Sieve or Screen Analysis of Fine and Coarse Aggregates.
4. ASTM C 144, Aggregate for Masonry Mortar.
5. ASTM C 150, Portland Cement.
6. ASTM C 207, Hydrated Lime for Masonry Purposes.
7. ASTM C 270, Mortar for Unit Masonry.
8. ASTM C 404, Aggregates for Masonry Grouts.
9. ASTM C 476, Grout for Masonry.
10. UL, Design Numbers U901 through U908.

1.3 SUBMITTALS

A. Shop Drawings: Submit for approval the following:

1. Copies of manufacturer's specifications and instructions for each manufactured product.
2. Product specification data for integral waterproofing admixture.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Delivery of Materials: Manufactured materials, such as cement and lime, shall be delivered and stored in their original containers, plainly marked with identification of materials and manufacturer.

B. Storage of Materials:

1. Store mortar materials off the ground in a dry location and under a properly constructed shelter using tarpaulins, felt paper, or polyethylene sheets.
2. Protect liquid admixtures from freezing.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Portland Cement: Provide the following for portland cement-lime mortars:

1. USTM C 150, Type I.
2. Use ASTM C 150, Type III, high early strength, for laying masonry when outside temperature is less than 50°F.
3. Provide nonstaining portland cement of natural color.
4. Product and Manufacturer: Provide one of the following:
   a. Speed Portland Cement and Hi-Speed Portland Cement by Louisville Cement Company.
   b. Atlas Type I and Atlas Type III Portland Cement by Lehigh Portland Cement Company.
   c. Or equal.
5. Product and Manufacturer: Provide one of the following:
   a. White Portland Cement by Ideal Basic Industries.

b. Atlas White Portland Cement Type I and Type III by Lehigh Portland Cement Company.

B. Hydrated Lime: ASTM C 207, Type S, or lime putty ASTM C 5.

C. Sand Aggregates

1. ASTM C 144, except for joints less than 1/4 inch use aggregate graded with 100 percent passing the No. 16 sieve.
2. White Mortar Aggregates: Provide natural white sand or ground white stone for portland cement-lime mortars.
3. Fine Aggregate for Grout: Sand, ASTM C 404, Size No.1.
4. Course Aggregate for Grout: ASTM C 404, Size No. 8 or Size No. 89.

D. Water: Free from injurious amounts of oils, acids, alkalis, or organic matter, and clean, fresh and potable.

E. Waterproofing Admixture for Load-Bearing Concrete Unit Masonry:

1. Provide an cross linking acrylic polymer integral waterproofing system.
2. Proportion and Mixing: In strict accordance with manufacturer's instructions.
3. Product and Manufacturer: Provide one of the following:
   a. DRY-BLOCK Mortar Admix by Forrer Industries.

2.2 MORTAR MIXES

A. General:

1. Anti-Freeze Admixture or Agents: Not permitted.
2. Calcium Chloride: Not permitted.

B. Fire Resistant Mortar:

1. Standard: UL Design Numbers U901, U902, U903, U904, U905, U906 and U907.
2. Proportion: Use 1 part portland cement, 3 parts clean sand,and 15 percent hydrated lime (by cement volume).

C. Mortar for All Other Unit Masonry: Comply with ASTM C 270, Table 2, except limit materials to those specified herein, do not substitute ASTM C 91 masonry cement for ASTM C 150 portland cement without an approved Shop Drawing review by ENGINEER, and limit cement to lime ratio by volume as follows:

1. Type S:
   a. Provide the following proportions by volume:
      1) Portland Cement: 1 part.
      2) Hydrated Lime or Lime Putty: Over 1/4 to 1/2 maximum.
      3) Aggregate Ratio (Measured in Damp Loose Condition): Not less than 2-1/4 and not more than 3 times the sum of the volumes of cementitious materials.
   b. Property Specification:
      1) Average Compressive Strength, ASTM C 270: 1800 pounds per square inch.
      2) Minimum Water Retention, ASTM C 270: 75 percent.
      3) Maximum Air Content, ASTM C 270: 12 percent for portland cement-lime mortars.
2. Type N:
   a. Provide the following proportions by volume:
      1) Portland Cement: 1 part.
      2) Hydrated Lime or Lime Putty: Over 1/2 to 1-1/4 maximum.
      3) Aggregate Ratio (measured in damp loose condition): Not less than 2-1/4 and not more than 3 times the sum of the volumes of cementitious materials.
   b. Property Specifications:
      1) Average Compressive Strength, ASTM C 270: 750 pounds per square inch.
      2) Minimum Water Retention, ASTM C 270: 75 percent.
      3) Maximum Air Content, ASTM C 270: 12 percent for portland cement-lime mortars.

D. Grout:

1. Fine Grout:

a. Provide the following proportions by volume:

1) Portland Cement: 1 part.

2) Hydrated Lime or Lime Putty: 0 to 1/10 part.

3) Aggregate Ratio (Measured in a Damp Loose Condition): Sand; not less than 2-1/4 and not more than 3 times the sum of the volumes of cementitious materials.

b. Mix grout to have a slump of 10-inches plus or minus 1-inch, at time of placement.

2. Coarse Grout:

a. Provide the following proportions by volume:

1) Portland Cement: 1 part.

2) Hydrated Lime or Lime Putty: 0 to 1/10 part.

3) Fine Aggregate Ratio (Measured in a Damp Loose Condition): Sand; not less than 2-1/4 and not more than 3 times the sum of the volumes of cementitious materials.

4) Coarse Aggregate Ratio: Not less than 1 and not more than 2 times the sum of the volumes of cement and lime.

b. Mix grout to have a slump of 10-inches plus or minus 1-inch, at time of placement.

3. Grout Fill Around Reinforcement in Masonry Lintels: Portland cement, sand, gravel and water, to be proportioned as required to provide a 28-day minimum compressive strength of 3000 pounds per square inch.

PART 3 - EXECUTION

3.1 PREPARATION

A. Measurement of Materials:

1. Cement and Hydrated Lime: Batched by the bag.

2. Sand: Batched by volume in suitably calibrated containers, provided proper allowance is made for bulking and consolidation and for weight per cubic foot, of contained moisture.

3. Proportion of Volumetric Mixtures: One 94-pound sack of portland cement and one 50-pound sack of hydrated lime constitute nominal one cubic foot.
4. Shovel measurement: Not permitted.

B. Mortar Mixing:
1. Type of Mixer: Machine mix in approved mixer in which the quantity of water is accurately and uniformly controlled.
2. While mixer is in operation add approximately 3/4 the required water, 1/2 the sand, all the cement,a then add remainder of sand.
3. Allow batch to mix briefly then add water in small quantities until satisfactory workability is obtained.
4. Mix for not less than five minutes after all materials have been added.
5. Hydrated Lime for Mortar Requiring Lime Content: Use dry-mix method. Turn over together the materials for each batch until the even color of the mixed, dry materials indicates that cementitious material has been thoroughly distributed throughout the mass, then add water to obtain required plasticity.
6. Lime putty if approved for use shall be prepared in accordance with ASTM C 5.
7. Waterproofing Admixture: Add to mortar mix for all exterior masonry in strict accordance with manufacturer's instructions.
8. The mixer drum shall be completely emptied before recharging the next batch.
9. Limit batch size to avoid retempering. Retempering of mortar shall not be permitted.

3.2 INSTALLATION

A. Refer to the following:
1. Section 4C1, Unit Masonry Construction.

3.3 FIELD QUALITY CONTROL

A. CONTRACTOR shall engage an independent testing laboratory Yacceptable to ENGINEER, to take samples and conduct tests to evaluate air entrainment,water retention and the compliance of materials with the Specifications and to determine the compressive strength of mortar and grout. Tests shall be conducted in accordance with ASTM C 91. Test results shall be made available to ENGINEER prior to the commencement of Work.

B. After the initial test, ENGINEER may require a maximum of 5 additional tests to be conducted at his discretion.

END OF SECTION

SECTION 4B

MASONRY ACCESSORIES

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish all masonry accessories Work.
2. This Section specifies the masonry accessories for masonry materials specified in the following:
   a. Section 4C1, Units Masonry Construction.
   b. Section 4C3, Concrete Unit Masonry.
3. The types of masonry accessories Work required includes, but is not necessarily limited to, the following:
   a. Continuous horizontal wire reinforcing and ties.
   b. Individual wire ties.
   c. Anchoring devices.
   d. Miscellaneous masonry accessories.

B. Related Sections:

1. Section 4A, Mortar.
2. Section 4C1, Unit Masonry Construction.
3. Section 4C7, Glass Unit Masonry.
4. Section 5A3, Structural Steel.
5. Section 5E3, Miscellaneous Metal Fabrications.
6. Section 9L, Painting.

1.2 QUALITY ASSURANCE

A. Requirements of Regulatory Agencies: Wherever a fire-resistance classification is shown or scheduled for unit masonry construction (4-hour, 3-

hour and similar designations),provide masonry accessories complying with the requirements established by UL and other governing authorities.

B. Codes: Comply with the applicable requirements of the State of Rhode Island Official Compilation of Codes, Rules and Regulations for types of masonry accessories Work shown and specified.

C. Reference Standards: Comply with applicable provisions and recommendations of the following, except where otherwise shown or specified.

1. ASTM A 82, Cold-Drawn Steel Wire for Concrete Reinforcement.
2. ASTM A 153, Zinc-Coating (Hot Dip) on Iron and Steel Hardware.
3. ASTM A 615, Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
4. ASTM AA 663, Steel Bars, Carbon, Merchant Quality, Mechanical Properties.
5. ACI 315, "Manual of Standard Practice for Detailing Reinforced Concrete Structures."
6. UL, Design Numbers U901 through U908.

1.3 SUBMITTALS

A. Samples: Submit for approval the following:

1. 6-inch lengths of each item specified and one of each individual item.
2. Compliance with all other requirements is the exclusive responsibility of CONTRACTOR.

B. Shop Drawings: Submit for approval the following:

1. Copies of manufacturer's specifications and installation instructions for each masonry accessory required. Include data substantiating that materials comply with specified requirements, and where each masonry accessory shall be used in the Work.
2. Explain where each masonry accessory will be used in the Work and the intended spacing.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Delivery of Materials: Deliver accessories in original packages, plainly marked with identification of materials and manufacturer.

B. Storage of Materials: Store and cover materials to prevent corrosion and deterioration.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Continuous Horizontal Wire Reinforcing and Ties for Masonry: Provide the following unless otherwise shown:

1. General: Welded wire units prefabricated in straight lengths of not less than 10 feet, with matching corner "L" and intersection "T" units. Fabricate from cold-drawn steel wire complying with ASTM A 82, with deformed continuous 9 gage side rods and plain 9 gage cross rods, with unit width of 1-1/2 to 2 inches less than thickness of wall or partition. All reinforcing and ties shall be hot dipped galvanized after fabrication with 1.5 ounces per square foot of zinc coating complying with ASTM A 153, Class B-1 and B-2 unless otherwise specified.
2. For single-wythe and multi-wythe masonry, use units fabricated as follows:
   a. Truss-type fabricated with one horizontal rode beneath each unit masonry shell wall and continuous diagonal cross-rods spaced not more than 16 inches on centers.
   b. Product and Manufacturer: Provide one of the following:
      1) Blok-Trus AA600 and 3-Wire Blok-Trus by AA Wire Products Company.
      2) Or equal.

B. Individual Wire Ties for Masonry: Provide the following where shown:

1. General: Fabricate from 3/16 inch cold-drawn steel wire complying with ASTM A 82, with 1.5 ounces per square foot of hot-dip coating

complying with ASTM A 153, Class B-3 with unit width of 1-1/2 a to 2 inches less than thickness of wall or partition.

2. Where facing and back-up joints align use single-piece ties as follows:
   a. For use with hollow masonry units laid with cells vertical, provide 4-inch wide rectangular shaped ties.
   b. For use with solid masonry units or hollow units laid with cells horizontal, provide ties with ends bent to 90 degree angles to form hooks not less than 2-inches long.
   c. Product and Manufacturer: Provide one of the following:
      1) AA309 Wire or AA304 Rectangular Wire Tie by AA Wire Products Company.
3. Where facing and back-up joints do not align, use adjustable two-piece ties as follows:
   a) For use with hollow masonry units laid with cells vertical, and with solid masonry units or hollow units laid with cells horizontal provide 4-inch wide adjustable rectangular shaped ties with lock bars welded across box ties and adjustable ties with ends bent to 90 degree angles to form box ties not less than 2-inches long. Eye-type units are not acceptable and shall not be approved by CONTRACTOR.
   b) Product and Manufacturer: Provide one of the following:
      1) AA301 Adjustable U-Bar and Rectangular Box Ties by AA Wire Products Company.

C. Anchoring Devices for Masonry: Provide the following unless otherwise shown:
   1. General:
      a. Unless otherwise specified all anchoring devices for masonry shall be hot dipped galvanized after fabrication with 1.5 ounces per square foot of zinc coating complying with ASTM A 153, Class B-1, B-2 and B-3.
      b. Flexible Anchors: Whenever masonry abuts structural walls or framework provide flexible anchors which permit horizontal and vertical movement of masonry but provides lateral restraint.
   2. For anchorage to concrete structure provide the following:

a. Two-piece anchors with 24 gage sheet metal dovetail and 16 gage rectangular corrugated tie 1-inch wide, sized to extend to within one inch of face of masonry.

b. Product and Manufacturer: Provide one of the following:

1) No. AA100 Dovetail and AA205 Anchors by AA Wire Products Company.

3. For anchorage to steel framework provide the following:

a. Two-piece anchors with 8-inch long channel slot fabricated from 11 gage steel and 16 gage rectangular corrugated 1-inch wide tie sections sized to extend within one inch of opposite face of masonry, to a depth of 12 inches abutting flanges, or between 1-1/2 inch and 2 inches less than width of masonry abutting web.

b. Product and Manufacturer: Provide one of the following:

1) No. AA209 Channel and AA210 Tie by AA Wire Products Company.

D. Miscellaneous Masonry Accessories: Provide the following where shown:

1. Reinforcing Bars:

a. Deformed carbon steel, ASTM A 615, Grade 60 for bars No. 3 to No. 18 except as otherwise shown.

b. Plain carbon steel, ASTM A 663, Grade 80 where No. 2 bars are shown or required.

c. Provide galvanized steel reinforcing bars complying with ASTM A 153, Class B-1, where shown.

2. Compressible Filler:

a. Use foamed polyurethane strip saturated with polybutylene waterproofing material. When compressed to 50 percent of its original volume, filler shall hold six feet of water hydrostatically,and 10 feet at 60 percent compression. Filler shall maintain its resiliency to allow for installation in temperatures as low as 40°F. Filler shall be waterproof when compressed to 50 percent of its original volume in temperatures from -40°F to +200°F. Elongation shall be at least 325 percent with a tensile strength of not less than 53

pounds per square inch. No migration of polybutylene compound in the polyurethane strip will be allowed.

b. Product and Manufacturer: Provide one of the following:

1) Polytite by Sandell Manufacturing Company.

2) Compriband by Secoa Corporation, Division of Phoenix Building Products, Incorporated.

3. Premolded Control Joint Strips: Solid polyvinyl chloride strips with a Shore A durometer hardness of 80 to 90, designed to fit standard sash block and maintain lateral stability in masonry wall, size and configuration shall be as specified.

a. Product and Manufacturer: Provide one of the following:

1) Blok-Tite AA2003 and AA2005 by AA Wire Products Company.

4. Sealants: Section 7J1, Calking and Sealants.

5. Cavity Fill Mesh: Provide hot dip galvanized 1/2-inch mesh hardware cloth, backed with asphalt impregnated cloth below. Install below all block courses that are to be filled with mortar.

2.2 FABRICATION

A. Weld-in-place all channel slots and other specified weld-on anchors at the shop. Field welding is not acceptable.

B. Coordinate location of all weld-on anchors and show on structural steel Shop Drawings included under Section 5A3, Structural Steel.

C. Weld anchor slots and other required accessories in place before shop priming of structural steel.

D. Prime all weld-on anchors and other accessories and passivate anchor coating as required and specified under Section 9L, Painting.

E. Shop-fabricate reinforcing bars which are shown or required to be bent or hooked. Comply with ACI 315 for the fabrication of reinforcing steel for unit masonry construction Work.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Refer to the following:

1. Section 4C1, Unit Masonry Construction.

END OF SECTION

SECTION 4C1

UNIT MASONRY CONSTRUCTION

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified and required to install all unit masonry construction Work. The Work also includes:
   a. Providing openings in unit masonry construction to accommodate the Work under this and other Sections and building into the unit masonry construction all items such as sleeves, anchor bolts, inserts and all other items to be embedded in unit masonry construction for which placement is not specifically provided under other Sections.

B. Coordination:

1. Review installation procedures under other Sections and coordinate the installation of items that must be installed with the unit masonry construction Work.
2. Unit masonry construction Work advanced without built-in flashing and other built-in Work shall be removed and rebuilt at no additional expense to OWNER even if discovered after unit masonry construction Work has been completed.
3. Coordinate the Work of other Sections to avoid delay of the unit masonry construction Work.

C. Related Sections:

1. Section 4A, Mortar.
2. Section 4B, Masonry Accessories.
3. Section 4C7, Glass Unit Masonry.
4. Section 5E3, Miscellaneous Metal Fabrications.

5. Section 6A, Rough Carpentry.
6. Section 7C1, Building Insulation.

1.2 QUALITY ASSURANCE

A. Requirements of Regulatory Agencies: Wherever a fire-resistance classification is shown or scheduled for unit masonry construction Work (4-hour, 3-hour, and similar designations), comply with applicable requirements for materials and installation established by UL and other governing authorities.

B. Codes: Comply with the applicable requirements of the State of Rhode Island Official Compilation of Codes, Rules and Regulations for the types of unit masonry construction Work shown.

C. Construction Tolerances:

1. Variation from Plumb: For lines and surfaces of columns, walls and arises, do not exceed 1/4 inch in 10 feet, or 3/8 inch to a story height or 20 feet maximum, nor 1/2 inch in 40 feet or more. Except for external corners, expansion joints and other conspicuous lines, do not exceed 1/4 inch in any story or 20 feet maximum, nor 1/2 inch in 40 feet or more.
2. Variation from Level: For lines of exposed lintels, sills, parapets, horizontal grooves and other conspicuous lines,do not exceed 1/4 inch in any bay or 20 feet maximum, nor 3/4 inch in 40 feet or more.
3. Variation of Linear Building Line: For position shown and related portion of columns, walls and partitions, do not exceed 1/2 inch in any bay or 20 feet maximum, nor 3/4 inch in 40 feet or more.
4. Variation in Cross-Sectional Dimensions: For columns and thickness of walls, from dimensions shown, do not exceed minus 1/4 inch nor plus 1/2 inch.

D. Job Mock-up:

1. Prior to installation of unit masonry construction Work, but after ENGINEER's approval of samples, erect job mock-up using materials, pattern bond and joint tooling shown or specified for final Work.

Provide special features as directed including finished opening 1 foot-4 inches by 1 foot-4 inches, finished end, and masonry control joint. Build mock-up at the site, in location approved by ENGINEER, of full required wall thickness and approximately 4 feet by 3 feet-4 inches, unless otherwise shown. Indicate the proposed range of color, texture and workmanship to be expected in the completed Work. Obtain ENGINEER's acceptance of visual qualities of the mock-up before start of unit masonry construction Work. Retain and protect mock-up during construction as a standard for judging completed unit masonry construction Work. Do not alter, move or destroy mock-up until given written permission by ENGINEER.

2. Build as many job mock-up panels as required to obtain ENGINEER'S acceptance of the Work.
3. Unit masonry construction Work which proceeds without an approved job mock-up panel shall be removed.
4. Masonry construction that does not meet the standards approved on the sample panel shall be removed and rebuilt as required by ENGINEER. Provide mock-up panel or the following:
   a. Typical complete exterior wall including elastic masonry flashing.
   b. Typical complete interior wall of glass unit masonry.

E. Preconstruction Conference:

1. Prior to the installation of unit masonry construction Work, CONTRACTOR shall schedule a preconstruction conference at the project site. Review foreseeable methods and procedures related to the unit masonry construction Work including, but not necessarily limited to, the following:
   a. Project requirements, including Drawings, Specifications and other Contract Documents.
   b. Structural concept.
   c. Method of sequence of masonry construction.
   d. Special masonry details.
   e. Required submittals, both completed and yet to be completed.
   f. Standard of workmanship.
   g. Quality control requirements.

h. Job organization and availability of materials, tradesmen, equipment and facilities needed to make progress and avoid delays.

i. Masonry control and expansion joint location and materials.

j. Modular planning requirements.

k. Weather and forecasted weather conditions, and procedures for coping with unfavorable conditions.

l. Required inspection, testing and certifying procedures.

m. Regulations concerning building code compliance.

F. Reference Standards: Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.

1. ASTM C 67, Standard Methods of Sampling and Testing Brick.
2. Brick Institute of America, "Technical Notes on Brick and Tile Construction."
3. Brick Institute of America, Technical Bulletin 1A. "Construction and Protection Recommendations for Cold Weather Masonry Construction."
4. Brick Institute of America, Technical Notes on "Cleaning Clay Products Masonry."
5. National Concrete Masonry Association, "guide Specifications" and "Technical Bulletins."

1.3 SUBMITTALS

A. Shop Drawings: Submit for approval the following:

1. Complete layout of all masonry walls showing modular planning and all special shapes to be used in the Work. Show all details for each condition encountered in the Work. Provide plans and elevations drawn at 1/4 inch scale and details drawn at 1-1/2 inch scale. Show all items required to be built into unit masonry construction Work.
2. Masonry control joint locations and details.
3. Shop Drawings showing the location, extent and accurate configuration and profile of all items shown, specified and required by this and other sections to be built into the unit masonry construction Work as the

Work progresses. Provide elevations drawn at 1/4 inch scale and all details drawn at 1-1/2 inch scale.

4. Shop Drawing for fabrication, bending, and placement of reinforcing bars. Show bar schedules, diagrams of bent bars, stirrup spacing, lateral ties and other arrangements and assemblies as required for fabrication and placement of reinforcing for unit masonry construction Work.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Delivery of Materials:

1. Deliver reinforcing to the site, bundled, tagged and marked. Use metal tags indicating size, lengths and other markings shown on approved Shop Drawings.

B. Storage of Materials:

1. Protect masonry materials during storage and construction with a properly erected shelter from wetting by rain, snow or ground water and from soilage or intermixture with earth or other materials.
2. Maintain temperatures in shelter so that masonry materials are above 20°F when laid.

C. Handling Materials:

1. Handle materials in a manner that minimizes chips, cracks, voids, discolorations or other defects which might be visible or cause staining in finished Work.

1.5 JOB CONDITIONS

A. Site Facilities: Supplemental heat sources as may be required should CONTRACTOR wish to continue unit masonry construction Work in cold weather are not available at the project site. The provision of all supplemental heat energy sources and equipment is the responsibility of CONTRACTOR.

B. Environmental Requirements:

1. Do not place any unit masonry construction Work when air temperature is below 28°F on a rising temperature or below 36°F on falling temperatures without temporary heated enclosures or without heating materials or other precautions necessary to prevent freezing as specified in 1.5.C below.
2. No frozen materials shall be used nor shall frozen unit masonry construction Work be built upon.
3. Remove and replace all unit masonry construction Work damaged by frost or freezing.

C. Protection:

1. Protect all unit masonry construction Work against freezing for at least 48 hours after being placed.
   a. Mean Daily Air Temperature 40°F to 32°F: Protect unit masonry construction Work from rain or snow for 48 hours after installation.
   b. Mean Daily Temperature 32°F to 25°F: Completely cover unit masonry construction Work for 48 hours after installation.
   c. Mean Daily Temperature 25°F to 20°F: Completely cover unit masonry construction Work with insulating blankets for 48 hours.
   d. Mean Daily Temperature 20°F and Below: Maintain unit masonry construction Work above 32°F for 48 hours by enclosure and supplementary heat.
2. Protect partially completed masonry against rapid heat loss and from water entering masonry, when Work is not in progress, by covering top of walls with strong, waterproof, nonstaining membrane. Extend membrane at least 2 feet down both sides of walls and secure in place using wall cover clamps spaced at intervals of 4 feet-0 inches and at each end and joint of covering.
3. Do not apply uniform floor or roof loading for at least three days after completing masonry columns or walls.
4. Do not apply concentrated loads for at least seven days after completing masonry columns or walls.

D. Cold Weather Unit Masonry Construction Work:

1. All mortar for use in unit masonry construction Work when the mean daily temperature is below 40°F shall be portland cement-lime-sand mortars using high early strength portland cement.
2. Clay or shale unit masonry with suction in excess of 20 grams per 30 square inches shall be sprinkled with heated water just prior to laying. Provide water temperature above 70°F when units are above 32°F. Water temperature shall be above 120°F when temperature of units are below 32°F.
3. Air Temperature 40°F to 32°F: Heat sand or mixing water to minimum of 70°F and maximum of 160°F.
4. Air Temperature 32°F to 25°F: Heat sand and mixing water to minimum of 70°F and maximum of 160°F.
5. Air Temperature 25°F to 20°F: Heat sand and mixing water to minimum of 70°F and maximum of 160°F. Provide heat on both sides of wall under construction. Employ wind breakers when wind is in excess of 15 mph.
6. Air Temperature 20°F and Below: Heat sand and mixing water to minimum of 70°F and maximum of 160°F. Provide enclosure and auxiliary heat to maintain air temperature above 32°F. Temperature of masonry units when laid shall not be less than 20°F.

E. Hot Weather Unit Masonry Construction Work: Protect unit masonry construction Work by methods acceptable to ENGINEER, from direct exposure to wind and sun when the surrounding air temperature is 99°F in the shade with relative humidity less than 50 percent.

PART 2 - PRODUCTS

2.1 MATERIALS

a. Refer to the following Sections for required masonry materials.

1. Section 4A, Mortar.
2. Section 4B, Masonry Accessories.
3. Section 4C3, Concrete Unit Masonry.

PART 3 - EXECUTION

3.1 INSPECTION

A. CONTRACTOR and his installer shall examine areas and conditions under which unit masonry construction Work is to be installed, and notify ENGINEER of unsatisfactory conditions. Do not proceed with the Work until unsatisfactory conditions have been corrected in a manner acceptable to ENGINEER.

3.2 PREPARATION

A. Wetting of Masonry Units:

1. Use wetting methods which ensure that each masonry unit is nearly saturated but surface dry when laid.
2. Except for absorbent units specified to be wetted, lay masonry units dry. Do not wet concrete masonry units.

B. Cleaning Reinforcement: Before being placed, remove all loose rust, mill scale, earth, ice and other contamination from reinforcement. Do not use reinforcing bars with kinks or bends not shown on Drawings or approved Shop Drawings, or bars with reduced cross-section due to excessive rusting or other causes.

3.3 INSTALLATION, GENERAL

A. Thickness: Build walls, floors and other unit masonry construction Work to the full thickness shown. Build single-wythe walls to the actual thickness of the masonry units, using units of nominal thickness shown or specified.

B. Build chases and recesses as shown or required by others. Refer to Paragraph 1.1.B. herein for the requirements of coordination with others. Provide not less than 8 inches of masonry between chase or recess and jamb of openings, and between adjacent chases and recesses.

C. Leave openings for equipment, piping, ducts, and other items to be installed subsequent to starting of masonry Work. After installation of said items, complete unit masonry construction Work to match Work immediately adjacent to openings.

D. Cut masonry units using motor driven saws to provide clean, sharp, unchipped edges. Cut units as required to provide pattern shown and to fit adjoining Work neatly. Use full size units without cutting wherever possible.

3.4 LAYING MASONRY WALLS

A. General:

1. Mortar Types: Unless otherwise indicated, use mortar as specified in Section 4A, Mortar, and as follows:
   a. For all wythes of exterior wall construction Work use Type S mortar.
   b. For interior wall construction Work, use Type N mortar.
   c. Use grout fill for structural requirements and for grouting reinforcing steel in unit masonry construction Work.
   d. Do not use mortar which has begun to set or if more than 1/2 hour has elapsed since initial mixing. Retemper mortar during the 1/2-hour period only as required to restore workability.
2. Layout walls in advance for accurate spacing of surface pattern bond with uniform joint widths and to properly locate openings, masonry control joints, returns and offsets. Avoid the use of less than half size units at corners, jambs and wherever possible at other locations.
3. Lay up walls plumb and true to comply with specified tolerances, with courses level, accurately spaced and coordinated with other Work.
4. Pattern Bond:
   a. Lay all concrete unit masonry construction Work in a running bond pattern with vertical joints centered on units in courses above and below.
   b. Bond and interlock each course of each wythe at corners.
   c. Do not use units with less than 8-inch horizontal face dimensions at corners or jambs.

5. Color and Texture:

   a. Lay all concrete unit masonry construction Work using colored or white portland cement mortar.

B. Mortar Bedding and Jointing:

1. Lay solid masonry units with completely filled bed and head joint; butter ends with sufficient mortar to fill heat joints and shove into place. Do not slush head joints.
2. Lay hollow concrete masonry units with full mortar coverage on horizontal and vertical face shells. Bed webs in mortar in starting course of piers, columns and pilasters, and where adjacent to cells or cavities to be reinforced or filled with concrete or grout.
3. Maintain joint widths shown except for minor variations required to maintain pattern bond alignment. If not shown lay concrete unit masonry walls with 3/8-inch joint.
4. Cut joints flush for masonry walls that are to be concealed or to be covered by other materials, except paint, unless otherwise shown.
5. Tool exposed joints, when mortar is "thumbprint" hard, slightly concave. Rake out mortar in preparation for application of calking or sealants where required.
6. Concave-tool exterior joints below grade.
7. Remove masonry units disturbed after laying; clean and reset in fresh mortar. Do not pound corners at jambs to fit stretcher units which have been set in position. If adjustments are required, remove units, clean off mortar and reset in fresh mortar.

C. Collar Joints: Fill the vertical space between wythes solidly with mortar by parging the in-place wythe and shoving units into the parging, for the following unit masonry construction Work:

1. All multi-wythe concrete unit masonry and unfilled ground face concrete unit masonry walls.

D. Stopping and Resuming Work: Rake back one unit masonry length in each course; do not tooth. Clean exposed surfaces of set masonry, wet units lightly, if required, and remove loose masonry units and mortar prior to laying new masonry.

E. Built-in Work:

1. As the Work progresses, build in items shown, specified or required by others. Refer to paragraph 1.1.B. herein for the requirements of coordination with others. Fill cores in one block width solidly with masonry around built-in items.
2. Fill space between hollow metal frames and masonry solidly with mortar.
3. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of cavity fill mesh in the joint below and rod mortar or grout into core.
4. Where required by governing code requirements and to meet thickness to height ratio and to provide required fire-resistance, fill all cells of unit masonry construction solid with grout.

F. Structural Bonding of Multi-Wythe Masonry:

1. Use continuous reinforcing embedded in horizontal mortar joints for bond tie between wythes as specified herein.
2. Corners: Provide interlocking masonry unit bond in each course at corners, unless otherwise shown.
   a. For horizontally reinforced masonry, provide continuity at corners with prefabricated "L" units as specified herein, in addition to masonry bonding.
3. Intersecting and Abutting Walls: Unless vertical expansion or masonry control joints are shown at juncture, provide same type of bonding specified for structural bonding between wythes and space as follows:
   a. Provide masonry bond in alternate courses.
   b. Provide individual metal ties at not more than 24 inches on centers vertically, unless shown at closer spacing.
   c. Provide continuity with horizontal joint reinforcing using prefabricated "T" and "L" units.

G. Non-Load-Bearing Partitions Wythes:

1. Build full height of story to underside of structure above, unless otherwise shown.

2. Tie non-load-bearing partitions at top and sides with masonry anchors at terminations. Build in end blocks to facilitate placing compressible filler. Insert compressible filler, specified in Section 4B, Masonry Accessories in all horizontal and vertical joints where non-load-bearing masonry terminates. Insert filler 3/4 inches from both faces of masonry. Use filler four times as thick as the widest part of the joint. Thickness of filler shall be a minimum of 1.5 times the compressed thickness. Compress filler to less than thickness of joint and insert. At splices, overlap strips by 3 inches and compress ends to form tight joint. Finish with backer rod and sealant.

H. Horizontal Joint Reinforcing:

1. Provide continuous horizontal joint reinforcing as shown and specified. Refer to Section 4B, Masonry Accessories, for type of reinforcing units required. Fully embed longitudinal side rods in mortar for their entire length with a minimum cover of 5/8 inch on exterior side of walls and 1/2 inch at other locations. Lap reinforcement a minimum of 6 inches at ends of units. Do not bridge masonry control joints and building expansion joints with reinforcing.
2. Reinforce all walls with continuous horizontal joint reinforcing unless specifically noted or specified to be omitted.
3. Provide continuity at corners and wall intersections by use of prefabricated "L" and "T" sections. Cut and bend units in accordance with manufacturer's written instructions for continuity at returns, offsets, pipe enclosures and other special conditions.
4. Space continuous horizontal reinforcing as follows:
   a. For solid multi-wythe walls, where continuous horizontal reinforcing also acts as structural bond or tie between wythes, space reinforcing as required by code but not more than 16 inches on centers vertically.
   b. For single wythe walls, space reinforcing at 16 inches on center vertically.
5. Reinforce masonry openings greater than 12 inches wide, with horizontal joint reinforcing placed in two horizontal joints approximately 8 inches apart, immediately above the lintel and

immediately below the sill. Extend reinforcing a minimum of 24 inches beyond jambs of the opening.

6. In addition to wall reinforcing, provide additional reinforcing at openings as required to comply with the above.

I. Structural Reinforced Unit Masonry Construction:

1. Shape and dimension reinforcement as shown and are required by governing codes.
2. Position reinforcing accurately at the spacing shown. Support and secure vertical bars against displacement.
3. Where vertical bars are shown in close proximity, provide a clear distance between bars of not less than the nominal bar diameter or 1 inch, whichever is greater.
4. For columns, piers and pilasters, provide a clear distance between vertical bars as shown, but not less than 1-1/2 times the nominal bar diameter or 1-1/2 inches, whichever is greater. Provide lateral ties.
5. Provide lapped splices with reinforcing steel placed in contact and wire tied. Provide minimum lap required by governing code unless more stringent requirements are shown. Do not splice reinforcement at points other than shown or as approved on Shop Drawings.

J. Grouting Structural Reinforced Unit Masonry Construction:

1. Limit extent of masonry construction to sections which do not exceed the maximum pour requirements specified. Provide temporary dams or barriers to control horizontal flow of grout at ends of wall sections. Build dams full height of grout pour. If masonry units are used, do not bond into permanent masonry wythes. Remove temporary dams after completion of grout pour.
2. Use fine grout for filling spaces less than 4 inches in both horizontal directions. Use coarse grout for filling spaces 4 inches or larger in both horizontal directions.
3. For spaces 10 inches and larger use concrete fill.
4. Low-Life Grouting:
   a. Use low-lift grouting techniques using fine grout mix for the following:

1) Two-wythe walls with grout space of 2-inches or less in width.

2) Multi-wythe walls.

3) At CONTRACTOR'S option, low-lift grouting technique may be used for structural reinforced unit masonry construction Work with grout spaces wider than 2 inches, except use coarse grout mix and place in lifts not to exceed 8 inches in height.

b. Grout spaces less than 2 inches in width at intervals not to exceed 24 inches in lifts of 6 to 8 inches.

c. Construct low-lift structural reinforced unit masonry construction Work by placing reinforcing, laying masonry units and pouring grout as the Work progresses.

d. Place vertical reinforcing bars and supports prior to laying of masonry units. Extend above elevation of maximum pour height as required to allow for splicing. Horizontal reinforcing bars may be placed progressively with laying of masonry units.

e. Limit grout pours as required to prevent displacement of masonry by grout pressures (blowout), but do not exceed 12 inch pour height.

f. Lay masonry units prior to each grout pour, but do not construct more than 12 inches above maximum grout pour height in one exterior wythe and 4 inches above in other exterior wythe. Provide metal wall ties if required to prevent blowouts.

g. Pour grout using container with spout and consolidate immediately by rodding or puddling; do not use trowels. Place grout continuously; do not interrupt pouring of grout for more than one hour. If poured in lifts, place from center-to-center of masonry courses. Terminate pour 1-1/2 inches below top of highest course in pour.

K. Anchoring Masonry Work:

1. Provide anchoring devices of the type shown and as specified under Section 4B, Masonry Accessories. If not shown or specified, provide standard type for facing and back-up involved.

2. Anchor masonry to structural members where masonry abuts or faces such members to comply with the following:
   a. Provide an open space not less than 1/2 inch in width between masonry and structural member, unless otherwise shown. Keep open space free of mortar or other rigid materials.
   b. Anchor masonry to structural members with metal ties embedded in masonry joints and attached to structure. Provide anchors with flexible tie sections, unless otherwise shown.
   c. Space anchors as shown, but not more than 24 inches on center vertically and 36 inches on center horizontally.
   d. Provide end blocks where masonry abuts structural support to facilitate installation of compressible filler, fire safing insulation, backer rod and sealant.
3. Anchor single wythe masonry veneer to backing with metal ties as follows:
   a. Anchor veneer to structural members with metal anchors embedded in masonry joints and attached to structure. Provide anchors with flexible tie section, unless otherwise shown.
   b. Anchor veneer to concrete back up with dovetail anchors.

L. Masonry Control Joints:
1. Provide vertical control joints in masonry where shown. Build in related items as the unit masonry construction Work progresses. Rake out mortar in preparation for application of calking and sealants. Refer to Section 7J1, Calking and Sealants.
2. Provide masonry control joints consisting of items specified under Section 4B, Masonry Accessories, where masonry control joints are shown.
   a. Build in compressible fillers where shown. Install in accordance with manufacturer's written instructions.
   b. Build in factory premolded control joint strips into masonry. Build in sash block and premolded control joint strips as the Work progresses.
   c. Provide end blocks where masonry partitions abut structure to facilitate installation of compressible filler, fire safing insulation, backer rod and sealant.

3. Masonry Control Joint Spacing: Locate masonry control joints as shown.

M. Lintels and Bond Beams:

1. Provide steel lintels where shown and as specified in Section 5E3, Miscellaneous Metal Fabrications.
2. Provide masonry lintels and bond beams where shown and wherever openings of 16 inches or more are shown without structural steel lintels. Provide formed in place masonry lintels and bond beams. Temporarily support formed-in-place lintels and bond beams.
   a. Unless otherwise shown, provide one horizontal number six deformed reinforcing bar for each 4 inches of wall thickness.
   b. For hollow masonry unit walls, use specially formed "U" shaped lintel and bond beam units with reinforcing bars placed as shown, filled with grout as specified in Section 4A, Mortar.
3. Provide minimum bearing at each jamb, of 4 inches for openings less than 6 feet-0 inches wide, and 8 inches for wider openings.
4. On concrete unit masonry walls where pattern bond remains visually exposed, increase minimum bearing of masonry lintels to maintain joint pattern of wall and install so as to be indistinguishable from surrounding masonry.

N. Flashing of Masonry Work:

1. Provide concealed flashings in masonry Work as shown. Refer to Section 7H1, Flashing and Trim. Prepare masonry surfaces smooth and free from projections which might puncture flashing. Place through wall flashing on bed of mortar and cover with mortar. Seal flashing penetrations with mastic before covering with mortar. Terminate flashing 1/2 inch from face of wall, unless otherwise shown.

3.5 REPAIR, POINTING AND CLEANING

A. Remove and replace masonry units which are loose, chipped, broken, stained or otherwise damaged, or if units do not match adjoining units as intended.

Provide anew units to match adjoining units and install in fresh mortar or grout, pointed to eliminate evidence of replacement.

B. Pointing Concrete Unit Masonry: During the tooling of joints, enlarge any voids or holes, except weep holes, and completely fill with mortar. Point up all joints at corners, openings and adjacent Work to provide a neat, uniform appearance, properly prepared for application of sealant compounds.

C. Cleaning Exposed, Unglazed Masonry Surfaces:

1. Wipe off excess mortar as the Work progresses. Dry brush at the end of each day's work.
2. Final Cleaning: After mortar is thoroughly set and cured, clean sample wall area of approximately 20 square feet as described below. Obtain ENGINEER'S acceptance of sample cleaning before proceeding to clean remainder of masonry work.
   a. Dry clean to remove large particles of mortar using wood paddles and scrapers. Use chisel or wire brush if required.
   b. Presoak wall by saturating with water and flush off loose mortar and dirt.
   c. Comply with the requirements and recommendations for "Cleaning Clay Products Masonry" of the Technical Notes on Brick and Tile Construction by Brick Institute of America for the type of masonry and conditions involved in the Work.
   d. Apply acid type cleaners in compliance with manufacturer's instructions.
   e. Protect other Work from acid solutions and cleaning operations.

D. Protection:

1. Protect the unit masonry construction Work from deterioration, discoloration or damage during subsequent construction operations. See Section 6A, Rough Carpentry.

END OF SECTION

SECTION 4C3

CONCRETE UNIT MASONRY

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish concrete unit masonry Work.
2. The extent of each type of concrete unit masonry is shown.
3. The types of concrete masonry units required includes, but is not necessarily limited to, the following:
   a. Hollow load-bearing units.

B. Related Sections:

1. Section 4A, Mortar.
2. Section 4B, Masonry Accessories.
3. Section 4C1, Unit Masonry Construction.

1.2 QUALITY ASSURANCE

A. Requirements of Regulatory Agencies: Wherever a fire-resistance classification is shown or scheduled for concrete unit masonry construction (4-hour, 3-hour and similar designations), provide concrete masonry units complying with the requirements established by the UL and other governing authorities.

B. Codes: Comply with applicable requirements of the State of Rhode Island Official Compilation of Codes, Rules and Regulations for types of concrete unit masonry shown and specified.

C. Source Quality Control: Obtain each type of concrete masonry units from one manufacturer, cured by one process and of uniform texture and color or in an established uniform blend thereof.

D. Reference Standards: Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.

1. ASTM C 33, Concrete Aggregates.
2. ASTM C 55, Concrete Building Brick.
3. ASTM C 67, Sampling and Testing Brick and Structural Clay Tile.
4. ASTM C 90, Hollow Load-Bearing Concrete Masonry Units.
5. ASTM C 331, Lightweight Aggregates for Concrete Masonry Units.
6. ASTM C 426, Drying Shrinkage of Concrete Block.
7. ASTM E 84, Standard Method of Test for Surface Burning Characteristics of Building Materials.
8. ASTM E 119, Fire Tests of Building Construction and Materials.
9. UL Design Numbers U901 through U908.

1.3 SUBMITTALS

A. Samples: Submit for approval the following:

1. Each type of concrete masonry unit specified. Select each type of concrete masonry unit to show the range of color and texture which can be expected in the finished Work.
2. ENGINEER'S review will be for color and texture only. Compliance with all other requirements is the exclusive responsibility of CONTRACTOR.

B. Shop Drawings: Submit for approval the following:

1. Copies of manufacturer's specifications and test data for concrete masonry unit specified, including certification that concrete masonry units comply with the specified requirements. Include instructions for handling, storage, installation and protection of concrete masonry unit.
2. Product specification data for integral waterproofing admixture.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Delivery of Materials: Deliver concrete masonry units in original packages and pallets, plainly marked with identification of materials and manufacturer.

B. Storage of Materials: Store and cover concrete masonry units to prevent damage such as chipping and staining.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Size: Manufacturer's standard units with nominal face dimensions of 16-inches long by 8-inches high (15-5/8 inches by 7-5/8 inches actual).

B. Special Shapes: Provide for interior and exterior corner shapes, solid jambs,lintels, bond beams, sash block, premolded control joint blocks, end blocks, bullnosed vertical corners at all openings, headers, and other special conditions.

2.2 CONCRETE MASONRY UNITS

A. General: Where concrete masonry units are shown or specified, comply with the following classifications, weight, grade, curing and other requirements as specified.

B. Hollow Load-Bearing Concrete Masonry Units: ASTM C 90, Grade N-I.

C. Weight:

1. Provide medium weight units using concrete aggregates complying with ASTM C 33 producing dry net weight of not less than 125 pounds per cubic foot.

D. Curing:

1. Cure units in a moisture controlled atmosphere or in an autoclave at normal pressure and temperature to comply with ASTM C 90, Type I.

2. Limit moisture absorption during delivery and until time of installation to the maximum percentage specified for Type I units for the average annual relative humidity as reported by the United States Weather Bureau Station nearest the project site and the corresponding percentage of linear shrinkage of the concrete masonry units.

E. Exposed Faces: Provide manufacturer's standard color texture.

F. Provide two-core concrete masonry units.

G. Waterproofing Admixture: Manufacture all concrete unit masonry with an integral waterproofing admixture as follows:

1. Proportion: In strict accordance with manufacturer's instructions.

2. Product and Manufacturer: Provide one of the following:

a. Dry-Block Mortar admix by Forrer Industries, a Unit of W.R. Grace & Company Construction Products Division.

PART 3 - EXECUTION

3.1 INSTALLATION

A. See Section 4C1, Unit Masonry Construction.

END OF SECTION

SECTION 5A3

STRUCTURAL STEEL

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall furnish all labor, materials, equipment, and incidentals required to provide the structural steel, including surface preparation and shop priming, as shown and specified.

B. Coordination:

1. Review installation procedures under other Sections and coordinate the Work that must be installed with or attached to the structural steel.

1.2 QUALITY ASSURANCE

A. Reference Standards: Comply with applicable provisions and recommendations of the following except as otherwise shown or specified.

1. AISC Code of Standard Practice for Steel Buildings and Bridges.
2. AISC Specifications for Structural Steel Buildings including Commentary".
3. AWS D1.1, Structural Welding Code.

1.3 SUBMITTALS

A. Shop Drawings:

1. Submit for approval Shop Drawings including complete details and schedules for fabrication and shop assembly of members and details, schedules, procedures and diagrams showing the sequence of erection.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Rolled Steel Plates, Shapes and Bars: ASTM A 36, except where other type steel is shown.

B. Cold-Formed steel Tubing: ASTM A 500, Grade B.

C. Steel Pipe: ASTM A 53, Type E or S, Grade B.

D. Fasteners: High-strength bolts and nuts, ASTM A 325 or A 490; unfinished bolts and nuts, ASTM A 307, Grade A.

E. Electrodes for Welding: E70XX complying with AWS D1.1, Design of New Buildings, Section 8.

F. Shop Paint: Included herein but as specified in Section 9L.

2.2 FABRICATION

A. Shop Fabrication and Assembly:

1. General:

a. Fabricate and assemble structural assemblies in the shop to the greatest extent possible. Fabricate items of structural steel in accordance with AISC, Manual of Steel Construction, and as shown on the Shop Drawings.

b. Provisions for Other Work: Fabricate structural steel members to provide holes for securing other work and for passage of other work through steel framing as indicated.

B. Connections:

1. Shop Connections:

a. Unless otherwise shown, shop connections may be welded or high strength bolted. Unless shown otherwise, all welds shall be 1/4-inch minimum.

b. Wherever reaction values of a beam are not shown, the connections shall be designed to support the total uniform load capacity tabulated in the AISC tables for allowable loads on beams for the given shape, span, and steel specified for the beam in question.

2. Field Connections:

a. All field connections unless otherwise specified below or noted shall be made with high strength bolts, and shall be bearing type connections.

C. Columns: Columns shall have milled bearing surfaces at the base and at all splice lines.

PART 3 - EXECUTION

3.1 INSPECTION

A. CONTRACTOR and his erector shall examine areas and conditions under which structural steel Work is to be installed, and notify ENGINEER of conditions detrimental to proper and timely completion of Work. Do not proceed with Work until unsatisfactory conditions have been corrected in a manner acceptable to ENGINEER.

3.2 ERECTION

A. General: Comply with the AISC Specifications and Code of Standard Practice, and as herein specified.

B. Anchor Bolts:

1. Furnish anchor bolts and other connectors required for securing structural steel to foundations and other in-place Work.
2. Furnish templates and other devices as necessary for presetting bolts and other anchors to accurate locations.

C. Setting Bases and Bearing Plates:

1. Clean concrete and masonry bearing surfaces of bond-reducing materials a roughen to improve bond to surfaces. Clean the bottom surface of base a bearing plates.
2. Set loose and attached base plates and bearing plates for structural memb on steel wedges and grout.

D. Field Assembly: Set structural frames accurately to the lines and elevations indicated. Level and plumb individual members of the structure within tolerances as specified in AISC Manual.

E. Touch-Up Painting:

1. Comply with all requirements of touch-up painting in Section 9L.

END OF SECTION

D. Shop Assembly: Preassemble items in the shop to the greatest extent possible, so as to minimize field splicing and assembly of units at the project site. Disassemble units only to the extent necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

1.3 SUBMITTALS

A. Samples: Submit for approval sets of representative samples of materials including nosings, rungs and other finished products as may be requested by ENGINEER. Review will be for color, texture, style, and finish only. Compliance with all other requirements is exclusive responsibility of CONTRACTOR.

B. Shop Drawings: Submit for approval the following:

1. Shop Drawings for the fabrication and erection of all assemblies of miscellaneous metal fabrications Work. Include plans, elevations, and details of sections and connections. Show anchorage and accessory items. Include setting drawings and templates for location and installation of miscellaneous metal fabrications items and anchorage devices.
2. Copies of manufacturer's specifications, load tables, dimension diagrams, anchor details, and installation instructions for products to be used in miscellaneous metal fabrications Work.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Stainless Steel Sheet and Plate: ASTM A 240.

B. Steel Plates, Shapes and Bars: ASTM A 36.

C. Aluminum:

1. Alloy and Temper: Provide alloy and temper as shown or specified, or as otherwise recommended by the aluminum producer or finisher.

2. Extruded Shapes and Tubes: ASTM B 221.
3. Plate and Sheet: ASTM B 209.
4. Bars, Rods and Wire: ASTM B 211.
5. Finish: Provide Architectural Class I anodized finish AA-M32C22A41 Clear as specified in the NAAMM Manual.

D. Stainless Steel Fasteners and Fittings: ASTM A 320.

E. Zinc Coated Hardware: ASTM A 153.

2.2 MISCELLANEOUS METAL ITEMS

A. Aluminum Ladders:

1. Fabricate ladders for the locations shown, with dimensions, spacings, details and anchorages as shown and specified. Comply with the requirements of ANSI A14.3, except as otherwise shown or specified.
   a. Unless otherwise shown, provide aluminum pipe, ASTM B 429, 554, 1.90-inch outside diameter, Schedule 80 side rails spaced 18 inches apart, minimum.
   b. Provide solid aluminum square rungs, spaced 12 inches on centers, maximum, with non-slip surface on the top of each rung.
2. Fit rungs in centerline of side rails, plug weld and grind smooth on outer rail faces.
3. Support each ladder at top and bottom and at intermediate points spaced not more than 5 feet on centers. Use welded or bolted brackets, designed for adequate support and anchorage, and to hold the ladder clear of the wall surface with a minimum of 7 inches clearance from wall to centerline of rungs. Extend rails 42 inches above top rung, and return rails to wall or structure unless other secure handholds are provided. If the adjacent structure does not extend above the top rung, gooseneck the extended rails back to the structure to provide secure ladder access.

B. Aluminum Ladder Safety Cages:

1. Fabricate ladder safety cages from flat bars, assembled by welding. Unless otherwise shown, provide 1/2-inch by 3-inch top, bottom and intermediate hoops spaced not more than 5 feet on centers; and 3/8-inch by 2-inch vertical bars, secured to each hoop. Space vertical bars approximately 9 inches on centers. Fasten assembled safety cage to ladder rails and adjacent construction as shown. Grind all welds, sharp edges and projections smooth.
2. Comply with the requirements of ANSI A14.3.

C. Fall Prevention System: All ladders shall be provided with a fall prevention system. The system shall meet OSHA standards.

1. The system shall consist of curved and straight custom lengths of Type 316 stainless steel notched carrier rails and rung clamps permanently attached to the ladder to which a harness belt is attached. Spacing of ladder attachments shall be provided as recommended by the manufacturer.
2. Provide each ladder with one of each of the following in addition to rail and support assemblies:
   a. Cast manganese bronze locking sleeve with locking pawl filled with fire stainless steel sealed roller bearings in covered housing.
   b. Polyester nylon and leather safety belt recommended by the system manufacturer for full feature compatibility.
   c. Removable stainless steel extension system consisting of rail, stainless steel tie-down rod and mandril.
3. System manufacturer shall review each ladder to determine desirability of detachment sections. Inform Engineer of recommendations.
4. Product and Manufacturer: Provide fall prevention systems as manufactured by one of the following:
   a. Saf-T-Climb System by North Consumer Products, A division of Siebe North Incorporated.
   b. Or equal.

Loose Steel Lintels: Provide loose hot dipped galvanized structural steel lintels for openings and recesses in masonry walls and partitions as shown. Where not shown provide loose steel lintels as specified. Weld adjoining members together to form a single unit and grind welds smooth where exposed in the finished Work. Provide not less than 4 inches bearing at each side of openings, unless otherwise specified. Unless otherwise shown size loose lintels as follows:

Clear Span (Max)	Exterior Angle	Interior Angles
-0"	3-1/2-inches x 3-1/2-inches x 5/l6-inches	(2) 3-1/2-inches x 3-1/2-inches x 5/16-inches
6'-0"	4-inches x 3-1/2-inches x S/16-inches	(2) 4-inches x 3-1/2-inches x 5/16-inches
8'-0"	5-inches x 3-1/2-inches x S/16-inches	(2) 5-inches x 3-1/2-inches x S/16-inches
Greater than 8'-0"	Submit calculations prepared, signed end stamped with the seal of a greater than 8'-0" Registered Professional Engineer licensed to practice in the State of Rhode Island and recognized as an expert in the required Work.	

E. Shelf Angles: Provide galvanized steel shelf angles of sizes shown for attachment to concrete and masonry construction. Provide horizontal slotted holes to receive 3/4-inch bolts, spaced not more than 6 inches from ends and not more than 2 foot-6 inches on centers. Weld adjoining members together to form a single unit and grind welds smooth where exposed in the finished Work.

F. Miscellaneous Framing and Supports:

1. Provide miscellaneous metal framing, supports and other metal items required which are not a part of the structural steel framework and are required to complete the Work.
2. Fabricate miscellaneous units to the sizes, shapes and profiles shown or, if not shown, of the required dimensions to receive adjacent grating, plates, tanks, doors, or other work to be retained by the framing. Except as otherwise shown, fabricate from structural shapes, plates, and bars, of all welded construction using mitered corners, welded brackets and splice plates and a minimum number of joints for field connection. Cut, drill and tap units to receive hardware and similar items to be anchored to the Work.
3. Equip units with integrally welded anchors for casting into concrete or building into masonry. Furnish inserts if units must be installed after concrete is placed.
   a. Except as otherwise shown, space anchors, 24 inches on centers, and provide units and equivalent of 1-1/4-inch by 1-1/4-inch by 8-inch strips.
   b. Galvanize all exterior miscellaneous framing and supports.
   c. Galvanize interior miscellaneous framing and supports where shown.

G. Alternating tread cross-over ladder and platform:

1. Provide stair 24-inches wide and platform 24-inches square fabricated from AAF356F cast alloy aluminum with all walking surfaces cast with skid resistant patterns as follows:
   a. Provide stair 68 degrees to horizontal.
   b. Fabricate to clear containment wall.
   c. All castings MIG welded.
   d. Provide cast aluminum foot divider integral with platforms.
   e. Railings shall be contoured for body guidance and underarm support and be fabricated of 6061-T4 aluminum.
   f. Central stringer shall be aluminum 6063-T52.
   g. All aluminum shall be A41 clear anodized.

2. Product and Manufacturer: Provide one of the following:
   a. Alternating tread cross-over aluminum ladder and associated platforms by Lapeyre Stair Incorporated.

H. Truck Bollards: Provide 8-inch diameter, double extra strong galvanized steel pipe, 3 foot-4 inches above grade, 3 feet below grade. Fill with concrete and mound top.

I. Primer Paint: Unless otherwise shown or specified, prepare surfaces and prime steel items as required under Section 9L, Painting.

J. Galvanizing: All galvanizing of fabricated steel items shall comply with the requirements of ASTM A 123.

K. Aluminum Finish: Provide a natural mill finish for all aluminum Work unless otherwise shown or specified.

L. Expansion Shield Fasteners: Unless otherwise specified by materials or equipment manufacturer, expansion anchors shall conform to the following:
   1. For items not anchored into concrete or masonry with integral anchors welded or bolted to the item, provide fasteners for anchoring made of stainless steel as specified.
   2. Install fastener in accordance with manufacturer's recommendations.
   3. 1/2-inch diameter, 2-inches embedment length minimum.
   4. Power driven pin" and stud" type fasteners will not be permitted.
   5. Product and Manufacturer: Provide one of the following:
      a. Molly Parabolts by USM Corporation.
      b. Kwik-Bolt by Hilti Corporation.

2.3 SURFACE PREPARATION AND SHOP PAINTING

A. Surface preparation and shop painting is required for all ferrous metals, equipment and accessories. Stainless steel shall not be painted.

B. All ferrous metal surfaces shall be cleaned and provided with surface preparation and two coats of priming paint in accordance with the applicable requirements of Section 9L, Painting. All prime coat materials shall be

compatible with the finish coat materials to be furnished under Section 9L, Painting.

PART 3 - EXECUTION

3.1 FABRICATION, GENE ML

A. Use materials of the size and thicknesses shown or if not shown, of the required size and thickness to produce adequate strength and durability in the finished product for the intended use. Work to the dimensions shown or accepted on Shop Drawings using proven details of fabrication and support. Use the type of materials shown or specified for the various components of Work.

B. Form exposed Work true to line and level with accurate angles and surfaces and straight sharp edges. Ease exposed edges to a radius of approximately 1/32 inch unless otherwise shown or specified. Form bent metal corners to the smallest radius possible without causing grain separation or otherwise impairing the Work.

C. Weld corners and seams continuously and in accordance with the recommendation of AWS. Grind exposed welds smooth and flush to match and blend with adjoining surfaces. Discoloration of finished surfaces of materials not to be painted will not be acceptable.

D. Form exposed connections with hairline joints which are flush and smooth using concealed fasteners wherever possible. Use exposed fasteners of the type shown or if not shown, use flathead (countersunk) screws or bolts.

E. Cut, reinforce, drill, and tap miscellaneous metal fabrications Work as may be required to receive finish hardware and similar items of Work.

F. Use hot-rolled steel bars for Work fabricated from bar stock unless Work is otherwise shown or specified to be fabricated from cold-finished or cold-rolled stock.

3.2 INSTALLATION

A. Set miscellaneous metal fabrications accurately in location, alignment and elevation, plumb, level, true and free of rack, measured from established lines and levels. Brace temporarily or anchor temporarily in formwork where fabrications are to be built into concrete, masonry or similar construction.

B. Anchor securely as shown or as required for the intended use, using concealed anchors wherever possible. Comply with the following:

1. Drilling equipment used and installation of expansion anchors shall be in accordance with manufacturer's instructions.
2. Assure that embedded items are protected from damage and are not filled in with concrete.
3. Expansion anchors may be used for hanging or supporting 2-inch diameter pipes and smaller. Expansion anchors shall not be used for larger pipe unless otherwise shown or approved by ENGINEER. 4. Use concrete inserts for pipe hangers and supports for the pipe size and loading recommended by the insert manufacturer.
   a. Minimum embedment depth in concrete: 5 diameters.
   b. Minimum anchor spacing on centers: 10 diameters
   c. Minimum distance to edge of concrete: 5 diameters.
   d. Increase dimensions above if required to develop the required anchor load capacity.

C. Fit exposed connections accurately together to form tight hairline joints. Weld steel connections which are not to be left as exposed joints, but cannot be shop welded because of shipping size limitations. Grind steel joints smooth and touch up shop paint coat. Do not weld, cut or abrade the surfaces of exterior units which have been hot-dip galvanized after fabrication, and are intended for bolted or screwed field connections.

D. Protection of Aluminum from Dissimilar Materials: Using approved washers, strips or sheets of felt, and coating specified in Section 9L, Painting, protect all surfaces of aluminum from contact with dissimilar materials such as concrete, masonry, steel, nonferrous metals, etc.

END OF SECTION

SECTION 5E5

ALUMINUM GRATING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish aluminum grating and frames.
2. The types of grating required shall be the following: a. Pressure locked.
   1) Rectangular section.
   2) I-bar section.
3. The Work also includes:
   a. Providing openings in grating to accommodate the Work under this and other Sections and attaching to the grating all items such as sleeves, bands, studs, fasteners and all items required for which provision is not specifically included under other Sections.

B. Coordination:

1. Review installation procedures under other Sections and coordinate the Work that must be installed with or attached to the grating.

1.2 QUALITY ASSURANCE

A. Reference Standards: Comply with applicable provisions and recommendations of the following except as otherwise shown or specified.

1. ASTM B 210, Standard Specification for Aluminum and Aluminum Alloy Drawn Seamless Tubes.

2. ASTM B 221, Standard Specification for Aluminum and Aluminum Alloy Extruded Bars, Rods, Wire, Shapes and Tubes.
3. MMM, Metal Finishes Manual, and Metal Bar Grating Manual.

B. Field Measurements:
1. Take field measurements prior to preparation of Shop Drawings and fabrication where required, to ensure proper fitting of the Work.

1.3 SUBMITTALS

A. Samples: Submit for approval the following: Representative samples of grating, appurtenances and other finished products requested by ENGINEER. His review will be for type and finish only. Compliance with all other requirements is the exclusive responsibility of CONTRACTOR.

B. Shop Drawings: Submit for approval the following:
1. Fabrication and erection of all Work. Include plans, elevations, and details of sections and connections. Show anchorage and accessory items.
2. Setting drawings and templates for location and installation of anchorage devices.
3. Manufacturer's specifications, load tables, dimension diagrams, anchor details and installation instructions.

PART 2 - PRODUCTS

2.1 PERFORMANCE CRITERIA

A. The manufacturer shall furnish grating to conform the following criteria:

1. Design Loads: Uniform live load or a concentrated load on any area 24 inches square, whichever gives the greatest stresses.

Live Load	Concentrated Load
a. 200 psf	2000 lbs

2. Maximum Clear Span Deflection: 1/120 of span.
3. Maximum Fiber Stress: 12,000 psi.
4. Bearing bars shall be a maximum of 1-3/16 inches on center and 3/16 inches minimum thickness.
5. Cross bars or bent connecting bars shall not exceed 7 inches on center.

2.2 MATERIALS

A. Bearing Bars: Alloy 6061-T6 or Alloy 6063-T6, conforming to ASTM B 221.

B. Cross Bars or Bent Connecting Bars: Alloy conforming to either ASTM B 221 or ASTM B 210.

C. Rivets: Aluminum-Alloy as recommended by the Manufacturer.

2.3 FABRICATION

A. Use materials of the minimum size and thickness as specified above unless shown otherwise. Work to the dimensions shown on approved Shop Drawings.

B. Grating shall be as shown and shall comply with the NAAMM "Metal Bar Grating Manual", except as specified herein.
   1. Cross Bars: Perpendicular to bearing bars, secured by mechanical locking.
   2. Traffic Surface: Plain.

C. Type of Finish: Mill, as fabricated.

D. Provide grating sections with end-banding bars welded about 4 inches on centers for each panel, 4 saddle clip or flange block anchors designed to fit 2 bearing bars, and 4 stud or machine bolts with washers and nuts, unless otherwise indicated.

E. Cut gratings for penetrations as indicated. Layout units to allow grating removal without disturbing items penetrating grating.

1. For openings in grating separated by more than 4 bearing bars, provide banding of same material and size as bearing bars, unless otherwise indicated. Weld band to each bearing bar.
2. Notching of bearing bars at supports to maintain elevations will not be permitted.

F. Weld stainless steel stud bolts to receive saddle clip or flange block anchors to supporting steel members. Drill for machine bolts when supports are aluminum.

G. Provide gratings in concrete with aluminum angle frames having mitered corners and welded joints. Grind exposed joints smooth. Frames shall have welded anchors set into concrete. Angle size shall match grating depth selected to assure flush fit.

H. Provide gratings attached to existing concrete, masonry or steel with aluminum bearing angles fastened with anchors as shown or otherwise approved by ENGINEER.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Fastening to In-Place Construction:

1. Use anchorage devices and fasteners to secure grating to supporting members or prepared openings, as recommended by the manufacturer.

B. Cutting, Fitting and Placement:

1. Perform all cutting, drilling and fitting required for installation. Set the Work accurately in location, alignment and elevation, plumb, level, true and free of rack. Do not use wedges or shimming devices.
2. However gratings are pierced by pipes, ducts, and structural members, cut openings neatly and accurately to size and attach a strap collar not less than 1/8-inch thick to the cut ends of the bars.
3. Divide the panels into sections only to the extent required for installation wherever grating is to be placed around previously installed pipe, ducts, and structural members.
4. For contact surfaces between aluminum and concrete, masonry, steel, or other dissimilar surface use a coat of bituminous paint or other approved insulating material.

C. Protection of Aluminum from Dissimilar Materials: Using approved asphaltic or zinc chromate paint, provide two heavy coats on aluminum surfaces in contact with dissimilar materials such as concrete, masonry, steel and other metals.

END OF SECTION

SECTION 5E10

ALUMINUM HANDRAILS AND RAILINGS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish and install aluminum handrail and railing Work. The Work also includes:
   a. Providing openings in and attachments to railing to accommodate the Work under this and other Sections and providing for the handrail and railing all items such as anchor bolts, fasteners, studs and all items required for which provision is not specifically included under other Sections.
2. The extent of each type of aluminum handrail and railing is shown and specified.
3. The types of aluminum handrail and railing Work required includes, but is not necessarily limited to, the following:
   a. Top and one intermediate horizontal railing.
   b. Handrail.
   c. Toeboards.
   d. Anchors and fasteners.
   e. Sleeves, castings, reinforcing inserts, wall brackets, and other miscellaneous accessories.

B. Coordination:

1. Review installation procedures under other Sections and coordinate the Work that must be installed with or attached to the aluminum handrail and railing Work.

C. Related Sections:

1. Section 3I, Grout.
2. Section 5E3, Miscellaneous Metal Fabrications.

1.2 QUALITY ASSURANCE

A. Manufacturer Qualifications:

1. Engage a single firm, with undivided responsibility for performance of the aluminum handrail and railing Work.
2. Engage a firm which can show five years previous successful experience in the fabrication and erection of aluminum handrail and railing systems of scope and type similar to the required Work.
3. Provide manufacturer capable of fabricating custom details shown.

B. Design Criteria:

1. Provide adequate expansion within the fabricated system which allows a thermal change of 100 F above installation temperature without warp or bow. Provide 0.1 inch space for each 20 feet of length of rail for each 25 F difference of thermal change specified or use manufacturer's published formulas for determining expansion joint movement and spacing. Limit the exposed width of each expansion joint to 1/4 inch.
2. Provide expansion joint in aluminum handrail and railing system work where systems cross expansion joints in structure.
3. Aluminum handrail and railing is shown to indicate general locations where handrail and railing is required by ENGINEER. All aluminum handrail and railing shown shall be as specified herein regardless of the number of immediate horizontal rails shown. In addition, where handrail or railing is required by either the State of Rhode Island Official Compilation of Codes, Rules and Regulations or the Occupational Safety and Health Act of 1970, aluminum handrail and railing of the type specified herein shall be provided at no additional cost to ENGINEER, whether or not shown.

4. Configuration of all handrail and railing details shall be as shown on the General Railing and Handrail Sheet regardless of symbolic indications which may be otherwise shown.

5. Provide aluminum handrail and railing system Work that conforms to OSHA, Part 1910.23, including the 200 pound loading requirement. In addition, the system shall conform to the following requirements of ANSI A1264:

   a. Completed aluminum handrail and railing system Work to withstand a load of 25 pounds per linear foot applied in any direction at the top of the handrail and railing.

   b. Intermediate rail to withstand a horizontal load of 20 pounds per linear foot.

   c. All above loads are not additive.

   d. Other pertinent requirements ceded to ANSI A1264.1 by governing codes.

6. Select systems components and post spacing so that specified applied loads produce no permanent set in the completed aluminum handrail and railing system Work.

7. All railing system posts shall be provided with a circular profile solid reinforcing bar with outside diameter equal to inside diameter of post. All posts shall receive one reinforcing bar. Select schedule of pipe using alloys, minimum diameter, loadings and maximum post spacing specified in order to limit deflection in each single-span of handrail and railing to 1.5-inches maximum and on railing posts to 1.4-inches maximum and with a safety factor of 1.65:1 for all Work.

C. Codes: Comply with the applicable requirements of the State of Rhode Island Official Compilation of Codes, Rules and Regulations and the Occupational Safety and Health Act of 1970 for types of aluminum handrail and railing system Work shown and specified.

D. Allowable Tolerances:

1. Limit variation of cast-in-place inserts, sleeves and field drilled holes to the following:

   a. Spacing: +3/8 inch.

b. Alignment: +1/4 inch.

c. Plumbness: +1/8 inch.

2. Limit variation of completed railing system alignment to 1/4 inch in 12 feet.

3. Set rails horizontal or parallel to rake of steps or ramp to within 1/4 inch in 12 feet.

E. Reference Standards: Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.

1. ASTM B 26, Aluminum-Alloy Sand Castings.
2. ASTM B 210, Aluminum-Alloy Drawn Seamless Tubes.
3. ASTM B 221, Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes and Tubes.
4. ASTM B 241, Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube.
5. ASTM B 247, Aluminum-Alloy Die and Hand Forgings.
6. ASTM B 429, Aluminum-Alloy Extruded Structural Pipe and Tube.
7. AWS D10.7, Gas Shielded-Arc Welding of Aluminum and Aluminum Alloy Pipe.
8. The Aluminum Association, Aluminum Standards and Data; and Standards for Anodized Architectural Aluminum.
9. N MMM, Metal Finishes Manual".
10. N M MM, Pipe Railing Manual.
11. ANSI A1264.1, Safety Requirements for Workplace Floor and Wall Openings, Stairs and Railing Systems.
12. OSHA Part 1910.23 - Guarding Floor and Wall Openings and Holes.

F. Field Measurements: Take field measurements, where required, prior to preparation of Shop Drawings and fabrication to ensure proper fitting of the Work.

G. Shop Assembly: Preassemble items in the shop to the greatest extent possible, so as to minimize field splicing and assembly of units at the project site. Disassemble units only to the extent necessary for shipping

and handling limitations. Clearly mark units for reassembly and coordinate installation.

1.3 SUBMITTALS

A. Samples: Submit for approval the following:

1. Full size sample of assembled post and rails intersections with all associated components including mounted toeboard and socket, all with specified metal finish, including typical welded or bolted connections, with rails not less than 6-inches long. Samples will be reviewed for finish, color, joinery tolerances, workmanship and general component assembly only. Compliance with all other requirements is the exclusive responsibility of CONTRACTOR.
2. Color Samples: Maximum range of clear anodized aluminum that shall appear in finished Work. Prepare range samples, to show the highest level of color control feasible for actual aluminum handrail and railing system Work, as determined by the licensor of the finishing process selected, on actual extrusions and castings of the Work.

B. Shop Drawings: Submit for approval the following:

1. Shop Drawings for the fabrication and erection of aluminum handrail and railing system Work. Include all plans and elevations identifying the location of all handrail and railing, and details of sections and connections. Show all anchorage items.
2. Calculations for the complete structural design of the aluminum handrail and railing system Work including calculations showing compliance with design criteria specified.
3. Manufacturer's complete catalogs showing complete selection of standard and custom components and miscellaneous accessories for selection by ENGINEER.
4. Maintenance Manuals: Upon completion of the Work, furnish copies of detailed maintenance manual including the following information:
   a. Product name and number.

b. Name, address and telephone number of manufacturer and local distributor.

c. Detailed procedures for routine maintenance and cleaning, including cleaning materials, application methods and precautions as to use of materials that may be detrimental to finish when improperly applied.

C. Certification: Furnish certification by manufacturer that load tests have been performed on the aluminum handrail and railing systems Work and that they conform to all applicable OSHA, ANSI and building code requirements for loading and deflections and meet minimum criteria specified herein.

D. Finish: Furnish a written certificate confirming specified coating film thickness, coating weight, sealing treatment and stain test.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Delivery of Materials:

1. Deliver materials to the site in good condition and properly protected against damage to finished surfaces.

B. Storage of Materials:

1. Store all materials in clean, dry location, away from uncured concrete and masonry.
2. Cover all materials with waterproof paper, tarpaulin or polyethylene sheeting.

C. Handling of Materials:

1. Keep on-site handling to a minimum.
2. Maintain protective covering on handrails and railings until installation is complete.

1.5 JOB CONDITIONS

A. Protection: Protect cast-in-place sleeves and field-drilled holes from debris and water intrusion by use of temporary covers or removable foam inserts.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Extruded Aluminum Architectural and Ornamental Shapes: ASTM B 221, Alloy 6063-T52.

B. Aluminum Forgings: ASTM B 247.

C. Extruded or Drawn Aluminum Pipe and Tube:
   1. ASTM B 429 or ASTM B 241, Alloy 6063-T5, 6063-T52 or 6063-T832 as required by loadings, deflections and post spacings specified.

   2. Provide all rails and posts with minimum outside diameter of 1.900-inches.

D. Reinforcing Bars: Solid 24-inch long 6061-T6 circular cross section aluminum reinforcing bars with outside diameter same as inside diameter of post.

F. Anchors and Fastenings: Stainless steel of the type recommended by the manufacturer of the aluminum handrail and railing system. Provide minimum of four bolt fasteners per post where surface mounted posts are shown.

G. Castings:
   1. Provide high strength aluminum alloy brackets, flanges and fittings suitable for anodizing as specified.
   2. Aluminum-Alloy Sand Castings: ASTM B 26.

H. Connector Sleeves: Schedule 40, 5-inches long by 1.610-inches diameter.

I. Brackets and Flanges: Provide manufacturer's complete selection of standard and custom brackets and flanges for railing posts and for handrail supports.

J. Sockets: Provide 6-inch deep by 2-1/2-inch outside diameter aluminum sockets with 3-1/2-inch wide socket cover on bottom of all sockets and on top and bottom of removable post sockets.

K. Hinges: Provide two self-closing aluminum hinges for each railing system gate shown.

L. Latches and Stops: Provide one latch and stop with rubber bumper and 1-inch diameter plastic knob for each railing system gate shown.

M. Chain, Snaps and Eye Bolts: Provide oblong 0.250-inch welded link, Type 316 stainless steel chain weighing 57 pounds per cubic foot, each link 1-1/8-inch by 7/16-inch. Provide stainless steel eyebolts, 1/4-inch stainless steel threaded quick links and heavy duty swivel snaps with spring loaded latch.

N. Cover Flanges: Provide 1-inch high by 4-inch diameter aluminum cover flanges for all non-removal posts and 3-1/2-inch wide by 1-1/8-inch high aluminum pipe collars with 1/4-inch set screws for all removable posts.

O. Components and Miscellaneous Accessories: Provide a complete selection of manufacturer's standard and custom aluminum handrail and railing components and miscellaneous accessories.

P. Adhesive: Epoxy type as recommended by handrail and railing manufacturer.

2.2 FABRICATION

A. Form exposed Work true to line and level with accurate angles, surfaces and straight edges.

B. Form bent-metal corners to the radius shown without causing grain separation or otherwise impairing the Work. Form all change in handrail and railing direction with radius bends.

C. Remove burrs from all exposed edges.

D. Form elbow bends and wall returns to uniform radius, free from buckles and twists, with smooth finished surfaces, or use prefabricated bends.

E. Locate intermediate rail equally spaced between top rail and finished floor.

F. Close aluminum pipe ends by using prefabricated fittings.

G. Weep Holes:

1. Fabricate joints which will be exposed to the weather so as to exclude water.
2. Provide 15/64 inch diameter weep holes at the lowest possible point on all railing system posts.
3. Provide pressure relief holes at closed ends of handrails and railings.

H. Toeboards:

1. Provide extruded 6063 alloy aluminum toeboards for railings, unless railing is mounted on curbs or other construction of sufficient height and type to meet the requirements of OSHA 1910.23. Bars or plates are not acceptable and shall not be approved by ENGINEER.
2. Unless otherwise specified, toeboards shall meet requirements of OSHA Part 1910.23, Section (e).

3. Provide manufacturer's toeboard detail which accommodates movement caused by thermal change specified without warping or bowing toeboards.

I. Reinforcing Bars: Provide circular profile solid reinforcing bar friction-fitted at all railing system posts. Extend reinforcing bars 6-inches into cast-in- place sleeves or other types of supporting brackets.

J. Mechanically Fitted Component Pipe Handrail and Railing:

1. Use a nonwelded pipe handrail and railing system with posts, top and intermediate rail(s) and flush joints.
2. Provide a top and one intermediate horizontal rail, equally spaced.
3. Blind rivets, pop rivets or other exposed fastening devices shall not be used in the Work. Fasteners used for side mounting fascia flanges where shown or specified may be exposed in the Work. Provide internal threaded tubular aluminum rivets, stainless steel through bolts with lock nuts, stainless steel sheet metal screws with lockwashers and epoxy adhesive for fastening all components of the Work.
4. Product and Manufacturer: Provide one of the following:
   a. Custom Fabricated Connectorail System by Julius Blum & Company, Incorporated.
   b. Custom Fabricated Series SOO Non-Welded Aluminum Pipe Railing by Superior Aluminum Products, Incorporated.

2.3 ALUMINUM COATINGS

A. General:

1. Prepare surfaces for finishing in accordance with recommendations of the aluminum producer and the finisher or processor.
2. Adjust and control the direction of mechanical finishes specified to achieve the best overall visual effect in the Work.
3. Color and Texture Tolerance: ENGINEER reserves the right to reject aluminum materials because of color or texture variations, which are visually objectionable, but only where the variation exceeds the range of variations established by the manufacturer

prior to the Work, by means of range samples which have been accepted by ENGINEER.

4. Anodize all aluminum components of the Work.

B. Exposed Aluminum Anodic Coating: Provide anodic coatings as specified which do not depend on dyes or impregnation processes to obtain color. Apply architectural Class 1 coatings using only the alloy and electrolyte to obtain specified colors. Comply with the following:

1. Chemically finish aluminum by etching to a medium matte finish,Aluminum Association Designation - C22.
2. Desmut by bathing the aluminum in either nitric acid solution or as recommended by the coating applicator.
3. Clean and rinse between steps as recommended by the aluminum manufacturer.
4. Provide architectural Class I high density anodic coating, Aluminum Association Designation A41, for clear coatings.
5. Coating Thickness, ASTM B 244: Minimum of 0.7 mils thick.
6. Coating Weight, ASTM B 137: Minimum of 32 mg/sq. in.
7. Resistance to Staining, ASTM B 136: No stain after 5 minutes dye solution exposure.
8. Salt Spray, ASTM B 117: 30,000 hours exposure with no corrosion or shade change.

PART 3 - EXECUTION

3.1 INSPECTION

A. CONTRACTOR and his installer shall examine the substrate and conditions under which the aluminum handrail and railing system Work is to be performed and notify ENGINEER in writing of unsatisfactory tolerances which exceed specified limits and other conditions detrimental to proper and timely completion of the Work. Do not proceed with installation until unsatisfactory conditions have been corrected in a manner acceptable to ENGINEER.

3.2 INSTALLATION

A. Fastening to In-Place Construction:

1. Adjust aluminum handrail and railing system Work prior to securing in place, to ensure proper matching at butting joints and correct alignment throughout their length. Plumb posts in each direction. Secure posts and rail ends to building construction as follows:

   a. Anchor posts in concrete by means of sockets and side mounted fascia flange brackets, set and anchored into the concrete floor slabs and sides of concrete walls and raised walkways. Provide closure secured to the bottom of sleeve. Before installing posts remove all debris and water from sleeves. Verify that reinforcing bars have been inserted into posts before installation. Do not install posts without reinforcing bar. For all nonremovable railing sections, after the posts have been inserted into the sockets, fill the annular space between posts and sockets solid with grout as specified in Section 3I, Grout.

   b. Anchor posts to stair stringers with stringer or support flanges, angle type or floor type as required by conditions, shop connected to posts and bolted to the supporting members. Flanges shall be as recommended by manufacturer. Verify that reinforcing bars have been inserted into posts before installation. Do not install posts without reinforcing bar.

   c. Provide removable railing sections where shown. Removable railing posts shall be provided with friction fitted reinforcing bar in each post. Provide sockets with socket covers stored in extruded toeboard. Provide aluminum pipe collars for all removable posts. Accurately locate sleeves to match post spacings.

   d. All posts set in concrete shall be provided with an aluminum floor cover flange.

2. Use devices and fasteners recommended by the aluminum handrail and railing manufacturer.

B. Cutting, Fitting and Placement:

1. Perform cutting, drilling and fitting required for installation. Set the Work accurately in location, alignment and elevation, plumb, level, true and free of rack, measured from established lines and levels.
2. Fit exposed connections accurately together to form tight hair-line joints. Do not cut or abrade the surfaces of units which have been finished after fabrication, and are intended for field connections.
3. Permanent field splice connections shall be made using manufacturer's recommended epoxy adhesive and 5-inch minimum length connector sleeves. Tight press-fit all field splice connectors and install in accordance with manufacturer's written instructions. Follow epoxy manufacturer's recommendations for requirements of installation and conditions of use.
4. Make all splices as near as possible to posts but not exceeding 12 inches from nearest post.
5. Space posts 6 foot-O inch minimum on centers and 8 foot-O inch maximum on centers, based on loading and deflection criteria specified and manufacturer's suggested maximum spacing except where details shown dimension required locations for posts. Where details show post location requirements at or near end of runs, uniformly space intermediate posts as required to meet loading and deflection criteria specified but not greater than maximum spacing specified.
6. Provide hinged railing sections as shown. Provide hinges and latch for connection to adjacent railing.
7. Provide chain sections as shown. Provide one chain length with fastening accessories for top and each intermediate railing.
8. Secure handrails to walls with wall brackets and end fittings as shown. Locate brackets as shown or, if not shown, at not more than 5 feet on centers.
9. Secure wall brackets to building construction as follows:
   a. For concrete and solid masonry anchorage, use bolt anchor expansion shields and lag bolts.
   b. For hollow masonry anchorage, use toggle bolts having square heads.

10. Securely fasten toeboards in place with not more than 1/4 inch clearance above floor level.
11. Drill one 15/64 inch diameter weep hole not more than 1/4 inch above the top of location of circular profile solid reinforcing bar in each post.

C. Expansion Joints:
1. Provide slip joint with internal sleeve extending 2 inches minimum beyond joint on each side.
2. Construct expansion joints as for field splices except fasten internal sleeve securely to one side of rail only.
3. Locate joints within 6 inches of posts.
4. Submit locations and details of all expansion joints to ENGINEER.

D. Protection from Dissimilar Materials:
1. Coat all surfaces of aluminum in contact with dissimilar materials such as concrete, masonry and steel as specified in Section 9L, Painting.
2. Remove coating where exposed in the finished Work.

3.3 CLEANING AND REPAIRING

A. Remove protective plastic as recommended by manufacturer immediately after installation.

B. Remove all stains, dirt, grease or other substances by washing railings thoroughly using clean water and soap; rinse with clean water.

C. Do not use acid solution, steel wool or other harsh abrasives. If stain remains after washing remove defective sections and replace with new material meeting the requirements of the Specification.

D. Remove all damaged or otherwise defective Work and replace with material that meets specification requirements.

END OF SECTION

SECTION 5G

ANCHOR BOLTS, EXPANSION ANCHORS AND CONCRETE INSERTS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified, and required to furnish and install anchor bolts, expansion anchors and concrete inserts.

B. This Section includes all bolts, anchors, toggles and inserts required for the Work but not specified under other Sections.

C. The types of work using the bolts, anchors, toggles and inserts include, but are not limited to the following:

1. Hangers and brackets.
2. Equipment.
3. Piping.
4. Tanks.
5. Grating and floor plate.
6. Electrical, Plumbing and HVAC Work.
7. Wood and plastic fabrications.
8. Partitions and ceilings.
9. Shelf angles and masonry lintels.

D. Related Sections:

1. Section 5A3, Structural Steel (SLV).
2. Section 5E3, Miscellaneous Metal Fabrications.
3. Section 5E10, Aluminum Handrails and Railings.
4. Section 15C3, Pipe Hangers and Supports.

1.2 QUALITY ASSURANCE

A. Reference Standards: Comply with the applicable provisions and recommendations of the following, except as otherwise shown and specified.

1. ASTM A 307, Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile.
2. ASTM A 320, Specification for Alloys-Steel Bolting Materials for Low-Temperature Service.

B. Expansion anchors and inserts shall be UL or FM approved.

C. Toggle Bolts: FS-FF-B-588C, Type I, Class A, Style 1.

1.3 SUBMITTALS

A. Shop Drawings: Submit for approval the following:

1. Setting drawings and templates for location and installation of anchorage devices.
2. Copies of manufacturer's specifications, load tables, dimension diagrams and installation instructions for the devices.

B. Samples: Submit for approval the following:

1. Representative samples of bolts, anchors and inserts as may be requested by ENGINEER. Review will be for type and finish only. Compliance with all other requirements is exclusive responsibility of CONTRACTOR.

PART 2 - PRODUCTS

2.1 DESIGN CRITERIA

A. When the size, length or load carrying capacity of an anchor bolt, expansion anchor, toggle bolt, or concrete insert is not shown on the Drawings, provide the size, length and capacity required to carry the design load times a minimum safety factor of four.

B. Determine design loads as follows:

1. For equipment anchors, use the design load recommended by the manufacturer and approved by ENGINEER.
2. For pipe hangers and supports, use one half the total weight of pipe, fittings, valves, accessories and water contained in pipe, between the hanger or support in question and adjacent hangers and supports on both sides.
3. Allowances for vibration are included in the safety factor specified above.
4. Anchors shall develop ultimate shear and pull-out loads of not less than the following values in concrete:

Bolt Diameter (Inches)	Min. Shear (Pounds)	Min. Pull-Out Load (Pounds)
1/2	4,500	6,300
5/8	6,900	7,700
3/4	10,500	9,900

2.2 MATERIALS

A. Anchor Bolts:

1. Provide carbon steel bolts complying with ASTM A 307, non headed type unless otherwise indicated.
2. In buried or submerged locations, provide stainless steel bolts complete with nuts and washers complying with ASTM A 320, AISI Type 304. Other AISI types may be used subject to ENGINEER'S approval.

B. Expansion Anchors:

1. Provide stainless steel anchors complying with ASTM A 320, AISI Type 304.
2. Anchors shall be of the size required for the concrete strength specified. Provide stud type (male thread) or flush type (female thread), as required.
3. Manufacturer: Provide anchors of one of the following:
   a. Molly Division of USM Corporation.

b. Hilti, Incorporated.

4. In buried or submerged locations, provide stainless steel anchors complying with ASTM A 320, AISI Type 303. Other AISI types may be used, subject to ENGINEER'S approval.

C. Toggle Bolts:

1. Provide spring-wing toggle bolts, with two-piece wings.
2. Provide carbon steel bolts with zinc coating in accordance with FS-QQ-Z-325.
3. Manufacturer: Provide toggle bolts of one of the following:
   a. U.S.E. Diamond, Incorporated.
   b. Haydon Bolts, Incorporated.

D. Concrete Inserts:

1. For piping, grating, floor plate and masonry lintels, provide malleable iron inserts. Provide those recommended by the manufacturer for the required loading.
2. Finish shall be black.
3. Product and Manufacturer: Provide one of the following inserts:
   a. Figure 282 by ITT Grinnell.
   b. No. 380 by Hohmann and Barnard, Incorporated.

E. Powder actuated fasteners and other types of bolts and fasteners not specified herein shall not be used unless approved by ENGINEER.

PART 3 - EXECUTION

3.1 INSPECTION

A. CONTRACTOR shall examine areas and conditions under which anchor bolts, expansion anchors, toggle bolts and concrete insert Work is to be installed, and notify ENGINEER of conditions detrimental to proper and timely completion of Work.

3.2 INSTALLATION

A. Drilling equipment used and installation of expansion anchors shall be in accordance with manufacturer's instructions.

B. Assure that embedded items are protected from damage and are not filled in with concrete.

C. Expansion anchors may be used for hanging or supporting pipe 2 inches diameter and smaller. Expansion anchors shall not be used for larger pipe unless otherwise shown or approved by ENGINEER.

D. Use concrete inserts for pipe hangers and supports for the pipe size and loading recommended by the insert manufacturer.

E. Use toggle bolts for fastening brackets and other elements onto masonry units.

F. Unless otherwise shown or approved by ENGINEER conform to following for expansion anchors:

1. Minimum embedment depth in concrete: 5 diameters.
2. Minimum anchor spacing on centers: 10 diameters.
3. Minimum distance to edge of concrete: 5 diameters.
4. Increase dimensions above if required to develop the required anchor load capacity.

3.3 CLEANING

A. After embedding concrete is placed, remove protection and clean bolts and inserts.

END OF SECTION

SECTION 6A

ROUGH CARPENTRY

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, material, equipment and incidentals as shown, specified and required to furnish and install all rough carpentry Work. The Work also includes:
   a. Providing openings in rough carpentry to accommodate the Work under this and other Sections and building into the rough carpentry all items such as sleeves, anchor bolts, inserts and all other items to be embedded in rough carpentry for which placement is not specifically provided under other Sections.
2. The extent of the rough carpentry is shown.
3. The types of rough carpentry Work required includes, but is not necessarily limited to, the following:
   a. Wood framing, blocking, furring strips and other miscellaneous wood framing.
   b. Plywood.
   c. Miscellaneous accessories, fasteners and anchorages.

B. Coordination:

1. Coordinate compatibility of pressure treatment with elastic sheet roofing Work. Provide wood treatment acceptable to manufacturer of built-up bituminous roofing used in the Work.

1.2 QUALITY ASSURANCE

A. Design Criteria:

1. Lumber Standard: Comply with PS-20, except as otherwise specified.
2. State of Rhode Island Official Compilation of Codes, Rules and Regulations.

B. Codes: Comply with the applicable requirements of governing authorities and the State of New York Official Compilation of Codes, Rules and Regulations for size, spacing and attachment of wood members.

C. Source Quality Control:

1. Factory-mark each piece of lumber and type, grade, mill and grading agency.
2. Shop-fabricate rough carpentry Work to the extent feasible and where shop fabrication will result in better workmanship than feasible for on-site fabrication.

D. Reference Standards: Comply with applicable provisions and recommendations of the following, except where otherwise shown or specified:

1. American Lumber Standard Committee, National Grading Rule for Dimension Lumber, PS-20.
2. Occupational Safety and Health Act of 1970.
3. West Coast Lumber Inspection Bureau, Grading Rules.

1.3 PRODUCT DELIVERY STORAGE AND HANDLING

A. Storage of Materials:

1. Keep materials dry during delivery and storage.
2. Protect against exposure to weather and contact with damp or wet surfaces.
3. Stack lumber, and provide air circulation within stacks.

1.4 JOB CONDITIONS

A. Coordination: Fit rough carpentry Work to other work and scribe and cope as required for accurate fit. Correlate location of furring, nailers, blocking, grounds and similar supports to allow proper attachment of other work.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Lumber, General:

1. Nominal sizes are shown, except as shown by detail dimensions. Provide actual sizes as required by American Lumber Standard Committee, National Grading Rule for Dimension Lumber PS-20, for the moisture content specified for each use.
   a. Provide dressed lumber, S4S, unless otherwise shown or specified.
   b. Provide seasoned lumber with 19 percent maximum moisture content at time of dressing.
2. Provide the following grade and species:
   a. Construction Grade.
   b. Douglas Fir, WWPA, or Southern Pine, SPIB.

B. Plywood:

1. Exterior Type: Grade CC/EXT-APA, 3/4-inch thick.
2. American Lumber Standard Committee, Plywood Standard, PS-1.

C. Fasteners and Anchorages:

1. Provide size and type as recommended by the State of New York Official Compilation of Codes, Rules and Regulations, complying with applicable Federal Specifications for nails, staples, screws, bolts, nuts, washers and anchoring devices.
2. Provide stainless steel nails for exterior Work. Zinc coated nails for all other uses.

D. Lumber for Protection and Temporary Support: Size and grades to meet applicable requirements of the Occupational Safety and Health Act of 1970 and structural requirements.

PART 3 - EXECUTION

3.1 INSPECTION

A. CONTRACTOR (and/or his installer) shall examine the substrates and supporting structure and the conditions under which the rough carpentry Work is to be installed, and notify ENGINEER in writing of the conditions detrimental to the Work. Do not proceed with the installation until unsatisfactory conditions have been corrected in a manner acceptable to ENGINEER.

3.2 INSTALLATION

A. General:

1. Discard units of material with defects which might impair the quality of the Work, and units which are too small to fabricate the Work with minimum joints or the optimum joint arrangement.
2. Set rough carpentry Work accurately to required levels and lines, with members plumb and true and accurately cut and fitted.
3. Securely attach rough carpentry Work to substrates by anchoring and fastening as shown and as required by recognized standards. Countersink nail heads on exposed rough carpentry Work and fill holes. Use common wire nails, except as otherwise shown. Use finishing nails for finish Work. Select fasteners of size that will not penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting of wood, predrill as required.

B. Wood Grounds, Nailers, and Blocking

1. Provide wherever shown and where required for attachment of other work. Form to shapes as shown and cut as required for true

line and level of Work to be attached. Coordinate location with other work involved.

2. Attach substrates as required to support applied loading. Countersink bolts and nuts flush with surfaces, unless otherwise shown.

3. Provide permanent grounds of dressed, preservative treated, key-bevelled lumber not less than 1-1/2 inch wide and of the thickness required to bring face of ground to exact thickness of finish material involved. Remove temporary grounds when no longer required.

C. Plywood: Install in accordance with the requirements of the State of New York Official Compilation of Codes, Rules and Regulations. Allow for installed clearances between individual plywood panels as specified by the plywood manufacturer.

END OF SECTION

SECTION 8A1

HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish and install all hollow metal doors and frames Work.
2. The extent of hollow metal doors and frames is shown.
3. The types of hollow metal doors and frame Work required includes, but is not necessarily limited to, the following:
   a. Flush doors and frames.
   b. Fire-rated flush doors and frames.
   c. Stick systems.
   d. Miscellaneous fabrications, anchors, reinforcements, fasteners and trim.

B. Coordination:

1. Review installation procedures under other Sections and coordinate them with the Work specified herein.
2. Where hollow metal doors and frames Work require the building-in of plates, inserts and other items, furnish required inserts to avoid delay in the work of other trades. Provide setting drawings, templates, and directions for installation of plates, inserts and anchors, required by the Work of this Section but installed under other Sections of the Work.

C. Related Sections:

1. Section 4C1, Unit Masonry Construction.
2. Section 6A, Rough Carpentry.
3. Section 8H1, Finish Hardware.

4. Section 9L, Painting.

1.2 QUALITY ASSURANCE

A. Manufacturer Qualifications: Provide hollow metal doors, frames and accessories manufactured by a single firm specializing in the production of this type of Work and complying with all applicable standards of the Steel Door Institute, recommended specifications for Standard Steel Doors and Frames (S.D.I. 100).

B. Requirements of Regulatory Agencies:

1. Fire-rated Assemblies: Wherever a fire-resistance classification is shown or scheduled for hollow metal doors and frames Work (3-hour, 1-1/2 hour, and similar designations), provide fire rated hollow metal doors and frames investigated and tested as an complete assembly including type of fire door hardware to be used. Identify each fire door, frame and stick system assembly with recognized testing laboratory labels, indicating applicable fire rating of both door, frame and stick system assembly.

2. Construct assemblies to comply with NFPA Standard No. 80, and applicable provisions of the State of Rhode Island Official Compilation of Codes, Rules and Regulations.

3. Temperature Rise Rating: Wherever a temperature rise rating is required provide doors for ratings as specified in accordance with UL 10(b).

4. Oversize Assemblies: However hollow metal assemblies are larger than size limitations established by NFPA, provide manufacturer's certification that assembly has been constructed with materials and methods equivalent to labeled construction.

C. Reference Standards: Comply with applicable provisions and recommendations of the following, except where otherwise shown or specified.

1. ASTM A 153, Zinc Coating on Iron and Steel Hardware.
2. ASTM A 366, Carbon Steel Cold-Rolled Sheet.
3. ASTM A 525, Steel Sheet, Galvanized by the Hot-Dip Process - General.
4. ASTM A 526, Steel Sheet, Galvanized by the Hot-Dip Process - Specifications.
5. ASTM A 568, Carbon Steel and High Strength Low Alloy Hot Rolled Sheet, Hot Rolled Strip and Cold-Rolled Sheet.
6. ASTM A 569, Steel, Carbon Hot-Rolled Sheet and Strip.
7. ASTM E 152, Fire Tests of Door Assemblies.
8. Steel Door Institute Standard Steel Doors and Frames.
9. ANSI A115, Specification for Door and Frame Preparations for Hardware.
10. NFPA 80, Standard for Fire Doors and Windows.
11. NFPA 252, Fire Tests of Door Assemblies.
12. UL10(b), Fire Tests of Door Assemblies.
13. UL 63, Fire Door Frames.
14. U.L. Building Materials Directory.
15. National Association of Architectural Metal Manufacturers (NM MM), Hardware Locations for Custom Hollow Metal Doors.

1.3 SUBMITTALS

A. Samples: Submit for approval the following:

1. Metal frame, 12-inch by 12-inch "L" section of frame showing corner detail of all types specified.
2. Stick system frame, 12-inch by 12-inch section of frame showing corner detail and molding and gasket of all types specified.
3. Door, 12-inch by 12-inch section of all door types specified showing internal construction, edge detail and reinforcement for butts.

B. Shop Drawings: Submit for approval the following:

1. Shop Drawings for the fabrication and installation of hollow metal doors and frames. Include details of each frame type, elevations of door design types, conditions at openings, details of construction,

location and installation requirements of finish hardware and reinforcements, and details of joints and connections.

2. Schedule of doors and frames using same reference numbers for details and openings as those on the Drawings.

C. Test Reports: Submit for approval the following:
   1. Certification of Labeled Construction Fire for Doors and Frames.
   2. Certification of label construction for doors not requiring labels but requiring labeled construction.

D. Certificates: Submit for approval the following:
   1. Oversize Fire-rated Doors and Frames: Certification for oversize fire-rated doors and frames that each assembly has been constructed with materials and methods equivalent to requirements for labeled construction.

1.4 DELIVERY, STORAGE AND HANDLING

A. Delivery of Materials:
   1. Deliver hollow metal doors and frames cartoned or crated to provide protection during transit and job storage.
   2. Inspect hollow metal Work upon delivery for damage. Minor damage may be repaired provided the finish items are equal in all respects to new Work and acceptable to ENGINEER; otherwise, remove and replace damaged items as directed.

B. Storage of Materials:
   1. Store doors and frames at the building site under cover.
   2. Place units up off the floors in a manner that will prevent rust and damage.
   3. Avoid the use of non-vented plastic or canvas shelters which could create a humidity chamber. If the cardboard wrapper on the door becomes wet, remove the carton immediately.
   4. Provide a 1/4 inch space between stacked doors to promote air circulation.

1.5 SCHEDULES

A. Coordinate with other work by furnishing Shop Drawings, inserts and similar items at the appropriate times for proper sequencing of construction without delays.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Frames: Hot-Rolled Steel Sheets and Strips: Commercial quality carbon steel, pickled and oiled, complying with ASTM A 569 and ASTM A 568.

B. Door Faces: Zinc-coated carbon steel sheets of commercial quality, complying with ASTM A 526, with ASTM A 525, G60 zinc coating, mill phosphatized.

C. Supports and Anchors: Sheet metal, hot-dip galvanized after fabrication complying with ASTM A 153, Class B.

D. Inserts, Bolts and Fasteners: Sheet metal, hot-dipped galvanized complying with ASTM A 153, Class C or D as applicable.

2.2 FABRICATION, GENERAL

A. Fabricate hollow metal units to be rigid, neat in appearance and free of defects, warp or buckle. Accurately form metal to required sizes and profiles. Practicable, fit and assemble units in the manufacturer's plant. Clearly identify Work, that cannot be permanently factory-assembled before shipment, to assure proper assembly at the project site. Weld exposed joints continuously, grind, dress, and make smooth, flush and invisible. Filler to conceal manufacturing defects is not acceptable.

B. Exposed Fasteners: Unless otherwise specified, provide countersunk flat Phillips or Jackson heads for exposed screws and bolts.

C. Finish Hardware Preparation:

1. Prepare hollow metal units to receive mortised and concealed finish hardware, including cutouts, reinforcing, drilling and tapping in accordance with final Finish Hardware Schedule and templates provided by hardware supplier. Comply with applicable requirements of ANSI A115, Specifications for Door and Frame Preparation for Hardware. Drilling and tapping for surface applied finish hardware may be done at the site.
2. Reinforce hollow metal units to receive surface-applied and recessed finish hardware.
3. Locate finish hardware as shown on approved Shop Drawings, in accordance with hardware templates provided by hardware manufacturer and in accordance with National Association of Architectural Metal Manufacturers, Hardware Locations for Custom Hollow Metal Doors. Refer to Section 8H1, Finish Hardware.

D. Shop Painting:

1. Clean, treat and paint exposed surface of fabricated hollow metal units, including galvanized surfaces.
2. Clean steel surfaces of mill scale, rust, oil grease, dirt and other foreign materials before the application of the shop coat of paint.
3. Apply pretreatment to cleaned metal surfaces, using cold phosphate solution (SSPC-PT 2), hot phosphate solution (SSPC-PT 4) or basic zinc chromate-vinyl butyral solution (SSPC-PT 3).
4. Refer to Section 9L, Painting for field applied primer and finish paint for exterior or interior exposed ferrous, non-ferrous, or galvanized surfaces.
5. Apply shop coat of prime paint within time limits recommended by pretreatment manufacturer. Apply a uniform dry film thickness of not less than 1.5 mils.

6. Finish shall be rust inhibitive primer capable of humidity test in accordance with ASTM B 117 as certified by an independent laboratory.

2.3 FLUSH DOORS

A. Door Types:

1. Provide flush design doors, 1-3/4-inches thick, seamless hollow construction, unless otherwise shown or specified.

B. Door Construction:

1. Fabricate doors of two outer stretcher-leveled steel sheets galvanized with a G60 zinc coating of 0.60 ounces per square foot in accordance with ASTM A 525 and A 526 and not less than 16 gage. Construct doors with smooth, flush surfaces without visible joints or seams or exposed faces or stile edges, except around glazed or louvered panel inserts. Provide continuously welded seams for all door construction. No fillers shall be used. Provide weep hole openings in the bottom of exterior doors to permit the escape of entrapped moisture.
2. Reinforce inside of doors with phenolic resin impregnated kraft 1-inch hexagonal cell honeycomb core completely filling the inside of the door and laminated to the inside of both face panels with an adhesive. The honeycomb material shall have a crushing strength not less than 4000 pounds per square foot and the lamination shall withstand not less than 1100 pounds per square foot in shear.
3. Door reinforcement may be modified in fabrication method approved by ENGINEER in order to provide a UL labeled fire rated door.
4. Reinforce tops and bottoms of doors with flushed mounted minimum 16 gage horizontal galvanized steel channels welded continuously to the outer sheets.
5. Edge profiles shall be provided on both stiles of doors as follows: beveled 1/8 inch in 2 inches.

C. Finish Hardware Reinforcement:

1. Refer to Section 8H1, Finish Hardware.
2. Hardware supplier shall furnish hollow metal door and frame manufacturer approved hardware schedule, hardware templates and samples of physical hardware where necessary to insure correct fitting and installation.
3. Preparation includes sinkages and cut-outs for mortise and concealed hardware.
4. Provide reinforcements for both concealed and surface applied hardware:
   a. Drill and tap mortise reinforcements at factory, using templates.
   b. Install reinforcements with concealed connections designed to develop full strength of reinforcements.
5. Reinforce doors for required finish hardware, with minimum gages as follows:
   a. Hinges: Steel plate 1/4-inch gage thick by 1-1/2-inches wide by 8-inches longer than hinge secured by not less than 6 spot or projection welds.
   b. Mortise Locksets and Dead Bolts: 12 gage steel sheet, secured with not less than 2 spot or projection welds.
   c. Flush Bolts: 12 gage steel sheet, secured with not less than 2 spot or projection welds.
   d. Surface-Applied Closers: 1/4-inch thick steel plate, secured with not less than 6 spot or projection welds.
   e. Push Plates and Bars: 16 gage steel sheet secured with not less than 2 spot or projection welds.
   f. Surface Panic Devices: 16 gage sheet steel secured with not less than 2 spot or projection welds.
   g. Automatic Door Bottoms: Reinforce for mortise-type units with 14 gage steel, and 16 gage for surface-applied units.

D. Product and Manufacturer: Provide one of the following:

1. Series CH with DURA-WELD seams by Pioneer Industries, Division of SOS Consolidated, Incorporated.

2.4 FIRE-RATED DOORS

A. Provide the same construction specified above under door construction and within UL requirements as specified.

B. Provide fire-rated doors in accordance with Underwriters' Laboratories Standard, UL 10(b), and NFPA No. 80 and as follows:

1. For a UL 3-hour (A) classification provide doors with a temperature rise rating of not more than 250 F maximum to 30 minutes of exposure.
2. For a UL 1-1/2 hour (B) classification provide doors with a temperature rise rating of not more than 450 F or 650 F maximum to 30 minutes of exposure.

C. Provide fire-rated doors with metal labels permanently fastened to the door. Labels shall display all UL required information.

D. Product and Manufacturer: Provide one of the following:

1. Series CH Underwriters' Label Doors with DURA-WELD seams by Pioneer Industries, Division of SOS Consolidated, Incorporation.

2.5 FRAMES

A. Frame Types: Provide hollow metal frames for doors, and other openings of size and profile as shown or specified.

B. Frame Construction:

1. Fabricate frames of full-welded unit construction, with corners mitered, reinforced, continuously welded full depth and width of frame with exposed welds ground flush and smooth.
2. Form frames of hot rolled prime quality carbon steel in accordance with ASTM A 568 and A 569 and galvanized with a G60 zinc coating of 0.60 ounces per foot in accordance with ASTM A 153, A 525, and A 526 or cold rolled steel sheets in accordance with ASTM A 366 and galvanized in accordance with ASTM A 153, A 525 and A 526.

3. Gage thickness of steel: not less than 14.
4. Finish Hardware Reinforcement: Reinforce frames for required Finish hardware with minimum gages as follows:
   a. Hinges and Pivots: Steel plate 1/4-inch gage thick by 1-1/2-inches wide by 8-inches longer than hinge, secured by not less than 6 spot or projection welds.
   b. Strike Plate Clips: Steel plate 10 gage thick by 1-1/2-inches wide by 3-inches long.
   c. Surface-Applied Closers: 1/4-inch thick steel plate, secured with not less than 5 spot or projection welds.
5. Head Reinforcing: Where installed in masonry, leave vertical mullions in frames open at the top so they can be filled with grout.
6. Jamb Anchors: Furnish jamb anchors as required to secure frames to adjacent construction, formed of not less than 16 gage galvanized steel.
   a. Masonry Construction (except as otherwise shown): Adjustable, corrugated or perforated, T-shaped to suit frame size with leg not less than 2-inches wide by 10-inches long. Furnish at least 3 anchors per jamb up to 7 feet 6 inches height; 4 anchors up to 8 feet-0 inch jamb height; one additional anchor for each 24 inch or fraction thereof over 8 feet-0 inch height. Furnish UL construction where required.
   b. Cast-In-Place Concrete: Anchor frame jambs with minimum 3/8-inch concealed bolts into expansion shields or inserts at 6-inches from top and bottom and 24-inches on centers. Reinforce frames at anchor locations. Apply removable stop to cover anchor bolts.
7. Floor Anchors: Provide floor anchors for each jamb and mullion which extends to floor, formed of not less than 14 gage galvanized steel sheet, clip type anchors, with 2 holes to receive fasteners, welded to bottom of jambs and mullions.
8. Head Anchors: Provide 2 anchors at head of frames exceeding 42 inches wide frames mounted in drywall partitions.
9. Head Strut Supports: Provide 3/8-inch by 2-inch vertical steel struts extending from top of frame at each jamb to supporting

construction above, unless frame is anchored to masonry or to other structural support at each jamb. Bend top of struts to provide flush contact for securing to supporting construction above. Provide adjustable bolted anchorage to frame jamb members.

10. Head Reinforcing: For frames over 4 feet-0 inch wide, in masonry openings, provide continuous steel channel or angle stiffener, not less than 12 gage for full width of opening, welded to back of frame at head.

11. Spreader Bars: Provide removable spreader bar across bottom of frames, tack welded to jambs and mullions.

12. Rubber Door Silencers: Drill stop to receive 3 silencers on single-door frames and 4 silencers on double-door frames. Install plastic plugs to keep holes clear during construction.

13. Product and Manufacturer: Provide one of the following:
    a. Series F-14 by Pioneer Industries, Division of SOS Consolidated, Incorporated.
    b. Or equal.

2.6 FIRE-RATED FRAMES

A. Provide the same construction specified above under frame construction and within UL and NFPA requirements as specified above.

B. Provide fire-rated frames with metal libels permanently fastened to the frame. Labels shall display all UL required information.

C. Provide fire-rated frames in accordance with UL Standards UL 10 (b) and UL 63 and NFPA Pamphlet No. 80 and as listed in UL.

D. Product and Manufacturer: Provide one of the following:
    a. Series F-14 Underwriters' Label Frames by Pioneer Industries, Division of SOS Consolidated Incorporation.

2.7 STICK SYSTEMS

A. Provide the same construction specified above for frame construction.

B. Provide stick system for interior window frames assembled as borrowed lights, sidelights, transom frames, or interior windows as shown. from components similar to standard hollow metal frames.

C. Product and Manufacturer: Provide one of the following:
   1. Series S-14 Stick System by Pioneer Industries, Division of SOS Industries, Incorporated.

2.8 STOPS AND MOULDINGS

A. Provide stops and mouldings around solid, glazed and louvered panels in hollow metal units and in frames to receive glass.

B. Form fixed stops and mouldings integral with frame. Provide fixed stops on inside of hollow metal units exposed to exterior and on corridor side of interior units.

C. Provide removable stops and molds at other locations, formed of not less than galvanized 20 gage steel sheets. Secure with countersunk machine screws spaced uniformly not more than 12 inches on center. Form corners with butted hairline joints.

D. Coordinate width of rabbet between fixed and removable stops with type of glass or panel and type of installation indicated.

PART 3 - EXECUTION

3.1 INSPECTION

A. CONTRACTOR and his installer must examine the substrate and conditions under which hollow metal doors and frames are to be installed and notify ENGINEER in writing of any conditions detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected in a manner acceptable to ENGINEER.

3.2 INSTALLATION

A. Install hollow metal units and accessories in accordance with the final Shop Drawings, manufacturer's data, and as shown and specified.

B. Place frames at fire-rated openings in accordance with NFPA Standard No. 80.

C. Frames that are bowed, twisted or otherwise unacceptable shall be removed from the jobsite and replaced with properly constructed frames.

D. Setting Masonry Anchorage Devices:

1. In masonry construction, building in of anchors and grouting of frames is included in Section 4C1, Unit Masonry Construction.
2. Provide masonry anchorage devices and machine screws where required for securing hollow metal frames to masonry construction.
3. Set anchorage devices opposite each anchor location, in accordance with details on approved Shop Drawings and anchorage device manufacturer's instructions. Leave drilled holes rough, not reamed, and free from dust and debris.
4. Floor anchors may be set with powder-actuated fasteners instead of masonry anchorage devices and machine screws, if so shown on final Shop Drawings.

E. Secure frames to concrete framing with reinforcement concealed in hollow metal frames.

F. Placing Frames:

1. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces and spreaders leaving surfaces smooth and undamaged. Remove spreader bars only after frames have been properly set and secured.
2. Make field splices in frames as detailed on approved Shop Drawings, welded and finished to match factory Work.

G. Protective Coating: Protect inside, concealed, faces of door frames in plaster or masonry construction using fibered asphalt emulsion coating. Apply over shop primer approximately 1/8 inch thick and allow to dry before handling.

H. Door Installation:

1. Fit hollow metal doors accurately in their respective frames, with the following clearances:
   a. Jambs and Head: 3/32 inch.
   b. Meeting Edges, Pairs of Doors: 1/8 inch.
   c. Bottom: 3/4 inch, where no threshold or carpet.
   d. Bottom: At threshold, 1/8 inch.
2. Place fire-rated doors with clearances as specified in NFPA Standard No. 80.
3. Finish hardware installation is specified under Section 8H1, Finish Hardware.

3.3 ADJUSTMENT AND CLEANING

A. Final Adjustments: Check and readjust operating finish hardware items in hollow metal Work just prior to final inspection. Leave Work in complete and proper operating conditions.

B. Prime Coat Touch-Up: Immediately after erection, sand and apply touch-up of compatible air-drying primer.

C. Protection: Protect installed hollow metal doors and frames against damage from other construction work.

END OF SECTION

SECTION 8C3

OVERHEAD ROLLING DOORS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish and install all overhead rolling door Work.
2. The extent of overhead rolling doors is shown and specified.
3. The types of overhead rolling door Work required includes, but is not necessarily limited to, the following:
   a. Galvanized steel weatherstripped overhead rolling door with insulated slats.
   b. Electric operator, control stations, starters, safety edge device and similar and associated components.
   c. Miscellaneous materials and accessories for a completely functioning system.

B. Coordination:

1. Review installation procedures under other Sections and coordinate the installation of items that must be installed with the overhead rolling doors.

C. Related Sections:

1. Section 4C1, Unit Masonry Construction.
2. Section 9L, Painting.
3. Section 16C1, 600 Volt Cable.

1.2 QUALITY ASSURANCE

A. Design Criteria: Design and reinforce overhead rolling door to withstand a wind loading pressure 30 pounds per square foot.

B. Source Quality Control: Provide overhead rolling doors as complete units produced by a single manufacturer specializing in the production of this type of Work, including hardware, accessories, mounting and installation components.

C. Reference Standards: Comply with applicable provisions and recommendations of the following, except where otherwise shown or specified.

1. National Electrical Manufacturers Association (NEMA), Standard KS 1-1969.

1.3 SUBMITTALS

A. Shop Drawings: Submit for approval the following:

1. All components and installations as shown or specified.
2. Copies of manufacturer's specifications, roughing-in diagrams, and installation instructions for rolling door. Include manufacturer's data, operating instructions and maintenance data. Indicate by transmittal form that installer has received a copy of diagrams and installation instructions.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Delivery of Materials:

1. Deliver doors and frames cartoned or crated to provide protection during transit and job storage.
2. Inspect metal Work upon delivery for damage. Minor damage may be repaired provided the finish items are equal in all respects to new Work and acceptable to ENGINEER; otherwise, remove and replace damaged items as directed.

B. Storage of Materials: Store overhead rolling doors at the building site under cover. Place units up off the floors in a manner that will prevent rust and damage. Avoid the use of non-vented plastic or canvas shelters which could create a humidity chamber.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Door Curtain:

1. Door Curtain Slats: Fabricate overhead rolling door curtain of flat interlocking slats designed to withstand the specified wind loading but not less than 20 gage galvanized steel, of continuous length for the width of the door without splices. Unless otherwise shown or specified, provide slats of the material gage recommended by the door manufacturer for the size and type of door and finish required, as follows:
   a. Galvanized Steel Door Curtain Slats: Provide double face slats, 5/8-inch thick, with galvanized finish.
   b. Provide slats completely filled with glass fiber reinforced polyisocyanurate foam plastic with aluminum foil facers with a minimum "R" valve of 5.0 and UL Flame Spread 25 maximum.
2. Windlocks: Provide continuous internal bent lock bar. Fit both sides of guide with flexible strip.
3. Bottom Bar: Furnish bottom bar consisting of two galvanized steel angles, each not less than 1-1/2-inches by 1-1/2-inches by 1/8-inch thick.

B. Curtain Jamb Guides:

1. Fabricate curtain jamb guides of galvanized steel with sufficient depth and strength to retain the curtain against specified wind loading. Build-up units with minimum 3/16-inch thick steel sections complying with ASTM A 36. Slot bolt holes for track adjustment.

2. Secure continuous galvanized steel wall angle to wall framing by 3/8-inch minimum stainless steel bolts at not more than 30 inches of center, unless otherwise recommended by door manufacturer. Extend wall angles above door opening head to support coil brackets, unless otherwise shown. Place anchor bolts on exterior wall guides so that they are concealed when door is in closed position. Provide removable stops on guides to prevent overtravel of curtain.

C. Weather Seals:

1. Provide natural rubber or neoprene rubber weatherstripping for exterior doors. Secure weather seals with continuous metal pressure bars. At door heads, use a 1/8-inch thick continuous sheet secured to the inside of the curtain coil hood. At door jambs, use a 1/8-inch thick continuous strip secured to the exterior side of the jamb guide.
2. Provide double guide weatherstripping which when tested at 1.30 pounds per square foot pressure differential allows 3.75 cubic feet per minute air infiltration per linear foot of overhead rolling door perimeter maximum.
3. Provide weatherstripping around all edges of door, including hood baffle, astragal, and guide weatherstripping.

D. Counterbalancing Mechanism:

1. Counterbalance doors by means of an adjustable steel helical torsion spring mounted around a galvanized steel shaft and mounted in a spring barrel and connected to the door curtain with the required barrel rings. Use grease-sealed ball bearings or self-lubricating graphite bearings for all rotating members.
2. Counterbalance Barrel:
   a. Fabricate spring barrel of hot-formed structural quality carbon steel, welded or seamless pipe, of sufficient diameter and wall thickness to support the roll-up of curtain without distortion of slats and limit barrel deflection to not more than 0.03 inch per foot of span under full load.

b. Provide spring balance of one or more oil-tempered, heat-treated steel helical torsion springs. Size springs to counterbalance the weight of the curtain, with uniform adjustment accessible from outside barrel. Provide cast steel barrel plugs to secure ends of springs to the barrel and the shaft.

c. Fabricate torsion rod for counterbalance shaft of case-hardened steel, of required size to hold the fixed spring ends and carry the torsional load.

3. Brackets: Provide mounting brackets of manufacturer's standard design, of cold-rolled stainless steel plate with bell-mouth guide groove for curtain.

4. Hood:

a. Form to entirely enclose coiled curtain and operating mechanism at opening head, and act as a weather seal. Contour to suit end brackets to which hood is attached. Roll and reinforce top and bottom edges for stiffness. Provide closed ends for surface-mounted hoods, and any portion of between jamb mounting projecting beyond wall face. Provide intermediate support brackets as required to prevent sag.

b. Fabricate hoods of 16 gage galvanized steel sheet with prime coat compatible with finish specified in Section 9L, Painting.

E. Product and Manufacturer: Provide one of the following:

1. AIR-BAR Door with AIR-BAR F3B Flat Slat by North American Rolling Door Incorporated.

2.2 ACCESSORIES

A. Electric Door Operator:

1. General: Furnish electric door operator assembly of the size and capacity recommended and provided by the door manufacturer; complete with electric motor and factory-prewired motor controls,

including starter, gear reduction unit, solenoid operated brake, clutch, remote control stations, and control devices and wiring.

2. Provide a hand-operated disconnect or a mechanism for automatically engaging a sprocket and chain operator and releasing brake for emergency manual operation. Mount disconnect and operator so that they are accessible from floor level. Include an interlock device to automatically prevent the motor from operating when emergency operator is engaged.

3. Design operator so that motor may be removed without disturbing the limit-switch adjustment and without affecting the emergency auxiliary operator.

4. Door Operator Type:
   a. Provide wall or bracket-mounted door operator units consisting of an electric motor, a worm gear drive from motor to reduction gear box, a chain or worm gear drive from reduction box to a gear wheel mounted on the counterbalance shaft, and a quick-clutch disconnect-release for manual operation.
   b. Provide motor, clutch, and drive assembly of horsepower and design as determined by the door manufacturer for the size of door required and as herein specified.

5. Electric Motor:
   a. Provide high-starting torque, reversible, constant duty, Class A insulated electric motors with overload protection.
   b. Provide maximum 1 horsepower motor suitable for 480 volt 3 phase supply or motor sized by manufacturer, sized to move door in either direction, from any position, at not less than 8 inches nor more than 12 inches per second.
   c. Coordinate wiring requirements and current characteristics of motors with the building electrical system; see Division 16 Sections of these Specifications.
   d. Provide totally enclosed, fan cooled (TEFC) type, waterproof electric motor, fitted with a plugged drain.

6. Remote Control Station:
   a. Unless otherwise shown, provide momentary-contact, 3-button control station with push button controls labeled "open", "close" and "stop".
   b. Provide interior units, full-guarded type, surface-mounted, heavy-duty, with NEMA 4X enclosure, key operated.
7. Safety Edge Device:
   a. Provide overhead rolling door with an electric safety switch, extending full width of the door bottom, and located within a U-shaped neoprene or rubber astragal mounted to the bottom door rail.
   b. Design the unit to operate such that contact with the switch before fully closing will immediately stop the downward travel and reverse the direction to the fully opened position.
   c. Connect to the control circuit through a retracting safety cord.
   d. The compressible strip shall also serve as a weatherseal along the bottom of the door.

2.3 PAINTING

A. Shop clean and prime all ferrous metal and galvanized surfaces, exposed and unexposed, except lubricated surfaces, with door manufacturer's standard rust inhibitive primer drying to a flat sheen.

B. Refer to Section 9L, Painting, to coordinate shop and field prime and finish paint of interior and exterior ferrous and non-ferrous metals.

PART 3 - EXECUTION

3.1 INSPECTION

A. CONTRACTOR must examine the substrates and conditions under which the Work is to be installed and notify ENGINEER in writing of conditions detrimental to the proper and timely completion of the Work. Do not

proceed with the Work until unsatisfactory conditions have been corrected in a manner acceptable to ENGINEER.

3.2 INSTALLATION

A. Install, wire, connect and adjust doors, motors, starters, pushbutton stations, limit and safety switches and all other electrical accessories and connections required in full accordance with the manufacturer's written instructions, the approved Shop Drawings and as shown and specified.

B. Refer to Paragraph 1.1.B of this Section for the requirements of coordination.

3.3 FIELD QUALITY CONTROL

A. Upon completion of installation including the work by other trades, test and adjust doors to operate easily, free from warp, twist or distortion.

B. Test the door in presence of ENGINEER to demonstrate compliance with the Specifications and the manufacturers design criteria.

3.4 ADJUSTMENT AND CLEANING

A. Adjust mechanism so moving parts operate smoothly.

B. Repair damage, and rolling doors, and match manufacturer's original finish.

C. Leave work area clean and free of debris.

END OF SECTION

SECTION 8H1

FINISH HARDWARE

PART 1 - GENERAL

1. 1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish and install all finish hardware Work.
2. The extent of finish hardware Work is specified and in schedules. Finish hardware is defined to include all items known commercially as finish hardware, as required for swing doors, except special types of unique and non-matching hardware specified in the same Section as the door and door frame.
3. The types of finish hardware Work required includes, but is not necessarily limited to, the following:
   a. Mortise hinges.
   b. Locksets.
   c. Latchsets.
   d. Panic exit devices.
   e. Door closers.
   f. Overhead holders and stops.
   g. Stops.
   h. Silencers.
   i. Stripping and seals.
   j. Thresholds.
   k. Miscellaneous items.

B. Coordination:

1. Review installation procedures under other Sections and coordinate the installation of items that must be installed with the finish hardware.

C. Related Sections:

1. Section 8A1, Hollow Metal Doors and Frames.
2. Section 8C3, Overhead Rolling Doors.

1.2 QUALITY ASSURANCE

A. Supplier Qualifications: The finish hardware supplier shall have in his employ a member of the American Society of Architectural Hardware Consultants who shall be responsible for checking and supervising the complete finish hardware installation.

B. Design Criteria:

1. Where the finish, shape, size or function of a member receiving finish hardware is such as to prevent the use of, or make unsuitable the types specified, furnish similar types having as nearly as practicable the same operation.
2. If finish hardware for any location is not specified, provide finish hardware equal in design and quality to adjacent finish hardware for comparable openings.
3. Furnish finish hardware items of proper design for use on doors and frames of the thickness, profile, swing, security and similar requirements, as necessary for proper installation and function.
4. Unless otherwise specified, comply with the National Builders Hardware Association, "Recommended Locations for Builders Hardware".
5. Provide stainless steel finish hardware, or matching finish hardware as specified, for all doors and frames.

C. Requirements of Regulatory Agencies:

1. Provide finish hardware for fire-rated openings in compliance with NFPA No. 80. This requirement takes precedence over other requirements for such finish hardware.
2. Provide only finish hardware which has been tested, listed and labeled by UL for the types and sizes of doors required, and complies with the requirements of the door and door frame labels. Modify scheduled finish hardware, as required, to meet UL requirements.
3. Codes: Comply with the applicable requirements of governing authorities and codes for the types of finish hardware specified.

D. Source Quality Control: To the greatest extent possible, obtain each type of finish hardware from only one manufacturer.

E. Reference Standards: Comply with the applicable provisions and recommendations of the following except where otherwise shown or specified:

1. FS TT-S-001657, Sealing Compound - Single Component, Butyl Rubber Based, Solvent Release Type.
2. National Fire Protection Association, Standard for Fire Doors and Windows No. 80.
3. UL, Building Materials Directory.
4. UL, List of Inspected Fire Protection Equipment and Materials.
5. UL, Hardware, Automatic Flush or Surface Bolts.
6. National Builders Hardware Association, Recommended Locations for Builders Hardware.

1.3 SUBMITTALS

A. Samples: Submit for approval each item of finished hardware with specified finish.

B. Shop Drawings: Submit for approval the following:

1. Copies of manufacturer's data for each item of finish hardware. Include whatever information may be necessary to show compliance with requirements, and include instructions for installation and for maintenance of operating parts and exposed finishes. Wherever needed, furnish templates to fabricators of other work which is to receive finish hardware.
2. Copies of the finish hardware schedule. Include a separate key schedule, showing clearly how final instructions on keying of locks have been fulfilled. Finish hardware schedules are intended for coordination of the Work. Review and acceptance by ENGINEER does not relieve CONTRACTOR of his exclusive responsibility to fulfill the requirements as shown and specified.
3. Based on the finish hardware requirements specified, organize the final finish hardware schedule into "hardware sets," indicating complete designation of every item required for each door or opening. Furnish initial draft of schedule at the earliest possible date, in order to facilitate the fabrication of other work (such as hollow metal frames) which may be critical in the Project construction schedule. Furnish final draft of schedule after samples, manufacturer's data sheets, coordination with Shop Drawings for other work, delivery schedules and similar information have been completed and accepted.
4. Maintenance Manual: Upon completion of the Work, furnish copies of detailed maintenance manual including the following information:
   a. Product names and numbers.
   b. Name, address and telephone number of manufacturer and local distributor.
   c. Complete repair, installation and parts manuals for all items.
   d. Detailed procedures for routine maintenance and cleaning.
   e. Detailed procedures for light repairs such as dents, scratches and staining.

5. Complete information on required maintenance tools to be furnished as recommended by the finish hardware manufacturer.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Delivery of Materials:

1. Deliver finish hardware sufficiently in advance of its setting for proper inspection.
2. Pack each piece of finish hardware separately, complete with screws, keying, instructions and templates, tagged to correspond with the approved finish hardware schedule.

B. Storage of Materials:

1. Provide secure lock-up for finish hardware stored at the site, but not yet installed.
2. Store finish hardware in manufacturers' original packages.

C. Handling of Materials: Control the handling and installation of finish hardware items which are not immediately replaceable, so that the completion of the Work will not be delayed by finish hardware losses, both before and after installation.

1.5 JOB CONDITIONS

A. Scheduling: Deliver individually packaged finish hardware items at the proper time to the proper locations for installation.

1.6 SUBSTITUTIONS

A. Do not make substitutions after ENGINEER's approval of final finish hardware schedule.

B. Clearly identify all proposed substitutions and provide complete comparative data with specified product at time of Shop Drawing submission.

PART 2 - PRODUCTS

2.1 MATERIALS AND FABRICATION

A. General:

1. Hand of Door: The Drawings show the swing or hand of each door leaf (left, right, reverse bevel, etc.). Furnish each item of finish hardware for proper installation and operation of the door swing as shown.
2. Manufacturer's Name Plate: Do not use manufacturer's products which have manufacturer's name or trade name displayed in a visible location (omit removable nameplates), except in conjunction with required UL labels.
3. Base Metals: Produce finish hardware units of the basic metal and forming method specified, using the manufacturer's standard metal alloy, composition, temper and hardness. Do not substitute materials or forming methods for those specified.
4. Fasteners: Manufacture finish hardware to conform to published templates, generally prepared for machine screw installation. Do not provide finish hardware which has been prepared for self-tapping sheet metal screws, except as specifically indicated.
5. Furnish screws for installation, with each finish hardware item. Provide Phillips flat-head screws except as otherwise specified. Finish exposed (exposed under any condition) screws to match the hardware finish or, if exposed in surfaces on other Work, to match the finish of such other Work as closely as possible, including "prepared for paint" in surfaces to receive painted finish.
6. Provide fasteners which are compatible with both the unit fastened and the substrate, and which will not cause corrosion or deterioration of finish hardware, base material or fastener.
7. Provide concealed fasteners for finish hardware units which are not exposed when the door is closed, except to the extent no standard manufacturer units of the type specified are available with concealed fasteners. Do not use through bolts for installation where the bolt head or the nut on the opposite face is exposed in other Work under any condition, except where it is not possible to

adequately reinforce the Work and use machine screws or concealed fasteners of another standard type to satisfactorily avoid the use of through bolts.

8. Tools for Maintenance: Furnish a complete set of specialized tools as needed for ENGINEER's continued adjustment, maintenance, removal and replacement of finish hardware.

B. Mortise Hinges: Provide all doors with mortise hinges unless specifically scheduled as receiving pivot hinges:

1. Templates and Screws: Provide only template-produced units.
2. Base Metal: Fabricate hinges from stainless steel and finish to match the latch and lock set.
3. Number of Hinges: Except as otherwise specified, provide 2 hinges on each door leaf of less than 60-inches height; provide one additional hinge for next 30-inches of door height; provide two additional hinges for each 30-inches or fraction thereof for doors above 90-inches tall.
4. Hinge Size: Except as otherwise specified or as required to comply with UL and NFPA, provide hinges of the following sizes:
   a. Interior and Exterior Doors, maximum 36-inches wide: 4-1/2 inch heavy weight (0.180-inch). b. Wide Exterior and Interior Doors:
      1) Maximum 47-inches Wide: 5-inch heavy weight (0.190 inch).
      2) 48-inches Wide and Over: 6-inch heavy weight (0.203 inch).
5. Types of Hinges: Provide full-mortise type, ball-bearing hinges swaged for mortise applications, inner leaf beveled, square cornered, unless manufacturer's recommendations indicate that half-mortise, half-surface, full-surface or other type should be used for the frame and door type or condition.
6. Hinge Pins: Except as otherwise specified, provide hinge pins as follows:
   a. Pins: Stainless steel.
   b. Exterior Doors: Non-removable pins.

c. Tips: Hospital tips and matching plug, finished to match leaves.

7. Product and Manufacturer: Provide one of the following:
   a. FBB 199H by The Stanley Works.
   b. T4B3386H by McKinney Manufacturing Company.

8. Comply with UL, List of Inspected Fire Protection Equipment and Materials and NFPA No. 80 requirements.

C. Mortise Locks and Latch Sets:

1. Strikes: Provide manufacturer's standard wrought box strike, for each location and use shown. Provide stainless steel curved lip strikes, unless otherwise recommended by manufacturer, finished to match lock or latch set trim.
2. Lock Throw: Provide minimum of 3/4-inch anti-friction latch bolt and 1-inch dead bolt throw wherever available on manufacturer's functions specified. Comply with UL requirements for throw of latchbolts and deadbolts on fire-rated openings.
3. Materials: Provide the following materials: a. Latch Bolt: Stainless steel. b. Dead Bolt: Stainless steel. c. Case: Heavy gage steel with corrosion resistant finish. d. Hub: Stainless steel. e. Scalp: Bronze finished to match trim specified. f. All components shall be of marine quality wherever possible.
4. Backset: Provide minimum backset of 2-3/4-inches.
5. Modify specified locks and latches to comply with UL, Building Materials Directory, and List of Inspected Fire Protection Equipment and Materials and NFPA No. 80 requirements.
6. Finish: US 32D stainless steel.
7. Product and Manufacturer: Provide one of the following:
   a. Heavy-Duty Mortise Lock 9700 Series 773L Design with LE2 Escutcheon (US 32D) by Corbin Division of Emhart Corporation.
   b. Heavy-Duty Mortise Lock A7000 Series LusMo-LE (US 32D) by Russwin, Division of Emhart Corporation.

D. Panic Exit Devices:

1. Strikes: Provide manufacturer's standard wrought steel open back strikes for each location and use shown to allow independent opening and closing of each leaf of double doors with panic exit devices. Comply with UL, List of Inspected Fire Protection Equipment and Materials and NFPA No. 80 requirements.
2. Exit Doors: Where required by governing regulations or where shown or scheduled, provide panic exit devices, of the type required.
3. Fire Doors: Where shown or specified as a fire-rated door, provide units listed and labeled by UL to comply with the rating and size of door shown.
4. Lock Throws: Provide minimum of 3/4-inch latch bolt throw.
5. Provide surface mounted vertical rod type exit device and mortise type exit devices as specified.
6. Provide the following materials:
   a. Latch Bolt: Brass.
   b. Case: Heavy gage chrome plated steel.
   c. Cylinders: Bronze.
   d. Front: Heavy gage steel.
   e. Chassis: Brass.
   f. Crossbar: Stainless steel, 0.062-inches minimum thickness, with steel reinforcing tube.
   g. Surface Mounted Bolts: Minimum 1/2-inch diameter stainless steel.
7. Backset: Provide minimum backset of 2-3/4-inches.
8. Finish: US 32D stainless steel.
9. Product and Manufacturer: Provide one of the following:
   a. 3126 1/2 for single doors and 3126 1/2 x 3245U-73 for double doors 31MG Design (US 32D) by Corbin Division of Emhart Corporation.
   b. 796 1/2 for single doors and 796 1/2 x U771-73 for double doors 7415 Modera (US 32D) by Russwin Division of Emhart Corporation.

E. Cylinders and Keying System:

1. Review the keying system with CONTRACTOR and provide the type required (master, grandmaster or greatgrandmaster).
2. Equip all locks with manufacturer's special 6-pin tumbler cylinder, with construction master key feature, which permits voiding of construction keys without cylinder removal.
3. Comply with the ENGINEER's instructions for masterkeying and, except as otherwise specified, provide individual change key for each lock which is not designated to be keyed alike with a group of related locks.
4. Key Material: Provide keys of nickel silver only.
5. Key Quantity: Furnish 3 keys for each lock and each master and grandmaster system. Provide one extra key blank for each lock.
6. Provide a key control system including envelopes, labels, tags with self-locking key clips, receipt forms, 3-way visible card index, temporary markers, permanent markers and standard metal cabinet, all as recommended by system manufacturer, with capacity for 150 percent of the number of locks required for the project. Provide a hinged-panel type cabinet, for wall mounting.

F. Door Closers:

1. Provide all doors, both active and inactive, with door closers, unless otherwise specified.
2. Size of Units: Except as otherwise specified, comply with the manufacturer's recommendations for size of door control unit, depending upon size of door, exposure to weather, and anticipated frequency of use.
3. Where parallel arms are specified, and for closers on exterior doors, provide closer unit one size larger than recommended for use with standard arms.
4. Use parallel arm arrangement for doors that would otherwise have the door closer appearing in finished corridors or entries.
5. Modify closers specified as required to comply with UL, Building Materials Directory, and List of Inspected Fire Protection Equipment and Materials, and NFPA No. 80 for doors requiring door closers.

6. Provide hold open feature for all non-fire rated doors unless otherwise specified.
7. Select all arms to clear weatherstripping, and overhead door holders.
8. Provide long arm to allow door to swing 180 degrees where long arm will eliminate floor mounted stops and as shown.
9. Provide closers with spring power adjustment feature capable of increasing spring power 50 percent minimum in all closer sizes.
10. Provide closer with delayed closing action feature. Position valve at top of closer.
11. Provide individual regulating valves for closing and latching speeds, and separate adjustable backcheck valve.
12. Material: Provide the following materials: a. Metallic Cover: Aluminum US 27. b. Case: Cast iron. c. Other Parts: Steel.
13. Finish: Color coordinate all arms and other accessories.
14. Product and Manufacturer: Provide one of the following:
    a. 110 Series Door Closers by Corbin, Division of Emhart Corporation.
    b. DA 2810 Series Door Closers by Russwin, Division of Emhart Corporation.

G. Holders and Stops:
1. Provide concealed overhead holders and stops on all exterior doors and as specified; with hold open feature. Comply with UL and NFPA requirements.
2. Material: Provide the following materials: a. Shock Absorber Spring: Heavy tempered steel. b. All other Parts: Extruded bronze.
3. Coordinate placement of overhead holder and stop with arm and bracket selection for door closers, for non-interference.
4. Two types of holders and stops are required as follows:
    a. For all door leaves with maximum width of 3 foot-0 inches provide the following:
        1) Product and Manufacturer: Provide one of the following:

a) GJlOOA Series Heavy Duty Concealed Overhead Door Holder by Glynn Johnson Corporation.

b. For all door leaves wider than 3 foot-O inches provide the following:

1) Design extra heavy-duty surface mounted door holders and connections where they are fastened to other materials, to resist a superimposed load of 30 pounds per square foot acting on the plane of the doors.

2) Provide extra heavy-duty units at head of each leaf which shall engage and release door automatically by roller cam action with a provision at the end of the arm to regulate the hold-open tension or place it in a neutral position.

3) Provide 3/4-inch diameter steel arm, all other parts shall be cast bronze.

4) Provide all manufacturer recommended door reinforcements and coordinate the furnishing of hardware templates required for the installation of the units.

5) Finish: US 32D stainless steel.

6) Product and Manufacturer: Provide one of the following:

a) GJ79HD by Glynn-Johnson Division of Dayton-Walther Corporation.

H. Stops:

1. All doors shall have stops. Provide wall stops for all interior doors wherever possible. Provide long arms on closers where possible in order to avoid use of floor stops.

2. Materials: Chassis with grey rubber tip.

3. Finish: US 3S 32D stainless steel.

4. Provide concealed stainless steel fasteners as required by the substrate.

5. Product and Manufacturer: Provide one of the following:

a. WB60MX wall mounted concave series type series by Glynn Johnson Division of Dayton-Walther Corporation.

I. Stripping and Seals:

1. Provide perimeter weather stripping at all exterior doors and as specified.
2. Continuity of Stripping: Except as otherwise specified, it is required that the stripping at each opening be continuous and without unnecessary interruptions at door corners and hardware.
3. Replaceable Seal Strips: It is required that the resilient or flexible seal strip of every unit be easily replaceable and readily available from stocks maintained by the manufacturer.
4. Provide bumper type weather stripping at jambs and head, including a resilient insert and metal retainer strip, surface-applied, of the following metal, finish and resilient bumper material:
   a. Housing: Extruded aluminum with clear anodized finish; 0.062-inch minimum thickness of main walls and flanges.
   b. Seals: Closed cell extruded sponge neoprene.
5. Product and Manufacturer: Provide one of the following:
   a. No. 350CSR by Pemko Manufacturing Company.
6. Provide automatic drop-seal sound-stripping door-bottom unit of manufacturer's standard design, with operating seal bar of the following material, retained in an extruded metal bar, and capable of operating to close a 3/4-inch gap (from door bottom to floor or threshold). House mechanism and operating bar in the following metal housing, for mounting on doors as follows:
   a. Housing: Extruded aluminum, 0.062-inch thick, with clear anodized finish on exposed surfaces.
   b. Seal: Closed-cell sponge neoprene.
   c. Mounting: Semi-montise mounted. Mount on stop-face of doors, except mount on hinge-face of swing-in exterior doors.
7. Product and Manufacturer: Provide one of the following:
   a. No. 430CMR by Pemko Manufacturing Company.

J. Thresholds:

1. Provide thresholds on all exterior doors. Interior doors shall be provided with thresholds as scheduled.
2. Metal: Extruded aluminum.
3. Surface Pattern: Grooved tread, manufacturer's standard.
4. Provide countersunk bronze screws and expansion shields.
5. Width: 5-inches wide and full width of opening.
6. Construction:
   a. Single-piece, complying with manufacturer's recommendations.
7. Profile: Provide manufacturer's standard unit which conforms with the minimum size and profile requirements specified.
   a. For doors equipped with panic hardware, including floor bolts, provide profile with stop bar of proper size and shape to function as the strike plate for the floor bolts.
8. Thickness: 1/4-inch minimum.
9. Product and Manufacturer: Provide one of the following:
   a. 171 and 227 with 196 by Pemko Manufacturing Company.

K. Silencers:

1. Provide silencers for all non-fire rated door frames.
2. Product and Manufacturer: Provide one of the following:
   a. No. 3446 by Sargent and Company.

L. Sealants: Provide butyl rubber sealant complying with FS TT-S-001657 for use with thresholds.

2.2 HARDWARE FINISHES

A. Provide matching finishes for finish hardware units at each door or opening, to the greatest extent possible. Reduce differences in color and textures as much as commercially possible where the base metal or metal forming process is different for individual units of finish hardware exposed at the same door or opening. In general, match all items to the manufacturer's standard finish for the latch and lock set for color and texture.

PART 3 - EXECUTION

3.1 INSPECTION

A. CONTRACTOR (and/or his installer) shall examine the substrate to receive finish hardware, and ascertain the conditions under which the Work will be performed, and notify ENGINEER in writing of unsatisfactory conditions. Do not proceed with the finish hardware Work until unsatisfactory conditions have been corrected in a manner acceptable to ENGINEER.

3.2 PREPARATION

A. Templates: Furnish finish hardware templates to each fabricator of doors, frames and other work to be factory-prepared for the installation of finish hardware. Upon request, check the Shop Drawings of such other work, to confirm that adequate provisions are made for the proper installation of the finish hardware.

3.3 INSTALLATION

A. Mount finish hardware units at heights recommended in, "Recommended Locations for Builders' Hardware," by National Builders Hardware Association, except as otherwise specified or required to comply with governing regulations.

B. Install each finish hardware item in compliance with the manufacturer's instructions and recommendations. Wherever cutting and fitting is required to install finish hardware onto or into surfaces which are later to be painted or finished in another way, install each item completely and then remove and store in a secure place during the finish application. After completion of the finishes, re-install each item. Do not install surface-mounted items until finishes have been completed on the substrate.

C. Set units level, plumb and true to line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.

D. Drill and countersink units which are not factory-prepared for anchorage fasteners. Space fasteners and anchors in accordance with industry standards.

E. Cut and fit threshold and floor covers to profile of door frames, with mitered corners and hair-line joints. Join units with concealed welds or concealed mechanical joints. Cut smooth openings for spindles, bolts and similar items, if any.

F. Screw thresholds to substrate with No. 10 or larger bronze screws, of the proper type for permanent anchorage.

G. Set thresholds in a bead of butyl rubber sealant to completely fill concealed voids and exclude moisture from every source. Do not plug drainage holes or block weeps. Remove excess sealant.

3.4 ADJUSTMENT AND CLEANING

A. Adjust and check each operating item of finish hardware and each door, to ensure proper operation or function of every unit. Lubricate moving parts with the type lubrication recommended by manufacturer (graphite-type if no other recommended). Replace units which cannot be adjusted and lubricated to operate freely and smoothly as intended for the application.

B. Final Adjustment: Where finish hardware installation is made more than one month prior to Final Acceptance or occupancy of a space or area, return to the Work during the week prior to Final Acceptance or occupancy, and make a final check and adjustment of all finish hardware items in such space or area. Clean and relubricate operating items as necessary to restore proper function and finish of finish hardware and

doors. Adjust door control devices to compensate for final operating of heating and ventilating equipment.

C. Instruct OWNER's personnel in proper adjustment and maintenance of finish hardware during the final adjustment of finish hardware.

D. Finish hardware which is blemished or defective will be rejected even though it was set in place before defects were discovered. Remove and replace with new finish hardware. Repair all resultant damage to other work.

E. Continued Maintenance Service: Approximately 6 months after the acceptance of finish hardware in each area, the installer, accompanied by the representative of the latch and lock manufacturer, shall return to the project and re-adjust every item of hardware to restore proper function of doors and finish hardware. Consult with and instruct OWNER's personnel in recommended additions to the maintenance procedures. Clean and lubricate operational items wherever required. Replace finish hardware items which have deteriorated or failed due to faulty design, materials or installation of finish hardware units. Prepare a written report of current and predictable problems (of substantial nature) in the performance of the finish hardware.

3.5 SCHEDULES

A. Scheduled items for each door are generic and rely on information specified above. The listing of hardware types provided is only a general guideline for the final finish hardware schedule. CONTRACTOR shall submit a finish hardware schedule acceptable to all codes and testing agencies.

END OF SECTION

SECTION 9J3

CONCRETE TOPPINGS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish and install all concrete toppings Work. The Work also includes:

   a. Providing openings in the concrete toppings to accommodate the work under other Sections and building into the concrete toppings all items such as sleeves, anchor bolts, inserts and all other items to be embedded in concrete toppings for which placement is not specifically provided under other Sections.

2. Extent of concrete toppings is shown and in addition includes, but are not necessarily limited to, the following:

   a. 8-inch high concrete topping cove bases (unless otherwise shown) for all walls in all areas receiving concrete toppings of same type as floor in that area.

   b. Concrete topping completely covering top and sides of all concrete, including equipment pads, tank and pump pads, containment walls and curbs using same type of concrete toppings as used for floor in that area.

c. Concrete topping on bottoms and sides of all trench drains, and horizontal pipe chases of same type as floor in that area.

3. Types of concrete topping Work required include, but are not necessarily limited to, the following:

a. Chemical resistant concrete topping.

b. Miscellaneous materials and accessories.

c. Sandblasting, acid etching and other substrate preparations.

B. Coordination:

1. Coordinate and schedule sandblasting of substrates before equipment and similar items are installed to avoid later difficulty or delay in performing the Work of this section.

2. Coordinate the protection of existing equipment to remain in place during substrate preparation.

3. Review installation procedures under other Sections and coordinate the installation of items that must be installed with the concrete toppings.

4. Coordinate the finishing of substrates for acceptability of substrates to concrete toppings manufacturers.

5. Coordinate floor drain mounting heights and types. Provide floor drain type which accommodates 1/4-inch thick concrete floor toppings.

6. Remove all chemicals, compounds and other materials from substrates to receive the Work of this Section, as may be required by the concrete toppings manufacturers, at no additional expense

to OWNER even if chemicals, compounds and other materials are permitted by other Sections of this Specification.

C. Related Sections:

1. Section 3D, Cast-In-Place Concrete.

1.2 QUALITY ASSURANCE

A. Applicator Qualifications: Certified or licensed by the flooring materials manufacturer.

B. Source Quality Control: Provide each component of concrete topping produced by a single manufacturer, including recommended primers (if any), base coat, aggregate, and top coat materials.

C. Allowable Tolerances: Provide the following:

1. Finished toppings level to 1/8 inch in 10 feet-O inches.

2. Smooth, continuous color with no color streaks or inconsistencies.

3. Uniformly textured non-slip finish.

D. Reference Standards: Comply with applicable provisions and recommendations of the following except as otherwise shown or specified.

1. ASTM C 109, Compressive Strength of Hydraulic Cement Mortars.

2. ASTM C 150, Portland Cement.

3. ASTM C 190, Tensile Strength of Hydraulic Cement Mortars.

4. ASTM C 321, Bond Strength of Chemical-Resistant Mortars.

5. ASTM C 501, Relative Resistance to Wear of Unglazed Ceramic Tile by the Taber Abraser.

6. ASTM D 696, Test for Coefficient of Linear Thermal Expansion of Plastics.

7. ASTM D 790, Test of Flexural Properties of Plastics.

8. ASTM D 1308, Effect of Household Chemicals on Clear and Pigmented Organic Finishes.

9. ASTM D 2240, Rubber Property-Durometer Hardness.

10. ASTM E 84, Surface Burning Characteristics of Building Materials.

11. Military Specification, MIL-3134F.

1.3 SUBMITTALS

A. Samples: Submit for approval the following:

1. 12-inch by 12-inch samples of each type of concrete toppings on plywood. Show range of color and pattern variation. Sample submittals will be reviewed for color, texture, and pattern only. Compliance with all other requirements is the exclusive responsibility of CONTRACTOR.

2. After samples have been approved, a sample of concrete toppings shall be applied to floor areas selected by ENGINEER. Upon acceptance by ENGINEER, the samples shall be the standard by which all Work shall be compared.

B. Shop Drawings: Submit for approval the following:

1. Show floor plans indicating where concrete toppings occurs in each space. Show interface details with other items occurring in

the spaces such as thresholds, floor drains, coves, equipment pads and trench drains or horizontal pipe chases.

2. Copies of manufacturer's technical data and installation instructions for concrete topping required.

3. Maintenance Manual: Copies of manufacturer's written instructions for recommended maintenance practices.

4. Test Reports: Copies of test data from an independent testing laboratory for all the physical properties listed herein.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Delivery of Materials:

1. Deliver material in manufacturer's original unopened and undamaged packages.

2. Clearly identify manufacturer, brand name, contents, color stock number, and order number on each package.

3. Packages showing indications of damage that may affect condition of contents are not acceptable.

B. Storage of Materials:

1. Store in original packaging under protective cover and protect from damage.

2. Stack containers in accordance with manufacturer's recommendations.

C. Handling of Materials: Handle materials in such a manner as to prevent damage to products or finishes.

1.5 JOB CONDITIONS

A. Environmental Requirements:

1. Maintain substrate temperature and room temperature before, during and after installation above SO F and rising in accordance with flooring material manufacturer's instructions.

2. Provide adequate ventilation during application and curing periods.

B. Scheduling:

1. Schedule the installation of concrete topping Work in order to provide concrete topping on top of equipment pads, within horizontal pipe chases and similar locations where installation of equipment, piping and similar items would cause concrete topping installation difficulties, before such equipment, piping and similar items which would preclude later installation of concrete topping have been installed.

2. Provide all temporary heat and shelters as may be required to schedule the installation of concrete topping Work at no additional expense to OWNER.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Chemical Resistant Concrete Topping: Provide the following chemical resistant topping all individual components of which shall be capable of and recommended by the manufacturer for immersion in the reagent specified for one year without loss of specified properties or color.

1. Acid Etch: Provide manufacturer's recommended acid etching compound in addition to sandblast surface preparation.

2. Bond Coat: As recommended by the manufacturer.

3. Aggregate: Acid resistant granite chips.

4. Reinforcement: Provide a glass reinforced system using materials recommended for the system and chemical resistance specified. Provide Type H glass cloth.

5. Underlayment Fill: As recommended by the manufacturer.

6. Binder: Troweled vinyl ester composition flooring.

7. Top Coats: Non-slip with complete selection of manufacturer's top coats for maximum chemical resistant.

8. Termination Strips: White metal, tapered bar type as recommended by the manufacturer.

9. Physical Properties: The complete installation when thoroughly cured shall have the following physical properties:

   a. Tensile Strength, ASTM D 638: 13,000 pounds per square inch minimum.

   b. Indentation, MIL-D-3134F, PAR. 4.7.3: 0.062 inches maximum.

   c. Bond Strength, ASTM C 321: 300 pounds per square inch minimum.

   d. Flame Spread, ASTM D 635: Self-extinguishing.

   e. Thermal Coefficient of Linear Expansion, ASTM C 531: 7.2 by 10 inches per inch per ·F maximum.

   f. Abrasive Resistance, ASTM C 501: 27 wear index.

g. Flexural Strength, ASTM C 580: 22,000 pounds per square inch minimum.

h. Compressive Strength, ASTM C 109: 16,000 pounds per square inch minimum.

i. Surface Hardness, ASTM D 2240: Scale "D" 77.

j. Water Absorption, MIL-D-3134, 4.78: 0.12.

k. Chemical Resistance, ASTM D 1308:

Reagent	Film Integrity
50% Sodium Hydroxide (Spills Only)	Unaffected
93% Sulfuric Acid	Unaffected

10. Color: Provide manufacturer's standard color Dark Grey 852.

11. Texture: Non-slip surface.

12. Product and Manufacturer: Provide one of the following:

a. Ceilcrete 6650 Vinyl Ester Flooring by the Ceilcote Company.

b. DR3116 Vinyl Ester Trafficote #16 by General Polymers Corporation.

PART 3 - EXECUTION

3.1 INSPECTION

A. CONTRACTOR (and/or his installer) shall examine the areas and conditions under which concrete toppings are to be placed and notify ENGINEER in writing of conditions detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected in a manner acceptable to ENGINEER.

B. Subfloor shall have a wood float finish. Concrete shall have cured for 28 days prior to initiation of this Work.

3.2 PREPARATION

A. Subfloors: Prior to start of applying flooring, broom clean or vacuum surfaces to be covered and inspect the subfloor. Start of application operations will indicate acceptance of subfloor conditions and full responsibility for the completed Work.

B. Sandblasting and Acid Etching: All areas to receive the Work of this Section shall be given a medium sandblast finish to insure maximum topping adhesion followed by concrete toppings manufacturer's recommended acid etching treatment.

C. Primer: Apply primer as recommended by flooring manufacturer, prior to application of the base coat. Apply in accordance with manufacturer's directions.

D. Fill or grind concrete substrate as may be required to achieve a smooth uniform, level finished appearance on finished Work.

3.3 APPLICATION

A. Do not power trowel the heavy duty concrete topping unless manufacturer provides written certification to ENGINEER that material shall experience no loss in compressive strength or tensile strength.

B. Apply termination and expansion joint strips at the junction of the flooring with other materials and at expansion joints as recommended by the manufacturer.

C. Apply flooring only after finishing operations have been completed and permanent heating system is operating. Moisture content of concrete slabs, building air temperature and relative humidity must be within limits recommended by manufacturer.

D. Mix materials and apply bonding coat in accordance with manufacturer's instructions.

E. Apply glass reinforcement as specified.

F. Apply grout coats to smooth body coat.

G. Apply vinyl ester floor topping coat to 1/4-inch dry cured minimum thickness, or greater if specifically recommended to achieve the physical properties, chemical resistances and dimensional tolerances specified.

H. Power sand to remove trowel marks.

I. Apply top coat sealer material for maximum chemical resistance and cleanability as recommended by the manufacturers.

3.4 ADJUSTMENT AND CLEANING

A. Finishing: Apply a final top coat, to match the texture of the approved samples.

B. Protect installed flooring from damage, by use of heavy Kraft paper or other covering so that flooring is without damage, or unusual or accelerated wear at time of Final Acceptance.

C. Flooring damaged in any manner shall be repaired or replaced at the discretion of ENGINEER, at no additional cost to ENGINEER.

D. The flooring at the time of Final Acceptance shall be clean and without damage, other than for normal wear associated with normal foot traffic, according to the manufacturer's published literature.

END OF SECTION

SECTION 9L

PAINTING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish and install all painting Work.

2. Extent of painting Work is specified.

3. Types of painting Work includes, but are not necessarily limited to, the following:

   a. Surface preparation, priming and coats of paint specified are in addition to shop priming and surface treatment specified under other sections of the Work.

   b. Preparing existing substrates to remain, as specified, to receive the Work of this Section.

4. The term "paint" as used herein means all coating systems materials, which includes pretreatments, primers, emulsions, enamels, stain, sealers and fillers, and other applied materials whether used as prime, intermediate or finish coats.

5. Paint all exposed surfaces whether or not colors are designated in any schedule, except where the natural finish of the material is specifically noted as a surface not to be painted. The term "exposed" as used herein means all items not covered with cement plaster or concrete. Conduits and other materials with corrosion resistant surfaces which are in chases, above finished

ceilings, or other inaccessible areas shall not require field painting. Where items or surfaces are not specifically mentioned, paint these the same as adjacent similar materials or areas.

6. Structural and miscellaneous metals covered with concrete, shall only receive a primer compatible with the covering material.
7. Pipe markers.

B. Coordination:

1. Review installation procedures under other Sections and coordinate the installation of items that must be field painted in this Section.

2. Coordinate the painting of areas that are inaccessible once equipment has been installed.

3. Provide finish coats which are compatible with the prime paints used. Review other Sections of these Specifications in which prime paints are to be provided to ensure compatibility of the total coatings system for the various substrates. CONTRACTOR shall be responsible for the compatibility of all shop primed and field painted items. Furnish information on the characteristics of the finish materials proposed to use, to ensure that compatible prime coats are used. Provide barrier coats over incompatible primers or remove and reprime as required. Notify ENGINEER in writing of anticipated problems using the coating systems as specified with substrates primed by others.

C. Related Sections:

1. Equipment markers in appropriate equipment section.

D. Painting Not Included: The following categories of Work are not included as part of the field-applied finish Work, or are included in other Sections of these Specifications or in other contracts.

1. Shop Priming: Unless otherwise specified, shop priming of structural metal, miscellaneous metal fabrications, other metal items and such fabricated components as shop-fabricated or factory-built heating and ventilating, instrumentation and electrical equipment or accessories shall conform to applicable requirements of Section 9L but is included under the appropriate Sections of this Specification.

2. Pre-Finished Items: Do not include painting when factory finishing such as baked-on enamel, ceramic glazes, ceramic porcelain, polyvinylidene fluoride, plastic laminate or other similar finish is specified.

3. CONTRACTOR shall be required to touch up factory painted items with paint supplied by the item manufacturer. CONTRACTOR shall field paint damaged prefinished items as directed by ENGINEER.

4. Metal surfaces of anodized aluminum, stainless steel, chromium plate, bronze, copper, and similar finished materials will not require finish painting, unless shown or specified.

5. Operating Parts and Labels:

a. Moving parts of operating units, mechanical and electrical parts, such as valve and damper operators, linkages, sinkages, sensing devices, motor and fan shafts do not require finish painting unless otherwise specified.

b. Do not paint over any code-required labels, such as UL and Factory Mutual, or any equipment identification, performance rating, name, or nomenclature plates.

c. Remove all paint, coating or splatter inadvertently placed on these surfaces.

6. Cast-in-place concrete floor slabs.

7. Cast-in-place concrete walls and ceilings.

8. Sealants.

1.2 QUALITY ASSURANCE

A. Applicator Qualifications:

1. Submit the name and experience record of the painting applicator. Include a list of utility or industrial installations painted, responsible officials, architects, or engineers concerned with the project and the approximate contract price.

2. Painting applicators whose submissions indicate that they have not had the experience required to perform the Work will not be approved.

B. Source Quality Control: Obtain all materials from the same manufacturer unless otherwise approved. Obtain materials only from manufacturers who will:

1. Provide the services of a qualified manufacturer's representative at the project site at the commencement of Work to advise on materials, installation and finishing techniques.
2. Certify long term compatibility of all coatings with all substrates.

C. Reference Standards: Comply with applicable provisions and recommendations of the following, except where otherwise shown or specified:

1. ANSI A13.1, Scheme for the Identification of Piping Systems.

2. OSHA 1910.144, Safety Color Code for Marking Physical Hazards.

3. SSPC Volume 2, Systems and Specifications, Surface Preparation Guide and Paint Application Specifications.

4. State of New York, Department of Public Health.

5. ANSI/NFS Standard 60, Drinking Water Treatment Chemicals - Health Effects.

6. ANSI/NFS Standard 61, Drinking Water System Components - Health Effects.

D. Requirements of Regulatory Agencies: Coatings for surfaces in contact with potable water or water being treated for potable use shall not impart any taste or odor to the water or result in any organic or inorganic content in excess of the maximum contaminant level established by applicable laws or regulations. All such coatings shall be approved by the applicable regulatory agency. Revise painting systems specified herein to provide manufacturer's regulatory agency approved coating systems at no additional cost to OWNER.

1.3 SUBMITTALS

A. Samples: Submit for approval the following:

1. Pipe Markers: Each type of marker specified.

B. Shop Drawings: Submit for approval the following:

1. Copies of manufacturer's technical information, including paint label analysis and application instructions for each material proposed for use.

2. Copies of CONTRACTOR'S proposed protection procedures in each area of the Work.

3. Copies of manufacturer's Product profile sheets.

4. List each material and cross-reference to the specific paint and finish system and application. Identify by manufacturer's catalog number and general classification.

5. Copies of manufacturer's complete color charts for each coating system.

6. Pipe Markers: Copies of manufacturer's technical brochure, including color chart and list of standard markers.

7. Maintenance Manual: Upon completion of the Work, furnish copies of a detailed maintenance manual including the following information:

    a. Product name and number.

    b. Name, address and telephone number of manufacturer and local distributor.

    c. Detailed procedures for routine maintenance and cleaning.

    d. Detailed procedures for light repairs such as dents, scratches and staining.

C. Test Reports: Submit for approval certified laboratory test reports for required performance tests.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Delivery of Materials: Deliver all materials to the job site in original, new and unopened packages and containers bearing manufacturer's name and label, and the following information.

1. Name or title of material.

2. Manufacturer's stock number and date of manufacture.

3. Manufacturer's name.

4. Contents by volume, for major pigment and vehicle constituents.

5. Thinning instructions where recommended.

6. Application instructions.

7. Color name and number.

B. Storage of Materials:

1. Store only acceptable project materials on project site.

2. Store in a suitable location approved by ENGINEER. Keep area clean and accessible.

3. Restrict storage to paint materials and related equipment.

4. Comply with health and fire regulations including the Occupational Safety and Health Act of 1970.

C. Handling of Materials:

1. Handle materials carefully to prevent inclusion of foreign materials.

2. Do not open containers or mix components until necessary preparatory Work has been completed and application Work will start immediately.

1.5 JOB CONDITIONS

A. Existing Conditions:

1. Before painting is started in any area, it shall be broom cleaned and excessive dust shall be removed.

2. After painting operations begin in a given area, broom cleaning will not be allowed; cleaning shall then be done only with commercial vacuum cleaning equipment.

B. Environmental Requirements:

1. Apply water-base paints only when the temperature of surfaces to be painted and the surrounding air temperatures are between 55 F and 90 F unless otherwise permitted by the paint manufacturer's printed instructions.

2. Apply other paints only when the temperature of surfaces to be painted and the surrounding air temperatures are between 65 F and 95 F, unless otherwise permitted by the paint manufacturer's printed instructions.

3. Do not apply paint in snow, rain, fog, or mist; or when the relative humidity exceeds 85 percent; or to damp or wet surfaces.

4. Painting may be continued during inclement weather only if the areas and surfaces to be painted are enclosed and heated within the temperature limits specified by the paint manufacturer during application and drying periods.

5. Adequate illumination and ventilation shall be provided in all areas where painting operations are in progress.

6. Install piping markers only after all painting and finish Work has been completed.

C. Protection:

1. Cover or otherwise protect finished Work of other trades and surfaces not being painted concurrently or not to be painted.

2. Comply with governing code requirements for air quality and material disposal regulations.

3. Provide fire extinguishers and post caution signs warning against smoking and open flame when working with flammable materials.

4. Submit protection procedures to be employed by CONTRACTOR to ENGINEER.

PART 2 - PRODUCTS

2.1 MATERIAL QUALITY

A. Manufacturer: Provide products manufactured by one of the following:

1. Tnemec Company, Incorporated.

2. Koppers, Incorporated.

B. Provide the best grade of the various types of coatings as regularly manufactured by acceptable paint materials manufacturers. Materials not displaying the manufacturer's identification as a standard, best-grade product will not be acceptable.

C. Provide primers produced by the same manufacturer as the finish coats. Use only thinners recommended by the paint manufacturer, and use only to recommended limits.

D. Provide paints, of durable and washable quality. Use materials which will withstand normal washing as required to remove grease, oil, chemicals, etc., without showing discoloration, loss of gloss, staining, or other damage.

2.2 SUBSTITUTIONS

A. No substitutions shall be considered that decrease the film thickness, the number of coats, the surface preparation or the generic type of coating specified. Approved manufacturers must furnish the same color selection as the manufacturers specified, including accent colors in all coating systems.

2.3 COLORS AND FINISHES

A. Surface treatments, and finishes, are shown under "Painting Systems" below. All substrates scheduled under "Painting Systems" shall be painted whether or not shown on the Drawings, or in Schedules, unless an item is specifically scheduled as not requiring the painting system scheduled below.

B. Color Selection: A maximum of 10 different colors shall be selected for the project.

C. After approval of submittals and prior to beginning Work, CONTRACTOR will furnish color schedules for surfaces to be painted listed in the painting systems below.

D. Pipe and Sign Color Coding: In general, and unless otherwise specified, all color coding of piping, ducts and equipment shall comply with applicable standards of ANSI A13.1 and OSHA 1910.144.

E. Use representative colors when preparing samples for CONTRACTOR'S review.

F. Color Pigments: Pure, nonfading, applicable types to suit the substrates and service indicated.

1. Lead: Lead content shall not exceed amount permitted by federal, state and local government laws and regulations.

2. Paints specified for application in contact with potable water shall be approved by the Rhode Island Department of Health.

G. Submit proposed application techniques to ENGINEER. Submit proof of acceptability, of technique proposed, by the paint manufacturer selected.

2.4 PAINTING SYSTEMS

A. Concrete Block Walls; Interior:

1. Surface Preparation: Remove grease, oil and all foreign matter as specified in 3.2.B.

2. Product and Manufacturer: Provide one of the following:

a. Tnemec:

1) Primer: 54-660 Block Filler - 1 coat, 10.0 dry mils, 75-100 square feet per gallon.

2) Finish: 66 H.B. Epoxoline - 2 coats, 2.0-3.0 dry mils per coat, 240-360 square feet per gallon per coat.

3) Finish: 156 Enviro-Crete - 1 coat, 4.0 - 8.0 dry mils, 80-160 square feet per gallon.

B. Ferrous Metals including all Structural Steel, Miscellaneous Ferrous Metals, and all Ferrous Piping and all Ferrous Piping to be Covered with Insulation; Interior:

1. Surface Preparation: SSPC-SP 6 Commercial Blast Cleaning as specified in 3.2.C.

2. Product and Manufacturer: Provide one of the following:

a. Tnemec:

1) Shop Primer: 66-1211 Epoxy - 2 coats, 1.5-2.5 dry mils per coat, 270-460 square feet per gallon per coat.

2) Field Primer or Field Touchup: 66-1211 Epoxy - 1 coat, 1.5-2.5 dry mils per coat, 270-460 square feet per gallon.

3) Finish: 66 H.B. Epoxoline - 2 coats, 2.0-3.0 dry mils per coat, 240-360 square feet per gallon per coat.

C. Ferrous, Non-Ferrous Metals, Fiberglass and Galvanized Metals; Exterior:

1. Surface Preparation:

a. Ferrous Metals: SSPC-SP 6 Commercial Blast Cleaning as specified in 3.2.C.

b. Galvanized and Non-Ferrous Metal: SSPC-SP 1 Solvent Cleaning as specified in 3.2.E. and 3.2.D.

c. Fiberglass: Sand as specified in 3.2.F.

2. Product and Manufacturer: Provide one of the following:

a. Tnemec:

1) Primer:

a) Ferrous Metals: -66-1211 Epoxy - 2 coats, 1.5-2.5 dry mils per coat, 270-460 square feet per gallon per coat.
b) Non-Ferrous and Galvanized: None.

2) Intermediate: 66 H.B. Epoxoline - 1 coat, 2.0-3.0 dry mils, 240-360 square feet per gallon.

3) Finish: 71 Endura-Shield - 1 coat, 1.5- 2.5 dry mils, 270-460 square feet per gallon.

D. Galvanized Metal and Non-Ferrous Metal; Interior:

1. Surface Preparation: SSPC-SP 1 Solvent Cleaning, as specified in Section 3.2.D., and 3.2.E.

2. Product and Manufacturer: Provide one of the following:

a. Tnemec:

1) Primer: 66 H.B. Epoxoline - 1 coat, 2.0-3.0 dry mils, 240-360 square feet per gallon.

2) Finish: 66 H.B. Epoxoline - 1 coat, 2.0-3.0 dry mils, 240-360 square feet per gallon.

E. All Metal Surfaces Exposed to Temperatures Over 250 F:

1. Surface Preparation: SSPC-SP 10 Near White blast as specified in Section 3.2.C.

2. Product and Manufacturer: Provide one of the following:

a. Tnemec:

1) Finish: 1261 Silicone Aluminum - 2 coats, 0.8 dry mils per coat, 500 square feet per gallon per coat.

F. All Aluminum in Contact with Dissimilar Materials:

1. Surface Preparation:

a. Remove all foreign matter.

b. Pretreatment Wash Coat of Polyvinyl Butyral Resin: 1 coat, 0.3-0.5 dry mils.

2. Product and Manufacturer: Provide one of the following:

a. Tnemec:

1) 66 H.B. Epoxoline - 2 coats, 2.0-3.0 dry mils per coat, 240-360 square feet per gallon per coat.

G. Pipe and Duct Insulation, Cloth; Interior:

1. Surface Preparation: Remove all foreign matter as specified in 3.2.G.

2. Products and Manufacturer: Provide one of the following:

a. Tnemec:

1) Primer: 51-792 PVA Sealer - 1 coat, 1.0 dry mils, 400 square feet per gallon.

2) Finish: 66 H.B. Epoxoline - 2 coats, 2.0-3.0 dry mils per coat, 240-360 square feet per gallon per coat.

H. PVC Piping, Fiberglass, Fiberglass Insulation Covering; Interior:

1. Surface Preparation: Sand as specified in 3.2.F.

2. Product and Manufacturer: Provide one of the following:

a. Tnemec:

1) Finish: 66 H.B. Epoxoline - 2 coats, 2.0-3.0 dry mils per coat, 240-360 square feet per gallon per coat.

I. Steel and Galvanized Steel Pipe; Buried Exterior:

1. Surface Preparation: SSPC-SP 10, Near-White Blast, as specified in Section 3.2.C.

2. Product and Manufacturer: Provide one of the following:

a. Tnemec:

1) Shop Primer: 66-1211 Epoxy - 2 coats, 1.5-2.5 dry mils per coat, 270-460 square feet per gallon per coat.

2) Field Primer or Field Touchup: Surface preparation as specified.

3) Finish: 46H-413 Tneme-Tar - 2 coats, 8.0-10.0 dry mils per coat, 90-120 square feet per gallon per coat.

2.5 PIPE MARKERS

A. Manufacturer: Provide products produced by one of the following:

1. W. H. Brady Company.

2. Seton Name Plate Corporation.

B. General:

1. Piping markers shall be formed from laminated plastic. All printing shall be sealed with a formed butyrate plastic film. Markers for piping up to 6-inch diameter shall be preformed to completely wrap around the pipe requiring no adhesive. Markers for pipes over 6-inch diameter shall be preformed to the contour of the pipe and attached with stainless steel spring fasteners.

2. For pipes under 3/4-inch outside diameter: Provide brass tags, 1 1/2-inch diameter, with depressed 1/4-inch high black filled letters above 1/2-inch high black filled numbers.

3. Each marker shall consist of at least 1 legend descriptive of the function of the pipe, and a directional arrow.

4. The size of lettering and marker shall conform to ANSI A13.1.

5. Location of Markers:

   a. Adjacent to each valve and "T" connection.

   b. At each branch and riser takeoff.

   c. At each pipe passage through a wall, floor and ceiling.

d. On all horizontal and vertical pipe runs at 25-foot intervals.

PART 3 - EXECUTION

3.1 INSPECTION

A. CONTRACTOR (and/or his applicator) shall examine the areas and conditions under which painting Work is to be performed and notify ENGINEER in writing of conditions detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected in a manner acceptable to ENGINEER.

B. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions otherwise detrimental to the formation of a durable paint film.

3.2 SURFACE PREPARATION

A. General:

1. Perform all preparation and cleaning procedures as specified herein and in strict accordance with the paint manufacturer's instructions for each particular substrate and atmospheric condition.

2. Remove all hardware, hardware accessories, machined surfaces, plates, lighting fixtures, and similar items in place and not to be finish painted, or provide surface applied protection prior to surface preparation and painting operations. Remove, if necessary, for the complete painting of the items and adjacent surfaces. Following completion of painting of each space or area, reinstall the removed items by workmen skilled in the trades involved.

3. Clean surfaces to be painted before applying paint or surface treatments. Remove oil and grease with clean cloths and cleaning solvents prior to mechanical cleaning. Program the cleaning and painting so that dust and other contaminants from the cleaning process will not fall in wet, newly painted surfaces.

4. All surfaces which were not shop painted or which were improperly shop painted, and all abraded or rusted shop painted surfaces, which are to be painted, as determined by ENGINEER, shall be prepared as specified below.

B. Masonry Surfaces:

1. Prepare surfaces of concrete block to be painted by removing all efflorescence, chalk, dust, dirt, grease, oils, with soap and water.

2. Determine the alkalinity and moisture content of the surfaces to be painted by performing appropriate tests. If the surfaces are found to be sufficiently alkaline to cause blistering and burning of the finish paint, correct this condition before application of paint. Provide ENGINEER with suitable testing materials in order to carry out alkalinity and moisture tests.

3. Do not paint over surfaces where the moisture content exceeds 8 percent, unless otherwise permitted in the manufacturer's printed directions.

4. Concrete block surfaces that cannot be adequately cleaned by soap and water shall be acid etched.

C. Ferrous Metals:

1. Clean ferrous surfaces including structural steel and miscellaneous metal to be shop primed, of all oil, grease, dirt, mill scale and other foreign matter by commercial blast cleaning complying with SSPC-SP 6.

2. Clean ferrous surfaces that have not been shop- coated of all oil, grease, dirt, loose mill scale and other foreign substances by commercial blasting, complying with SSPC-SP 6.

3. Clean ferrous surfaces that are exposed to temperatures above 250 F or which will be buried, or that, in the opinion of ENGINEER, have been improperly shop coated, of all oil, grease, dirt, mill scale and other foreign matter by near white blasting complying with SSPC-SP 10.

4. Treat bare and blasted or pickled clean metal with metal treatment wash coat, prior to priming only if recommended by the paint manufacturer.

5. Touch-up shop-applied prime coats which have damaged or bare areas, with primer recommended by the coating manufacturer after commercial blasting complying with SSPC-SP 6.

D. Non-Ferrous Metal Surfaces: Clean non-ferrous metal surfaces in accordance with the coating system manufacturer's instructions for the type of service, metal substrate, and application required.

E. Galvanized Surfaces:

1. Clean free of oil and surface contaminants with a non-petroleum based solvent, recommended by the coating manufacturer, complying with SSPC-SP 1.

2. Remove shop applied chromic acid treatments on galvanized surfaces to be painted. Galvanized metals which have been given a humid storage stain treatment shall be prepared for painting by sanding or by other techniques as recommended by the paint manufacturer at no additional expense to ENGINEER.

F. PVC Piping and Fiberglass: Lightly sand and clean all surfaces to be painted.

G. Covering on Pipe:: Clean free of oil and surface contaminants as recommended by the coating manufacturer for substrate and application required. Do not cut or damage the insulation in any way.

3.3 MATERIALS PREPARATION

A. General:

1. Mix and prepare painting materials in strict accordance with the manufacturer's directions.

2. Do not mix coating materials produced by different manufacturers, unless otherwise permitted by the manufacturer's instructions.

3. Store materials not in actual use in tightly covered containers. Maintain containers used in storage, mixing, and application of paint in a clean condition, free of foreign materials and residue.

4. Stir all materials before application to produce a mixture of uniform density, and as required during the application of the materials. Do not stir any film which may form on the surface into the material. Remove the film and, if necessary, strain the material before using.

5. Mixing:

   a. Mix only in containers placed in suitably sized non-ferrous or oxide resistant metal pans to protect concrete floor from splashes or spills which could stain exposed concrete or react with subsequent finish floor material.

   b. Mix and apply paint only in containers bearing accurate product name of material being mixed, or applied.

3.4 APPLICATION

A. General:

1. Apply paint by brush, roller, air spray, or airless spray in accordance with the manufacturer's directions and recommendations of Paint Application Specifications No. 1 in SSPC Vol. 2, where applicable. Use brushes best suited for the type of material being applied. Use rollers of carpet, velvet back, or high pile sheep's wool as recommended by the paint manufacturer for material and texture required. Use air spray and airless spray equipment recommended by the paint manufacturer for specific coating system specified. Submit a list of application methods proposed, listing paint systems and location.

2. The paint film thickness required is the same regardless of the application method. Do not apply succeeding coats until the previous coat has completely dried.

3. Apply additional coats when undercoats, stains, or other conditions show through the final coat of paint, until the paint film is of uniform finish, color and appearance. This is of particular importance regarding intense primary accent colors. Insure that all surfaces, including edges, corners, crevices, welds, and exposed fasteners receive a film thickness equivalent to that of flat surfaces.

4. Surfaces not exposed to view do not require color coding but require the same coating system specified for exposed surfaces.

   a. "Exposed to view surfaces" is defined as those areas visible when permanent or built-in fixtures convector covers, covers, covers for finned tube radiation, grilles, etc. are in place in areas scheduled to be painted.

5. Paint interior surfaces of ducts, where visible through registers or grilles, with a flat, non-specular black paint as specified, before final installation of equipment.

6. Paint aluminum parts in contact with dissimilar materials as specified with appropriate primer.

7. Omit field primer on metal surfaces which have been shop primed touch-up paint shop prime coats only when approved by ENGINEER.

8. Paint the backs of access panels, and removable or hinged covers to match the exposed surfaces.

B. Heating, Ventilating, Air Conditioning and Electrical Work:

1. Heating, ventilating, and air conditioning items to be painted include, but are not limited to, the following:

   a. Piping, pipe hangers, and supports.

   b. Heat exchangers.

   c. Tanks.

   d. Ductwork and insulation.

   e. Motors, mechanical equipment, and supports.

   f. Accessory items.

2. Electrical items to be painted include, but are not limited to, the following:

   a. Conduit and fittings.

b. Switchgear, panels, junction boxes, motor control centers, motors and accessories.

C. Minimum Coating Thickness:

1. Apply each material at not less than the manufacturer's recommended spreading rate, and provide total dry film thickness as specified.

2. Apply extra coat if required to obtain specified total dry film thickness.

D. Scheduling Painting:

1. Apply the first-coat material to surfaces that have been cleaned, pretreated or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.

2. Allow sufficient time between successive coatings to permit proper drying. Do not recoat until paint has dried to where it feels firm, does not deform or feel sticky under moderate thumb pressure, and the application of another coat of paint does not cause lifting or loss of adhesion of the undercoat.

E. Prime Coats: Recoat primed and sealed walls and ceilings where there is evidence of suction spots or unsealed areas in first coat, to assure a finish coat with no burn-through or other defects caused by insufficient sealing.

F. Pigmented (Opaque) Finishes: Completely cover to provide an opaque, smooth surface of uniform finish, color, appearance, and coverage.

G. Transparent (Clear) Finishes:

1. On exposed to view portions, use multiple coats to produce glass- smooth surface film continuity of even matt luster. Provide a finish free of laps, cloudiness, color irregularity, runs, brush marks, orange peel, nail holes, or other surface imperfections.

2. Provide satin finish for final coats, unless otherwise indicated.

H. Brush Application:

1. Brush-out and work all brush coats onto the surfaces in an even film. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections will not be acceptable. Neatly draw all glass and color break lines.

2. Brush apply all primer or first coats, unless otherwise permitted to use mechanical applicators.

I. Mechanical Applicators:

1. Use mechanical methods for paint application when permitted by governing ordinances, paint manufacturer, and approved by ENGINEER. If permitted, limit to only those surfaces impracticable for brush applications.

2. Limit roller applications, if approved by CONTRACTOR, to interior wall finishes for second and third coats. Apply each roller coat to provide the equivalent hiding as brush-applied coats.

3. Confine spray application to metal framework, siding, decking, wire mesh and similar surfaces where hand brush work would be

inferior and to other surfaces specifically recommended by paint manufacturer.

4. Wherever spray application is used, apply each coat to provide the equivalent hiding of brush-applied coats. Do not double back with spray equipment for the purpose of building up film thickness of 2 coats in one pass.

J. Completed Work: Match approved samples for color, texture and coverage. Remove, refinish, or repaint Work not in compliance with specified requirements as required by CONTRACTOR.

K. Piping Markers: Apply piping markers in accordance with the manufacturer's written instructions in locations herein specified.

3.5 PROTECTION

A. Protect work of other trades, whether to be painted or not, from the Work of this Section. Leave all such work undamaged. Correct all damages by cleaning, repairing or replacing, and repainting, as acceptable to ENGINEER.

B. Provide "Wet Paint" signs as required to protect newly painted finishes. Remove all temporary protective wrappings provided for protection of this Contract and other contracts after completion of painting operations.

3.6 CLEAN-UP

A. During the progress of the Work, remove from the site all discarded paint materials, rubbish, cans and rags at the end of each work day.

B. Upon completion of painting Work, clean all paint-spattered surfaces. Remove spattered paint by proper methods of washing and scraping, using care not to scratch or otherwise damage finished surfaces.

C. At the completion of work of other trades, touch-up and restore all damaged or defaced painted surfaces as determined by ENGINEER.

END OF SECTION

SECTION 10I

IDENTIFICATION DEVICES

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment and incidentals, as shown, specified and required to furnish and install all identification devices Work.
2. The extent of identification devices is specified herein.
3. The type of identification device Work includes, but is not necessarily limited to, the following:
   a. Interior room identification signs.
   b. Fire extinguisher location signs.
   c. Self-luminous exit signs.
   d. Miscellaneous fasteners and supports.
   e. Safety signs.
   f. Right-to-know labels and tags.

B. Related Sections:
1. Section 9L, Painting.

1.2 QUALITY ASSURANCE

A. Field Measurements: Take field measurements prior to preparation of Shop Drawings and fabrication, where possible, to ensure proper fitting of the Work.

B. Inserts and Anchorages:

1. Furnish inserts and mechanical anchoring devices for the installation of identification devices and related work.
2. Provide setting drawings, templates, instructions and directions for installation of anchorage devices. Coordinate delivery with other work to avoid delay.

C. Shop Assembly: Preassemble items in the shop to the greatest extent possible. Disassemble units only to the extent necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

1.3 SUBMITTALS

A. Samples: Submit for approval samples of each color and finish of exposed materials and accessories required for identification devices. ENGINEER's review of samples will be for color and texture only. Compliance with all other requirements is the exclusive responsibility of CONTRACTOR.

B. Shop Drawings: Submit for approval the following:

1. Shop Drawings for fabrication and erection of identification devices. Include plans, elevations, and full-size graphic layout. Show anchorages and accessory items. Furnish location template drawings for items supported or anchored to permanent construction.
2. Copies of manufacturer's technical data and installation instructions for each type of device required.
3. Complete selection of specified manufacturer's standard and custom colors.
4. Plans showing location of all required exit signs with information indicating mounting position, location and substrate. Coordinate location of exit signs for non-interference with other Work as required by governing building code.

PART 2 - PRODUCTS

2.1 ROOM IDENTIFICATION SIGNS, FIRE EXTINGUISHER LOCATION SIGNS AND SAFETY SIGNS

A. Material: Subsurfaced silk screened on transparent acrylic sheet, .015-inches thick, 1-5/8-inches by 13-inches, laminated to .125-inch thick colored background with white helvetica medium lettering, 3/4-inch size, all capitals, square edges and corners, 2-inch by 13-3/8-inch aluminum frame.

1. Room Identification Signs: Schedule of room names will be supplied by ENGINEER after award of Contract. Every interior door will receive two plaques and room names may be used to estimate quantities of letters.
2. Product and Manufacturer: Provide one of the following:
   a. 320 Series, SOG construction as manufactured by ASI Sign Systems, Incorporated.
   b. ES100 as manufactured by Vomar Products, Incorporated.
3. Safety Sign: Provide 25 signs to be used throughout the project, change background color to yellow with black lettering. Message, and location to be determined by ENGINEER. Signs shall be fiberglass or metal backed butylate, 10 inches by 14 inches.
4. Fire Extinguisher Identification Sign: Provide one for each surface mounted fire extinguisher. Background color red with white lettering. Sign shall incorporate a directional arrow as located by ENGINEER.
5. Product and Manufacturer: Provide one of the following:
   a. Butyrate signs as manufactured by Seton Name Plate Corporation.
   b. Fiberglass signs as manufactured by W.H. Brady Company.

2.2 SELF-LUMINOUS EXIT SIGNS

A. Provide self-luminous exit signs. Sign housing shall consist of an A42 color anodized extruded aluminum frame. The size, graphics and background color of the sign legend shall conform to all relevant code requirements. The legend shall be protected by a temper-resistant acrylic shield.

B. Lumination for exit signs shall be provided by sealed phosphor-coated tubes containing tritium located directly behind each portion of each letter. The tritium light sources shall be housed in a single impact resistant module.

C. Signs shall be listed by Underwriters Laboratories as being capable of providing a 10-15 year service life.

D. Mount exit signs in locations shown. Surface mount signs above all exit doors unless otherwise shown. Provide manufacturer's standard universal mounting bracket.

E. Product and Manufacturer: Provide one of the following:
   1. Everglo Signs by Self Powered Lighting Incorporated.
   2. Isolite Model 2040-01 Signs by Safety Light Corporation.

2.4 RIGHT-TO-KNOW LABELS AND TAGS

A. Provide right-to-know target organ labels for each chemical storage area. Provide right-to-know tags along chemical pipelines and fill pipes as specified.

B. Right-to-know labels for storage areas shall be provided with stick-on numbers/symbols and legends. Labels shall provide information such as chemical name and/or CAS number, fire and health hazard, reactivity, personal protection and target organ legends.

C. Provide right-to-know tags for attaching to pipelines and fill lines. Locate tags at 25 feet maximum center to center distance within range on each side of through-wall pipe penetrations and as directed by ENGINEER. Tags shall be constructed of laminated plastic and furnished with nylon tie fasteners.

D. Quantity:
   1. Right-to-know Labels: 25 labels minimum.
   2. Right-to-know Tags: As required based on criteria specified and installed lengths of pipelines and fill lines.

E. Product and Manufacturer: Provide one of the following:
   1. Right-to-know Labels and Style RTK-T2 Tags by Seton Name Plate Company.

PART 3 - EXECUTION

3.1 INSPECTION

A. CONTRACTOR and his installer must examine the substrates and conditions under which the devices are to be installed and notify ENGINEER in writing of conditions detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected in a manner acceptable to ENGINEER.

3.2 INSTALLATION

A. Install identification devices and components at the locations shown or, if not shown, as directed by ENGINEER, securely mounted with concealed theft- resistant fasteners. Attach signs to substrates in accordance with the manufacturer's instructions, unless otherwise shown.

B. Use stainless steel fasteners.

C. Install level, plumb, and at the proper height. Cooperate with other trades for installation of sign units to finish surfaces. Repair or replace damaged units as directed by ENGINEER.

END OF SECTION

SECTION 10522

FIRE EXTINGUISHERS, CABINETS, AND ACCESSORIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Fire extinguishers.

B. Fire blankets.

C. Cabinets.

D. Accessories.

1.2 RELATED SECTIONS

A. Section 13121 - Pre-Engineered Buildings

1.3 REFERENCES

A. ANSI/NFPA 10 - Portable Fire Extinguishers.

B. ANSI/UL 92 - Fire Extinguisher and Booster Hose.

C. ANSI/UL 711 - Rating and Fire Testing of Fire Extinguishers.

D. UL 299 - Dry Chemical Fire Extinguishers.

1.4 SUBMITTALS

A. Submit under provisions of Section 01300.

B. Shop Drawings: Indicate cabinet physical dimensions.

C. Product Data: Provide extinguisher operational features, color and finish, and anchorage details.

D. Manufacturer's Installation Instructions: Indicate special criteria and wall opening coordination requirements.

E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

1.5 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Section 01700.

B. Maintenance Data: Include test, refill or recharge schedules and re-certification requirements.

1.6 QUALITY ASSURANCE

A. Provide units conforming with ANSI/UL 711.

B. Maintain 1 copy of document on site.

1.7 REGULATORY REQUIREMENTS

A. Conform to ANSI/NFPA 10 for requirements for extinguishers and blankets.

1.8 ENVIRONMENTAL REQUIREMENTS

A. Do not install extinguishers when ambient temperature may cause freezing of extinguisher ingredients.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. [_____] Product [_____].

B. [_____] Product [_____].

C. [_____] Product [_____].

D. Substitutions: Under provisions of Section 01030.

2.2 EXTINGUISHERS

A. Dry Chemical Type: UL 299, Cast steel tank, with pressure gage; Class B:C, Size 10.

2.3 CABINETS

A. Metal: Formed sheet steel, primed; 18 gage (1.2 mm) thick base metal.

B. Configuration: Surface type, exterior nominal dimensions of 24 inch (610 mm) wide x 30 inch (762 mm) high x 10 inch (254 mm) deep.

C. Trimless Type: Returned to wall surface, with [____] inch ([____] mm) projection, [____] inch ([____] mm) wide face.

D. Door: 18 gage (1.2 mm) thick, reinforced for flatness and rigidity; latch access.

E. Door Glazing: Glass, clear, 1/8 inch (3 mm) thick tempered.

F. Cabinet Mounting Hardware: Appropriate to cabinet.

2.4 ACCESSORIES

A. Fire Blanket: Fire retardant treated red color, 62 x 84 inch (1 575 x 2 135 mm) size.

B. Extinguisher Brackets: Formed steel, galvanized finish.

C. Cabinet Signage: [_____].

2.5 FABRICATION

A. Form cabinet enclosure with right angle inside corners and seams. Form perimeter trim and door stiles.

B. Pre-drill for anchors.

C. Hinge doors for 180 degree opening with continuous piano hinge. Provide roller type catch.

D. Weld, fill, and grind components smooth.

E. Glaze doors with resilient channel gasket glazing.

2.6 FINISHES

A. Extinguisher: Steel, polished chrome color as selected.

B. Cabinet Exterior Trim and Door: Red enamel color as selected.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify wall openings under provisions of Section 01041.

B. Verify rough openings for cabinet are correctly sized and located.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install cabinets plumb and level in wall openings, [____] inches ([____] mm) from finished floor to inside bottom of cabinet.

C. Secure rigidly in place.

D. Place extinguishers and accessories in cabinets on wall brackets.

E. Position cabinet signage at [_____].

END OF SECTION

SECTION 11A10

AIR OPERATED DIAPHRAGM PUMPS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope: The CONTRACTOR shall furnish all labor, materials, equipment and incidentals required to provide and install the sludge recycle, sludge transfer, and filter press feed pumps. These pumps shall be of the positive displacement, air operated double diaphragm type complete with piping and valves as shown and specified.

B. Related Work Specified Elsewhere:
   1. Section 15A1, Piping Smaller Than 4 Inches in Diameter.

1.2 QUALITY ASSURANCE

A. Reference Standards: Comply with all applicable provisions and recommendations of the following:
   1. Standards of the Hydraulic Institute.

1.3 SUBMITTALS

A. Shop Drawings: Submit for approval the following:
   1. Manufacturer's literature, including illustrations, specifications, materials, performance date, flow rate and total dynamic head.
   2. Fabrication, assembly, installation and wiring drawings.
   3. Operation and Maintenance manual.

PART 2 - PRODUCTS

2.1 SERVICE CONDITIONS

A. The pumps shall be specifically designed and constructed for the service intended and shall comply with the following minimum conditions:

Design Condition:	Description:
Service:	Sludge Recycle
No. Required:	1
pH Range:	8 - 10
Design Flow:	15 gallons/minute
TDH:	25 feet
Inlet Size:	1-inch
Discharge Size:	3/4-inch
Temperature:	Ambient
Service:	Sludge Transfer
No. Required:	1
pH Range:	8 - 11
Design Flow:	25 gallons/minute
TDH:	50 feet
Inlet Size:	1-inch
Discharge Size:	3/4-inch
Temperature:	Ambient
Service:	Filter Press Feed
No. Required:	1
pH Range:	8 - 10
Design Flow:	25 gallons/minute
TDH:	100 psig
Inlet Size:	1-1/2-inch
Discharge Size:	1-1/2-inch
Temperature:	Ambient

2.2 DETAILS OF CONSTRUCTION

A. Materials of Construction: All pumps shall be designed for continuous operation, 24 hours per day, 7 days per week without damage. The pumps shall be held together with clamp bands for added security and easy maintenance.

1. The pump body and all non-wetted parts shall be constructed of close grain cast-iron.
2. Pump ball check valve shall be constructed of Teflon.
3. Valve seats shall be constructed of Teflon.
4. Pump diaphragms: Double diaphragms constructed of Teflon.
5. External Hardware: All bolts, nuts and cap screws shall have hexagon heads and be constructed of stainless steel, type 316.
6. Air Valve: The air control valve shall be constructed of an aluminum alloy which has been machined and hardened. The air control valve shall have only one moving part. The valve shall be able to be serviced without requiring disassembly of the pump.
7. Priming: Self priming dry to 20 feet.
8. Noise: Pumps shall include a muffler to reduce air exhaust noise to less than 85 Dba.

C. Painting: All pump non-wetted parts shall receive the manufacturer's standard finish paint system prior to shipment.

D. Warranty: All pumps shall be hydrostatically and functionally tested prior to shipment from the factory. All pump materials shall be guaranteed for a period of one-year from the date of start-up by the manufacturer.

E. Products and Manufacturer: Provide the sludge transfer and recycle pumps from one of the following:
1. Wilden Pump and Engineering Co.
2. ARO Pump Company.
3. Warren Rupp Sand Piper.

END OF SECTION

SECTION 11A11

POSITIVE DISPLACEMENT METERING PUMPS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope: The CONTRACTOR shall furnish all labor, materials, equipment and incidentals required to provide and install the four (4) metering pumps. These pumps shall be positive displacement, diaphragm type complete with piping and valves as shown and specified.

B. Related Work Specified Elsewhere:
   1. Section 15A1, Piping Smaller Than 4 Inches in Diameter.
   2. Division 16, Electrical.

1.2 QUALITY ASSURANCE

A. Reference Standards: Comply with all applicable provisions and recommendations of the following:
   1. Standards of the Hydraulic Institute.

1.3 SUBMITTALS

A. Shop Drawings: Submit for approval the following:
   1. Manufacturer's literature, including illustrations, specifications, materials, performance date, flow rate and total dynamic head.
   2. Fabrication, assembly, installation and wiring drawings.
   3. Operation and Maintenance manual.

PART 2 - PRODUCTS

2.1 SERVICE CONDITIONS

A. The pumps shall be specifically designed and constructed for the service intended and shall comply with the following minimum conditions:

Design Conditions	Caustic Soda Feed	Hydrogen Peroxide Feed	Sulfuric Acid Feed
1. Service:	25% Liquid Sodium Hydroxide	35% Bywt Hydrogen Peroxide	5-10% Bywt Sulfuric Acid
2. Number Required:	2	1	1
3. Maximum Flow (with 100:1 turndown):	1.5 GPH	1 GPH	1 GPH
4. Discharge Head (minimum):	25 FT	25 FT	10 FT
5. Temperature:	Ambient	Ambient	Ambient
6. Suction:	Flooded	Flooded	Flooded
7. Materials of Construction:			
Wetted Parts	PVC	PVC	PVC
Diaphragm	Teflon	Teflon	Teflon
Ballchecks	316SS/Teflon	Teflon	Alloy 20/Teflon
8. Stroke Adjustment:	Manual	Manual	Manual

B. Drives

1. Pump motor shall be TEFC rated for continuous duty.
2. Electric supply is 1/60/115V.
3. Motor shall be designed for normal starting torque. Service factor shall be 1.0.

C. Painting: All pump non-wetted parts shall receive the manufacturer's standard finish paint system prior to shipment.

D. Warranty: All pumps shall be hydrostatically and functionally tested prior to shipment from the factory. All pump materials shall be guaranteed for a period of one-year from the date of start-up by the manufacturer.

E. Products and Manufacturer: Provide the pumps from one of the following:

1. Milton Bay.
2. Neptune Pump Company.
3. LMI-Liquid Metronics Division - Milton Roy.

END OF SECTION

SECTION 11C4

TOP ENTERING MECHANICAL MIXING EQUIPMENT

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall furnish all labor, materials, equipment and incidentals required to provide top mounted parallel shaft mixers.
2. Mixer shall be top entering, furnished complete with motors, gears, and accessories as shown and specified. All equipment shall be furnished by a single mixer manufacturer, who shall assume responsibility for proper alignment and operation of the complete mixing unit.

B. General:

1. Drawings are for purposes of guidance and to show functional features required. They do not show all components required to accomplish the desired results or all components required to interface equipment. All parts, equipment and devices necessary to meet the functional requirements shall be provided.
2. Drawings are not intended to show exact dimensions peculiar to any specific mixing equipment. The dimensions of the mixer bases, may have to be changed in order to accommodate the equipment furnished.
3. All mixers shall be designed and built for the specified service, without overheating, without excessive vibration or strain, and requiring only that degree of maintenance generally accepted as peculiar to the specific type of mixer required.

C. Related Work Specified Elsewhere:

1. Division 3, Concrete.
2. Section 9L, Painting.
3. Division 16, Electrical.

1.2 QUALITY ASSURANCE

A. Reference Standards: Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.

1. American Gear Manufacturers Association.
2. Anti-Friction Bearing Manufacturers Association.
3. Occupational Safety and Health Act.
4. National Electric Code.
5. National Electrical Manufacturers Association.
6. Institute of Electrical and Electronic Engineers.
7. American National Standards Institute.
8. Joint Industrial Council.

1.3 SUBMITTALS

A. Shop Drawings:

1. Manufacturer's literature, illustrations, specifications and engineering data for all equipment including:
   a. Dimensions.
   b. Materials.
   c. Size.
   d. Weight.
   e. Torque.
   f. Bending moment.
   g. Critical speed.
   h. Diameter of shaft.
   i. Shaft rpm.
   j. Impeller diameter.
   k. Pitch of impeller.
   l. Distance from bottom of tank to impeller.

2. Drawings showing fabrication, assembly, installation and wiring diagrams.

B. Operation and Maintenance Manuals.

1. Submit in accordance with requirements of Section 1I3, Operation and Maintenance Data - 3 copies.

PART 2 - PRODUCTS

2.1 SERVICE CONDITIONS

A. Mixers:

1. Mixers shall be single speed, vertical type as shown and specified. They shall be specially designed, constructed and installed for the service intended and shall comply with the following conditions:

Design Conditions

A. Oxidation Tank/pH Adjustment Tank:

Location:	Interior
Use:	Air oxidation/pH adjustment
Liquid Mixed:	Groundwater
Tank Size:	11'-9" DIA, 8'-1" Height (ID)
Flow Rate:	180 gpm
Liquid Level:	Constant during operation

B. Deaeration Tank/pH Adjustment Tank:

Location:	Interior
Use:	Deaeration/pH adjustment
Liquid Mixed:	Groundwater
Tank Size:	11'-9" DIA, 8'-1" Height
Flow Rate:	180 gpm
Liquid Level:	Constant during operation

C. Final pH Adjustment Tank:

Location:	Interior
Use:	pH adjustment
Liquid Mixed:	Groundwater
Tank Size:	8'-0" DIA, 9'-0" Height
Flow Rate:	180 gpm
Liquid Level:	Variable during operation

D. Lift Station #3:

Location:	Interior
Use:	Wet well of lift station, mixed to avoid settling of solids
Liquid Mixed:	Groundwater
Tank Size:	6'x 6' x 5' (Depth)
Liquid Level:	Variable during operation

2. Mixing units shall be designed for continuous 24 hour per day, 7 day/week operation.
3. Sound pressure levels of the equipment shall not exceed 80 Db at any point 3 feet from the equipment.

2.2 DETAILS OF CONSTRUCTION

A. Mixers:

1. Speed Reducers:
   a. Double or triple reduction units, with fully-enclosed helical gears.
   b. Lubrication: Lifetime grease system.
   c. All gear motors shall have an AGMA Class III gear rating. Gears shall be designed and rated for an AGMA service factor of not less than 1.5.

d. Thermal rating of the speed reducer shall exceed the design mechanical rating to eliminate the need for external coolers.

e. Speed reducer output shaft shall be constructed and supported such that shaft deflections caused by operating loads do not cause misalignment of the bearings or of the gearing. Output shaft shall be equipped with extra heavy tapered roller bearings.

f. All bearings shall be antifriction type, oil lubricated, except for the lower output shaft bearing which may be grease lubricated. All bearings shall have a minimum B-10 life of 100,000 hours.

g. Housing and Baseplate: Cast iron.

2. Impeller Shaft:

a. Material: Carbon steel.

b. Removable from drive unit.

c. Teflon coated.

d. Maximum operating speed shall be less than 60 percent of first lateral critical speed. Bottom steady bearings are not acceptable.

e. Total shaft runout shall not exceed 0.125 inches per 10 feet of shaft length.

f. Maximum impeller shaft speed shall not exceed 70 rpm.

g. Impeller shaft shall be connected to the gear reducer output shaft by a rigid flanged coupling welded to the shaft. Coupling shall be designed to transmit any torque and withstand any bending moments which the coupling may be subject to. The unit shall be supplied with a gas-tight shaft seal for atmospheric pressure on both sides of shaft seal.

3. Impellers:

a. Four (4) blade, teflon coated, axial turbine type, keyed to the shaft.

b. Blades shall be pitched at a maximum of 45 degrees from the horizontal, and bolted to the impeller hub.

4. Motors:

a. Suitable for continuous operation, of sufficient horsepower to operate the mixer within the nameplate rating without

overloading. All motors shall be built in accordance with current NEMA, IEEE and ANSI standards.

b. Single speed, squirrel cage induction, TEFC, NEMA Design B. motor shall be suitable for operation on a 480 volt, 60 Hz, 3 phase supply, and shall include a 1.5 service factor. Motor speed shall not exceed 1800 rpm.

c. Equipped with non-hygroscopic ball bearings of the extended duty type, grease or oil lubricated.

d. Motor frame and shields shall be cast iron or heavy fabricated steel of such design and sizes as to hold the motor components rigidly in proper position. They shall be provided with lifting lugs and stainless steel rating nameplates indicating motor characteristics.

e. Critical speed of the shaft and rotor assembly shall be at least 20 percent greater than maximum motor operating speed.

5. Product and Manufacturer:

a. Lightnin Mixers.

b. Philadelphia Mixers.

2.3 TOOLS, SPARE PARTS AND MAINTENANCE MATERIALS

A. Each mixer shall be furnished with the following:

1. One set of each type of bearings used.

2.4 PAINTING

A. Equipment shall receive manufacturer's shop primer and standard protective coating system prior to shipment. Primer shall be compatible with field painting specified herein.

B. Machined, polished, and non-ferrous surfaces shall be coated with corrosion prevention compound.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Installation shall be in complete accordance with manufacturer's instructions and recommendations.

B. All electrical connections shall be in conformance with the requirements of Division 16, Electrical.

C. Once installation is complete, touch-up damaged paint with manufacturer supplied paint.

END OF SECTION

2. Drawings showing fabrication, assembly, installation and wiring diagrams.

B. Operation and Maintenance Manuals.

1. Submit in accordance with requirements of Section 1I3, Operation and Maintenance Data - 3 copies.

PART 2 - PRODUCTS

2.1 SERVICE CONDITIONS

A. Mixers:

1. Mixers shall be single speed, vertical type as shown and specified. They shall be specially designed, constructed and installed for the service intended and shall comply with the following conditions:

Design Conditions

A. Equalization Tank #1:

Location:	Exterior
Use:	Equalization
Liquid Mixed:	Groundwater with volatile organics
Tank Size:	21'-2" DIA, 20'-4" Height
Flow Rate:	180 gpm
Liquid Level:	Variable during operation

B. Equalization Tank #2:

Location:	Exterior
Use:	Equalization
Liquid Mixed:	Groundwater with volatile organics (toluene concentrations as high as 150 mg/l)
Tank Size:	12'-0" DIA, 15'-3" Height

C. Related Work Specified Elsewhere:

1. Division 3, Concrete.
2. Section 9L, Painting.
3. Division 16, Electrical.

1.2 QUALITY ASSURANCE

A. Reference Standards: Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.

1. American Gear Manufacturers Association.
2. Anti-Friction Bearing Manufacturers Association.
3. Occupational Safety and Health Act.
4. National Electric Code.
5. National Electrical Manufacturers Association.
6. Institute of Electrical and Electronic Engineers.
7. American National Standards Institute.
8. Joint Industrial Council.

1.3 SUBMITTALS

A. Shop Drawings:

1. Manufacturer's literature, illustrations, specifications and engineering data for all equipment including:
   a. Dimensions.
   b. Materials.
   c. Size.
   d. Weight.
   e. Torque.
   f. Bending moment.
   g. Critical speed.
   h. Diameter of shaft.
   i. Shaft rpm.
   j. Impeller diameter.
   k. Pitch of impeller.
   l. Distance from bottom of tank to impeller.

SECTION 11C5

SIDE ENTERING MECHANICAL MIXING EQUIPMENT

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall furnish all labor, materials, equipment and incidentals required to provide side mounted parallel shaft mixers.
2. Mixer shall be side entering, furnished complete with motors, gears, and accessories as shown and specified. All equipment shall be furnished by a single mixer manufacturer, who shall assume responsibility for proper alignment and operation of the complete mixing unit.

B. General:

1. Drawings are for purposes of guidance and to show functional features required. They do not show all components required to accomplish the desired results or all components required to interface equipment. All parts, equipment and devices necessary to meet the functional requirements shall be provided.
2. Drawings are not intended to show exact dimensions peculiar to any specific mixing equipment. The dimensions of the mixer bases, may have to be changed in order to accommodate the equipment furnished.
3. All mixers shall be designed and built for the specified service, without overheating, without excessive vibration or strain, and requiring only that degree of maintenance generally accepted as peculiar to the specific type of mixer required.

Flow Rate:	10-20 gpm
Liquid Level:	Variable during operation

2. Mixing units shall be designed for continuous 24 hour per day, 7 day/week operation.
3. Sound pressure levels of the equipment shall not exceed 80 dB at any point 3 feet from the equipment.

2.2 DETAILS OF CONSTRUCTION

A. Mixers:

1. Speed Reducers:
   a. Double or triple reduction units, with fully-enclosed helical gears.
   b. Lubrication: Lifetime grease system.
   c. All gear motors shall have an AGMA Class III gear rating. Gears shall be designed and rated for an AGMA service factor of not less than 1.5.
   d. Thermal rating of the speed reducer shall exceed the design mechanical rating to eliminate the need for external coolers.
   e. Speed reducer output shaft shall be constructed and supported such that shaft deflections caused by operating loads do not cause misalignment of the bearings or of the gearing. Output shaft shall be equipped with extra heavy tapered roller bearings.
   f. All bearings shall be antifriction type, oil lubricated, except for the lower output shaft bearing which may be grease lubricated. All bearings shall have a minimum B-10 life of 100,000 hours.
   g. Housing and Baseplate: Cast iron.

2. Impeller Shaft:
   a. Material: 316 stainless steel.
   b. Removable from drive unit.
   c. Maximum operating speed shall be less than 60 percent of first lateral critical speed. Bottom steady bearings are not acceptable.

d. Total shaft runout shall not exceed 0.125 inches per 10 feet of shaft length.

e. Maximum impeller shaft speed shall not exceed 70 rpm.

f. Impeller shaft shall be connected to the gear reducer output shaft by a rigid flanged coupling welded to the shaft. Coupling shall be designed to transmit any torque and withstand any bending moments which the coupling may be subject to. The unit shall be supplied with a gas-tight shaft seal for atmospheric pressure on both sides of shaft seal.

3. Impellers:

a. Four (4) blade, high efficiency, axial flow hydrofoil type, keyed to the shaft.

b. Blades shall be pitched at a maximum of 45 degrees from the vertical, and bolted to the impeller hub.

4. Motors:

a. Suitable for continuous operation, of sufficient horsepower to operate the mixer within the nameplate rating without overloading. All motors shall be built in accordance with current NEMA, IEEE and ANSI standards.

b. Single speed, squirrel cage induction, TEFC, NEMA Design B. motor shall be suitable for operation on a 480 volt, 60 Hz, 3 phase supply, and shall include a 1.5 service factor. Motor speed shall not exceed 1800 rpm.

c. Equipped with non-hygroscopic ball bearings of the extended duty type, grease or oil lubricated.

d. Motor frame and shields shall be cast iron or heavy fabricated steel of such design and sizes as to hold the motor components rigidly in proper position. They shall be provided with lifting lugs and stainless steel rating nameplates indicating motor characteristics.

e. Critical speed of the shaft and rotor assembly shall be at least 20 percent greater than maximum motor operating speed.

5. Product and Manufacturer:

a. Lightnin Mixers.

b. Philadelphia Mixers.

2.3 TOOLS, SPARE PARTS AND MAINTENANCE MATERIALS

A. Each mixer shall be furnished with the following:

1. One set of each type of bearings used.

2.4 PAINTING

A. Equipment shall receive manufacturer's shop primer and standard protective coating system prior to shipment. Primer shall be compatible with field painting specified herein.

B. Machined, polished, and non-ferrous surfaces shall be coated with corrosion prevention compound.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Installation shall be in complete accordance with manufacturer's instructions and recommendations.

B. All electrical connections shall be in conformance with the requirements of Division 16, Electrical.

C. Once installation is complete, touch-up damaged paint with manufacturer supplied paint.

END OF SECTION

SECTION 11H1

LAMELLA GRAVITY SETTLER/THICKENER SYSTEM

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall furnish all necessary labor, materials and equipment as required to provide one (1) Lamella Gravity Settler/Thickener System as shown and specified. The Lamella Gravity Settler/Thickener System shall include a flash-mix tank, flocculation tank, gravity thickener, sludge hopper and all required motors, controllers and controls.

B. Related Work Specified Elsewhere:

1. Section 3K, Concrete
2. Division 15, Mechanical
3. Division 16, Electrical

1.2 QUALITY ASSURANCE

A. Manufacturer's Qualifications:

1. Manufacturer shall have experience in producing similar equipment, and shall show evidence of similar installations in satisfactory condition and operation.

B. Reference Standards:

1. Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.
   a. AWS D1.1, Structural Welding Code.
   b. ASTM A 36, Structural Steel.
   c. National Electric Code.
   d. Standards of National Electrical Manufacturers Assc.

e. Institute of Electrical and Electronic Engineers.
f. American National Standards Institute.
g. Standards of American Water Works Association
h. American Institute of Steel Construction.
i. American Gear Manufacturer's Association.

1.3 SUBMITTALS

A. Shop Drawings:
1. Submit for approval Shop Drawings showing the following:
a. Manufacturer's literature, illustrations, specifications, and engineering data including: dimensions, materials, size and weight.
b. Fabrication, assembly, installation and wiring diagrams.
c. Provide setting drawings, templates and directions for the installation of anchor bolts and other anchorages.
d. Instrumentation and panel submittals in accordance with Section 13A, Instrumentation and Control.
e. Certified test data and curves for all associated pumps showing overall pump efficiencies, required net positive suction head, flow rate, head, brake horsepower, motor horsepower, speed and shutoff head.

B. Operation and Maintenance Manual:
1. Submit three (3) complete installation, operation and maintenance manuals including copies of all approved Shop Drawings.

PART 2 - PRODUCTS

2.1 SERVICE CONDITIONS

A. The Lamella Gravity Settler/Thickener shall be designed, constructed and installed for the service intended, and shall comply with the following conditions:

Design Conditions:

Location:	Indoors
Use:	Heavy Metal Precipitation
Flowrate:	180 gpm
Wastewater Temperature:	Ambient
Influent pH:	8-10 units
Max. Hydraulic Loading:	0.4 gpm/foot square of plate area.
Plate Material:	FRP
Plate Angle:	55°-60°
Sludge Tank Diameter:	8'-0"feet
Sludge Tank Volume:	3,000 gallons (minimum)
Flash Mixer Retention Time:	20 seconds
Flocculator Retention Time:	25 minutes
Electrical:	115 Volt, 1 phase
Flanged Nozzles:	
Wastewaver Influent	115 Volt, 1 phase
Sludge Recycle Influent	1"
Effluent	8"
Sludge Drain	1-1/2"
Sludge Recycle	1-1/2"

2.2 DETAILS OF CONSTRUCTION

A. General: The settling tank equipment shall conform with the following details of construction, materials and equipment.

1. All tanks, covers, supports, ladders, and all associated equipment shall be constructed of steel conforming to ASTM A-36, with a minimum thickness of 3/16-inch.
2. All gaskets shall be constructed of EPDM.
3. All weldments shall be designed and performed in strict conformance with AWS standards. Continuous welds shall be used

for all seal welds and structural support welds. Intermittent welding shall be permitted for stiffener welds. All continuous seal welds are to be visually examined and dye penetrant tested in the shop.

B. Flash Mixer/Flocculator

1. Materials of Construction: All wetted parts shall be bitumastic epoxy coated carbon steel. The speed reducer shall have a close ground cast-iron housing. All gears shall be case hardened and precision ground. All bearings shall be extra heavy duty and shall be provided with a suitable means of lubrication.
2. The flocculator mixer drive shall be a variable speed mixer comprised of a paddle-type mixer with a hollow-shaft gear reducer. Maximum motor size shall be 3/4 hp. The mixer motor shall be TEFC.
3. The flash mixer drive shall be a rapid-fixed speed unit, comprised of a hollow-shaft gear reducer. The flash mixer motor shall not exceed 1/2 hp. The mixer motor shall be TEFC.

C. Plates:

1. Settler plates shall be constructed of fiberglass reinforced polyester (FRP) with a minimum thickness of 0.09 inches. Stiffeners shall run the full length of each plate, spaced on a maximum of 12-inch on centers. Plates shall be manufactured in rigid plate pack assemblies.
2. The number of plates required shall be determined by the manufacturer to comply with the overflow rate, based upon laboratory settling tests, on-site pilot tests, or past operating experience.
3. Influent shall enter the plates through openings located on the sides of the plates at a point that will assure an even flow distribution across the plate.
4. All plates shall be removable from the unit.

D. Sludge Storage Tank:

1. The sludge tank, included with the package unit, shall be epoxy painted carbon steel. The sludge tank shall include an externally driven, full length picket fence sludge scraper/thickener rake. The tank shall include (4) sample valves, a 24-inch diameter manway, and a sludge outlet. The tank shell shall have a minimum thickness of 1/4 inch and the tank bottom plate shall have a minimum thickness of 3/8 inch.

2. A sludge rake drive unit shall be provided and be mounted at the top of the tank. Motor enclosure shall be TEFC. The drive shall have a visual torque indicator showing percentage of load and two electrical contacts for alarm and shut-down. The rake shall have a stalled torque rating of 511 ft-lbs.

E. Controls:

1. Provide a NEMA 4 control panel for operation of the gravity settler/thickener drive units. Panel shall be equipped with all necessary controllers, door mounted controls and all other components required to provide a complete and functional system. The panel shall be suitable for mounting at the gravity thickener.
2. The panel shall be arranged to receive a 480 volt, 3 phase power supply with a ground. A main disconnect dive shall be provided to remove the service supply from the enclosure. Provisions shall be made to distribute 3 phase service to each drive motor. Provide separate power circuit breaker disconnect, controller and circuitry for each drive motor arranged in accordance with NEC requirements.
3. Controllers shall be of the AC and DC type. ALL AC type controllers shall be magnetic coil operated, NEMA rated, and shall include three melting alloy type overload relays with manual reset, visual trip indicators and heater elements. All DC controllers shall be SCR type, suitable for operation from a 120 volt, single phase input supply which converts to adjustable DC output for supply to each motor. Each SCR controller shall be equipped with an isolation transformer to isolate the incoming power from the power required at the controller.

4. Panel shall include all auxiliary controls powered from a suitably sized and protected control power transformer. The controls shall consist of all devices and components for the following operation:
   a. Stop/start push buttons for each drive motor arranged for momentary control.
   b. Run pilot lights for each drive motor.
   c. Master local-off-remote selector switch. In the local position, drives shall be controlled from panel stop/start push buttons. In the remote position, drives shall be controlled from remote start/stop momentary push buttons at the main control panel.
   d. Manual speed rotentiometer shall be provided for each SCR controller.
   e. Rake drive torque shutdown control with dry contact alarm indication at the main control panel.
   f. Drive run status dry contacts for remote indication of each drive at the main control panel shall be provided.

F. Covers:

The flash mixer, flocculator, and clarifier sections shall include full, flat, Bolton covers to contain fumes. All hataches, or mixer and sludge drive shafts, shall include lip seals where they penetrate the cover. Provide a full rubber gasket to seal between cover and clarifier rim. Each section of the clarifier will include a hatch to view chamber contents.

G. Painting:

1. Minimum acceptable surface preparation for any equipment furnished with the manufacturer's standard paint system shall include cleaning with a commercial sandblast (SSPC-SP6).
2. Drive equipment and control panels shall be cleaned and provided with the manufacturer's standard painting system for equipment in corrosive environments.
3. All carbon steel surfaces shall be painted as follows:
   a. Exterior Surfaces:

      Base Coat: DuPont High Solids Epoxy Mastic LF63325P, 2 coats, 5-6 dry mils total.

Finish: DuPont High Solids 50P Polyacryl Anhydride Enamel, 2 coats, 1.5- 2.5 dry mils total.

b. Interior Surfaces:
Base Coat: DuPont High Solids Epoxy Mastic LF63325P, 2 coats, 5-6 dry mils total.
Finish: DuPont Solids Epoxy Mastic LF-65M25P, 2 coats, 5-6 dry mils total.

c. Stainless steels, nickel, monel, lead Hastelloy, galvanized steel, rubber, plastic and/or fiberglass shall not be painted.

H. Lubricants:
The Manufacturer shall furnish an initial supply of all lubricants and oils required to operate the equipment and a lubricant specification with the type and grade to meet the service requirements of the equipment. The Manufacturer shall supply a chart listing type of lubricant or oil, place used, and corresponding product name and number.

I. Specials:
The Manufacturer shall furnish one (1) complete set of all special tools, new and in first-class condition, which are required for maintenance of the equipment herein specified. Identification of all tools by name and number shall be provided, and this number shall appear on drawings and instructions to indicate the application of the tools furnished and to permit ordering replacements. An itemized list of these tools shall be submitted.

PART 3- EXECUTION

3.1 INSTALLATION

A. Installation shall be in complete accordance with manufacturer's instructions and recommendations.

B. Provide all conduit and wire from the driven equipment to the control panel.

3.2 MANUFACTURER'S SERVICES

A. The SUB-CONTRACTOR shall furnish the services of a qualified factory-trained serviceman who shall assist in the installation of the settling equipment, check the installation before it is place into operation, assist with performance of the field tests required, assist with initial operations and instruct the operators with the care, operation, and maintenance of the equipment. A minimum of two (2) days training shall be provided by the manufacturer.

END OF SECTION

SECTION 11I3

RECESSED PLATE FILTER PRESS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall furnish all labor, materials, equipment and incidentals required to provide:
   a. One (1) recessed plate filter press with drip tray.
2. Press shall be furnished complete with hydraulic closure system, CGR plates, filter cloths, drip tray, closing ram, blanking plate and controls. All equipment shall be furnished by a single manufacturer, who shall assume responsibility for proper alignment and operation of the complete unit.

B. General:

1. Drawings are for purposes of guidance and to show functional features required. They do not show all components required to accomplish the desired results or all components required to interface equipment. All parts, equipment and devices necessary to meet the functional requirements shall be provided.
2. Drawings are not intended to show exact dimensions peculiar to any specific equipment. The dimensions of the press mounting base, may have to be changed in order to accommodate the equipment furnished.
3. All components shall be designed and built for the specified service, without overheating, without excessive vibration or strain, and requiring only that degree of maintenance generally accepted as peculiar to that specific equipment type.

C. Related Work Specified Elsewhere:

1. Division 3, Concrete.
2. Section 9L, Painting.
3. Division 16, Electrical.

1.2 QUALITY ASSURANCE

A. Manufacturer's Qualifications:

1. Manufacturer shall have experience of producing substantially similar equipment and shall show evidence of at least five installations where sulfuric acid feed equipment of the type specified herein have been in satisfactory operation for at least three years.

B. Source Quality Control:

1. All equipment shall be shop tested prior to shipment.

C. Reference Standards: Comply with applicable provision and recommendations of the following, except as otherwise shown or specified:

1. American National Standards Institute.
2. Occupational Safety and Health Act.
3. National Electric Code.
4. Standards of National Electrical Manufacturers Association.
5. Standards of Institute of Electrical and Electronics Engineers. 6. Joint Industrial Council.

D. Required Manufacturer's Services: Retain manufacturer's technical representatives with demonstrated ability and experience in installation and operation of the feed equipment to perform the services listed below:

1. Test, calibrate and adjust all components of the equipment.
2. Inspect the completed installations and prepare an inspection report.
3. Instruct operating personnel in operation user maintenance.

1.3 SUBMITTALS

A. Equipment Shop Drawings: Submit for approval the following:
   1. Description of proposed equipment including materials of construction, weight and dimensions.
   2. Installation drawings.
   3. Electrical wiring and point-to-point connection drawings.
   4. Manufacturer's literature, illustrations, specifications, and engineering data including dimensions, materials of construction, size, weight and motor information.

B. Operation and Maintenance Data: Submit complete manuals including:
   1. Copies of all Shop Drawings, test reports, maintenance data and schedules, description of operation and spare parts information.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Equipment delivered to the job site shall be inspected by the CONTRACTOR for damage, unloaded and stored with a minimum of handling. Comply with manufacturer's recommendations in handling and storing equipment. All equipment shall be shipped in boxes or wooden crates. Shipments shall be made to the site by truck.

PART 2 - PRODUCTS

2.1 SERVICE CONDITIONS

A. The press shall be sized to comply with the following minimum conditions:
   1. Sludge Type: Metal Hydroxide, primarily iron.
   2. Dry Solids Per Day: 138 lb BDS
   3. Press Cycles per Week (7 Days): 2-3
   4. Press Cycle Time: 2-3 Hours
   5. Filter Cake Dry Solids: 30-35% wt
   6. Filter Cake Density: 75 lbs/cu ft
   7. Minimum Press Capacity: 25 cu ft
   8. Additional Expansion Capacity: 5 cu ft

9. Maximum Cake Thickness: 1.25 inch

2.2 FILTER PLATES

Filter plates shall be center feed, alternating corner discharge design for operation at 100 psi pressure at ambient temperature. Plates shall be of the gasketed design. Gasketing shall be on the perimeter sealing surface and around each of the corner eyes. Plates shall come complete with filter cloths installed.

Recessed plates shall be molded from virgin, gray polypropylene and shall contain no fillers. Plates shall have a drainage surface design that shall provide adequate support for filter cloths and shall have integrally molded stayboss supports equally spaced on the drain field. Plate sealing surfaces shall be machined to a maximum parallel plane tolerance of .3 mm. Chamber recess depth dimension shall have a tolerance not to exceed .5 mm.

Plates shall have a round bottomed caulking groove machined around the perimeter of each drainfield for installation of filter cloths. Grooves of the dovetail design shall be machined around each corner port and around the cake chamber on the sealing surface for the installation of gasketing.

Filter cloths shall be polypropylene fabric. Fabric shall be heat set and calendared. Cloths shall have a monofilament fiber warp and a monofilament fiber weave. Cloths shall have a plain design weave. Cloths shall be held in place on the filter plates by a woven, high density polypropylene cord sewn into the perimeter of the cloth. It shall be pressed or caulked into place on the filter plate and held there by an interference fit.

Gasketing shall be molded Viton elastomer compound and shall be of the O'ring-type design. Gasketing shall have a minimum 70A durometer hardness.

The filter press shall be supplied with a back up plate to allow for the processing of less than a full capacity press load. The blank back-up plate shall be capable of being inserted, along with the tail filter plate, at any point in the press plate stack to reduce the penetrating capacity of the filter press.

2.3 FILTER PRESS SKELETON

The filter press skeleton and related sub-components shall be designed to maintain the filter pack in a closed position against an internal operating pressure of 100 psi plus a minimum clamping factor of 25% greater than the maximum internal operating pressure multiplied times the filter area of the tail filter plate.

The filter press frame shall be fabricated of ASTM-A36 carbon steel plate and structures. Weldments shall be totally enclosed box construction for maximum strength and ease of maintenance. All weldments shall be designed to evenly distribute the operational forces developed during filtration over the entire component. All components shall be continuously welded with a fillet weld for maximum strength. Intermittent welding of joints shall not be acceptable. Enclosed compartments within the head end weldment shall have drain holes. All components shall be designed with a minimum safety factor of 1.5 times the maximum closure force. Critical assembly points such as sidebar/end weldment shall be machined to close tolerances to ensure uniform load distribution at all stress bearing areas.

All edges and welds shall be deburred and ground smooth. All weld splatter, weld slag and mill scale shall be removed before painting.

The head end weldment and the cylinder bracket shall be connected at two points each. Two side bars of hot rolled steel shall connect the head and cylinder bracket at the horizontal centerline of the plate pack so as not to interfere with cake discharge. Each connection point shall be designed with a minimum safety factor of 1.5 times the maximum closure force.

Each connection point shall have the intersecting components machined to tolerances that shall ensure proper fit.

The side bars shall be of sufficient size and weight to support the full operational weight of the filter plate pack including the follower head, plate pack and filter cake with a maximum deflection of 1/900 of the length of the filter press assembly.

To prevent corrosion of the sidebars due to surface finish erosion, the side bars shall come complete with 304 SS wear strips on the contact surface with plate suspension handles and follower head rollers.

The follower head sub-assembly shall be suspended from the side bars. The follower shall ride on Delrin rollers on stainless steel axles. Grease nipples shall be provided on the axles for periodic interspacial flushing of the roller/axle assembly.

All non-stainless steel metallic surfaces shall be finished for maximum corrosion resistance in accordance with the following:

A. Surface Preparation: Blast to SSPC-10, near white metal blast cleaned surface.

B. Primer: One coat, two component, chrome free, low VOC polyurethane primer @ 1.5 to 2.0 MDFT.

C. Finish: Two coats, single stage, two component acrylic urethane @ 1.5 MDFT each coat.

2.4 PNEUMATIC/HYDRAULIC CLOSURE

The pneumatic/hydraulic opening and closing system shall include one (1) double acting hydraulic cylinder and one(1) hydraulic power pack. The system shall be designed to automatically compensate for any thermal expansion or contraction of the plate stack as well as maintain the proper clamping force throughout the process cycle.

The pneumatic/hydraulic power pack shall contain an air driven hydraulic pumping module that shall clamp the press by pressurizing the hydraulic system after the plate pack is fully closed. The hydraulic pumping module shall be designed to only operate after the hydraulic cylinder has been fully extended through the use of a pressurized oil reservoir. To minimize the use of the hydraulic pumping module, the press shall be opened by means of pressurizing the retraction stroke of the cylinder with compressed air. All hydraulic tubing,

subject to system pressure, within the power pack and to and from the cylinder shall be of 304 SS and shall have a minimum burst pressure rating of 3.5 times the maximum operating pressure of the power pack. The power pack shall be fully enclosed in a fabricated steel cabinet for protection from damage and shall be easily accessible for maintenance from a full width hinged cabinet door. All components shall be modular for ease of maintenance.

2.5 CONTROLS

The filter press control panel shall be mounted to the hydraulic cylinder bracket and shall be NEMA 12. The control panel shall contain all necessary switches, gauges, valving and tubing. The panel shall come complete with two position selector switches for the following functions:

A. Air Supply, on/off

B. Filter press, open/close

C. Hydraulic Pump, on/off

D. Bombay Doors, open/close/auto

E. Air Blow Down Valve Sequence, on/off/auto

PART 3 - EXECUTION

3.1 INSTALLATION

A. CONTRACTOR shall make all necessary field connections required to place the filter press system in proper operation in accordance with manufacturer's instructions and recommendations.

B. Coordinate location of water supply piping, drain and pump suction with field requirements.

C. Make all electrical connections in conformance with requirements of Division 16, Electrical.

3.2 FIELD PAINTING

A. Provide in accordance with Section 9L.

3.3 START-UP AND TEST

A. CONTRACTOR shall make all adjustments to place pumps, tanks and accessories in proper operation. He shall perform operating tests and calibrate equipment to ensure that the system operates in accordance with these Specifications and to the satisfaction of the OWNER.

B. Manufacturer's representative shall check and approve the installation before operation and assist CONTRACTOR in performing field tests and in calibration of the equipment.

C. CONTRACTOR shall provide the services of a factory-trained operating specialist for an eight hour period for the instruction of the operating personnel. The instruction period may not be consecutive.

END OF SECTION

SECTION 11L8

LIQUID POLYMER FEED EQUIPMENT AND APPURTENANCES

PART 1 GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish and install one complete liquid polymer feed system for the addition of polymer into the flocculation compartment of the clarifier at the location(s) shown on the Drawings. The feed system shall include furnishing and installing one packaged liquid polymer blending system, including controls, rotameters, spare parts and all other appurtenances specified herein.

B. Limitations: All instrumentation, controls, control cabinets and the like, unless otherwise indicated herein shall be furnished under Section 13A.

C. Related Sections:

1. Division 3, Concrete.
2. Section 5G, Anchor Bolts, Expansion Anchors, Toggle Bolts and Concrete Inserts.
3. Section 9L, Painting.
4. Section 13A, Plant Monitoring and Control System.
5. Division 15, Sections on Piping and Valves.
6. Division 16, Electrical.

1.2 QUALITY ASSURANCE

A. Manufacturer's Qualifications:

1. Manufacturer shall have experience of producing substantially similar equipment and shall show evidence of at least five installations where liquid polymer feed equipment of the type specified herein have been in satisfactory operation for at least three years.

B. Source Quality Control:

1. All equipment shall be shop tested prior to shipment.

C. Reference Standards: Comply with applicable provision and recommendations of the following, except as otherwise shown or specified:

1. American National Standards Institute
2. Occupational Safety and Health Act
3. National Electric Code
4. Standards of National Electrical Manufacturers Association
5. Standards of Institute of Electrical and Electronics Engineers
6. Joint Industrial Council

D. Required Manufacturer's Services: Retain manufacturer's technical representatives with demonstrated ability and experience in installation and operation of the liquid polymer feed equipment to perform the services listed below:

1. Test, calibrate and adjust all components of the equipment.
2. Inspect the completed installations and prepare an inspection report.
3. Instruct operating personnel in operation user maintenance.

1.3 SUBMITTALS

A. Equipment Shop Drawings: Submit for approval the following:

1. Description of proposed equipment including materials of construction, weight and dimensions.
2. Installation drawings.

3. Electrical wiring and point-to-point connection drawings.
4. Manufacturer's literature, illustrations, specifications, and engineering data including dimensions, materials of construction, size, weight and motor information.

B. Operation and Maintenance Data: Submit complete manuals including:
1. Copies of all Shop Drawings, test reports, maintenance data and schedules, description of operation and spare parts information.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Equipment delivered to the job site shall be inspected by the CONTRACTOR for damage, unloaded and stored with a minimum of handling. Comply with manufacturer's recommendations in handling and storing equipment. All equipment shall be shipped in boxes or wooden crates. Shipments shall be made to the site by truck.

1.5 MANUFACTURER

A. Liquid polymer feed equipment shall be furnished by a single manufacturer who shall assume complete system responsibility. Liquid polymer feed equipment shall be Maxi-Yield as manufactured by Wallace and Tiernan, Inc.; PolyBlend by Stranco, Inc. or equal.

PART 2 - PRODUCTS

2.1 PACKAGED LIQUID POLYMER BLENDER

A. General: One packaged liquid polymer blending system shall be provided to meter, dilute, activate and feed concentrated liquid emulsion type polymers and water automatically. Concentrated neat liquid polymer at ambient temperatures and a pH of approximately 6 to 8 shall be mixed, activated and blended with water. Temperature limits of the polymer shall range between 33-100 F and dilution water temperatures shall range between 35-85 F. Maximum water pressure available to the unit before

regulation is up to 60 psig. Ambient air conditions will vary between temperatures of 40 to 104 F.

B. Enclosure: Packaged polymer blender shall be furnished with either a stainless steel or plastic housing meeting either NEMA-3 or 4 requirements.

C. Metering Pump:

1. Type: Self-priming diaphragm pump with variable stroke frequency and stroke length.
2. Operating Range: 200:1 minimum adjustable range.
3. Full Scale Capacity: 1.0 gph + of neat polymer at maximum 50 psig discharge pressure.
4. Diaphragm: TFE or TFE faced.
5. Ball Checks: Spring loaded single or double Type 316 Stainless steel or TFE balls on both suction/discharge ends.
6. Liquid Ends and Fittings: Type 316 Stainless steel or Kynar.
7. Power Requirements: 120 volts, 60 Hertz, single phase power.
8. Metering pump shall be equipped with multi-function discharge valve for backpressure/anti-syphon, pressure relief, priming aid and for discharge line pressure vent purposes.

D. Features:

1. Maximum neat polymer output: 0-1.0 gph.
2. Dilution Water Flow and pressure: 5-50 gph maximum and 20-60 psig, respectively.
3. Electrical Input: 120 VAC, 60 Hz, single phase power.
4. All wetted parts in contact with polymer shall be constructed of plastic corrosion - resistant materials.
5. System shall be equipped with either 5-inch or 10-inch glass tube rotometer type flow indicator and a means to adjust water flow using an external flow control valve with external adjustment.
6. System shall be mounted within an enclosure rated either NEMA 4.
7. System shall be equipped with a sight flow indicator to show at a glance the flow and clarity of the polymer solution.

E. Controls:

1. System shall be equipped with a solenoid valve for on-off control of dilution water supply.
2. Solenoid valve shall be a 2 way unit and shall close on a low pressure alarm condition.
3. Control system shall be equipped with an "ON-OFF" power disconnect switch, a "Local-Off-Remote" mode switch, a system start switch, a low water pressure alarm light and an indicator light to indicate that the system is in operation.
4. Controls shall be provided to accept a start-stop momentary control signal from the remote Main Control Panel for remote control.
5. Mode selector switch at the feed unit shall control the operation of the polymer feed system. In the "A" position of the selector switch, a dry start-stop signal from The Main Control Panel shall control the operation of the polymer feed system automatically. In the "H" position of the selector switch, manual operation from the unit shall be possible.
6. Local circuitry shall be furnished to repeat a low water pressure alarm signal at a remote panel.
7. Packaged feed system shall be equipped with a time adjustable automatic flushing system. Flushing system shall begin to function when system mode selector switch is turned off and power to the metering pump shuts down. Maximum flushing time cycle shall be adjustable between 15-20 minutes.
8. An adjustable pressure switch shall be furnished at the dilution water inlet and shall function to shutdown the system and initiate a low pressure alarm locally and remotely when pressure drops below preset pressure. System shall reset automatically and restart when water pressure rises above preset pressure.
9. System shall be equipped with a repeat "running" status dry contact for connection to controls at the Main Control Panel.

2.3 ACCESSORIES

The following accessories shall be furnished with the liquid polymer blending system:

A. Calibration Column (1 Required):
   1. Construction: Transparent, clear PVC graduated tube with bottom outlet and open top.
   2. Calibration kit to be calibrated in milliliters.
   3. Size: 250 ml minimum, 500 ml maximum.
   4. Unit to be equipped with three PVC ball valves and outlet hose.

B. Wall-Mount Shelf:
   1. Type: Shelf with mounting bracket.
   2. Materials of construction: Type 304 or 316 Stainless Steel.
   3. Hardware: Stainless steel.
   4. Manufacturer: Wallace & Tiernan Inc., Cat. No. 481.050; Stranco Model PB3030; or equal.

C. Backflow Preventer (1 Required):
   1. Type: Reduced pressure principle.
   2. Materials of Construction: All bronze with stainless steel internal parts and tight seating rubber check valve assemblies.
   3. Unit shall be furnished with inlet and outlet gate valves and a Y-type bronze strainer with blow-off valve.
   4. Size: 3/4 inch.
   5. Tested and Certified by American Society of Sanitary Engineering Standard 1013 and AWWA C506.
   6. Manufacturer: Watts Regulation Model 909; Mueller; or equal.

D. Pressure Gage (2 Required):
   1. Dial Size: 4-1/2-inch.
   2. Range: 0-100 psig.
   3. Materials: Cast aluminum case with flanged back and phosphor bronze bourdon tube. Case shall receive a black epoxy coating.
   4. Window: Acrylic.
   5. Unit furnished with shut off valve and snubber.

6. Manufacturer: Ashcroft, Duragauge No. 1379 AS; U.S. Gauge; or equal.

E. Pressure Regulating Valve (1 Required):
1. Bronze body construction with renewable stainless steel seat.
2. Integral stainless steel strainer.
3. Union inlet connection with threaded tailpiece.
4. Size: 3/4-inch.
5. Reduced Pressure Range: 25-75 psig.
6. Manufacturer: Wallace and Tiernan, Catalog No. 481.075; Stranco Model PB4.5-3005; or equal.

F. Sight Flow Indicator (1 Required):
1. Size: 3/4-inch.
2. Type: To show at a glance the blended polymer solution flow and clarity of the discharge, single cylinder wall.
3. Ends: Screwed ends, FPT.
4. Materials of Construction: PVC ends with nitrile or viton seals; acrylic or pyrex wall.

2.4 SPARE PARTS

A. General: The following spare parts shall be furnished with the liquid polymer feeder:
1. One spare diaphragm type metering pump identical to unit furnished with feeder.
2. One spare multi-function discharge valve.
3. One spare solenoid valve identical to unit furnished with equipment.
4. One complete assembly pressure switch identical to unit furnished.
5. One mixing chamber.

2.5 LIQUID POLYMER UNLOADING EQUIPMENT

A. Drum Piping Assembly:
1. Number of units required: 1.

2. Type: Each unit shall contain a 3/4-inch stainless steel hose coupling, screwed drum fitting and a clear one-inch plastic sight gage assembly. Disconnect connection shall be equipped with a 3/4-inch check valve to prevent leakage and a 3/4-inch ball shutoff valve.
3. Suitable for bung hole opening.

B. Vent Assembly:
1. Number of units required: 1.
2. Size: 2-inch.
3. Connection: 2-inch suitable to connect to vent connection on a 55-gallon drum.
4. Length: 5 inches ±.

C. Liquid Feeder Suction Tubing:
1. Tubing shall be one inch I.D. hypalon reinforced suction tubing equipped with a quick disconnect plug for hose connection on one end and a one inch ball valve with hose connection at the other end.
2. Ball valve shall have screwed and hose end connections.

2.6 DRUM MIXER

A. Type: Bayonet-mount drum mixer:
1. Materials of construction:
   a. Shaft: Type 304 stainless steel.
   b. Impeller: Type 304 stainless steel, collapsible design.
2. Mount: 2 inch bung hole opening, 1/4 inch thick flange.

B. Electrical:
1. Motor: 1/2-horsepower, TEFC, 1725 rpm.
2. Power: 120 volt, 60 Hz, single phase.
3. Cord: 3 wire, #18 AWG, 8 feet long with grounded plug and on-off switch. UL approved.

PART 3 - EXECUTION

3.1 INSPECTION

A. Inspect equipment specified herein prior to installation. If equipment is damaged, notify CONTRACTOR and manufacturer immediately.

B. Damaged equipment shall not be installed until repairs are made in accordance with the manufacturer's written instructions and approved by CONTRACTOR. Repairs shall be made under the manufacturer's direct supervision.

C. Inspect all concrete pads and bases for equipment for proper elevation, dimensions, cutouts, evenness and anchor bolt locations. Correct if required.

3.2 INSTALLATION

A. Installation of equipment shall be in complete accordance with manufacturer's instructions and recommendations.

B. Make all electrical connections in conformance with requirements of Division 16, Electrical.

C. Once installation is complete, touch up damaged paint with manufacturer's supplied paint.

D. Install all items to permit adjustment and calibration from floor or platforms without the use of ladders or scaffolding.

3.3 START-UP AND TEST

A. CONTRACTOR shall make adjustments required to place feed system in proper operating condition. CONTRACTOR shall field test and calibrate the equipment to assure that the system operates in accordance with these Specifications and to the satisfaction of the CONTRACTOR.

B. Manufacturer's representatives shall check and approve the installation before operation and assist CONTRACTOR in performing field tests and in the calibration of the equipment.

C. CONTRACTOR shall provide the services of a factory-trained operating specialist for one 4-hour period for the instruction of the operating personnel.

END OF SECTION

SECTION 11210

SOIL VAPOR EXTRACTION SYSTEM PUMPS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Water discharge pumps.

B. Pump motor.

1.2 RELATED SECTIONS

A. Section 02671 - Extraction Wells.
B. Section 15060 - Piping and Appurtenances.
C. Section 15260 - Piping Insulation.
D. Section 15410 - Plumbing Piping.
E. Section 15975 - Direct Digital Control Systems.
F. Section 16111 - Conduit.
G. Section 16482 - Motor Central Center.

1.3 REFERENCES

A. NEMA MG-1 - Motors and Generators.

B. NEMA 250 - Enclosures for Electrical Equipment (1000 Volt Maximum).

C. UL 778 - Motor Operated Water Pumps.

1.4 SYSTEM DESCRIPTION

A. Electric motor driven progressive cavity, wobble stator, horizontal pump with electric controllers.

1.5 SUBMITTALS

A. Shop Drawings: Indicate layout, general assembly, components, dimensions, weights, clearances, and methods of assembly.

B. Product Data: Provide manufacturers literature including general assembly, and operation and maintenance.

C. Manufacturer's Installation Instruction: Indicate support details, connection requirements, and include start-up instructions for pump system.

D Manufacturer's Certificate: Certify that pumps meet or exceed specified requirements at specified operating conditions.

E Field Reports: Indicate summary of hydrostatic test and field acceptance tests performed.

1.6 OPERATION AND MAINTENANCE DATA

A. Operation Data: Include manufacturers instructions, start-up data, trouble-shooting check lists, wiring diagrams and service connections for pumps, drivers, and controllers.

B. Maintenance Data: Include manufacturers literature, cleaning procedures, replacement parts lists, and repair data for pumps, drivers and controllers.

1.7 QUALITY ASSURANCE

A. Equipment and Components: Bear UL label or marking.

B. Maintain 1 copy of each document on site.

1.8 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the products specified in this Section with minimum 3 years documented experience.

B. Installer: Company specializing in performing the work of this Section with minimum 3 years documented experience.

1.9 REGULATORY REQUIREMENTS

A. Provide certificate of compliance from authority have jurisdiction indicating approval of field acceptance tests.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Delivery, store, protect and handle products to site under provisions of Section 01600.

B. Accept pumps and components on site in factory packing. Inspect for damage. Comply with manufacturers rigging and installation instructions.

C. Protect pumps and components from physical damage including effects of weather, water, and construction debris.

D. Provide temporary inlet and outlet caps, and maintain in place until installation.

1.11 MAINTENANCE SERVICE

A. Furnish service and maintenance of pump, driver, and controller for 1 year from date of Substantial Completion.

1.12 SPARE PARTS

A. Provide 1 set of seals for each pump type and model supplied.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Moyno; Product SP35601 Progressive Cavity Pump.

B. [_____] Product [_____].

C. [_____] Product [_____].

2.2 PUMPS

A. Type: Progressive Cavity
B. Casting: Cast iron with NPT female suction and discharge.
C. Stator: Viton.
D. Rotor: Solid 416 S.S, chrome plated.

E. Mechanical Seal: Abrasion resistant type - carbon rotating against a stationary ceramic seat viton fitted, 275 degrees F (135 degrees C) maximum continuous operating temperature.

F. Baseplate: ASTM A-36 Steel; 10 inch C Channel

G. Performance:

1. Motor: 1 hp (0.75 kW), 208 volt, 3 phase, 60 Hz, 1.25 service factor, 1200 RPM, Explosion Proof for Class I, Division 2 Hazardous Environments.
2. Pump Performance Curve attached - Model 356 operating .

H. Model: 35601 Moyno SP, manufactured by Robbins & Myers, Inc..

2.3 PUMP ACCESSORIES

2.4 ELECTRIC MOTOR DRIVE

A. Motor: In open drip proof NEMA MG-1 enclosure, 1200 rpm. Refer to Section 16482.

B. Controller: Refer to Section 15975.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Provide access space around pumps for service. Provide no less than minimum as recommended by manufacturer.

C. Decrease from line size with long radius reducing elbows or eccentric reducers. Support piping adjacent to pump such that no weight is carried on pump casings. For base mounted pumps, provide supports under elbows on pump suction and discharge. Refer to Section 15060.

D. Provide piping. Refer to Section 15410.

F. Provide for connection to electrical service. Refer to Section 16111.

G. Perform pre-operational services per manufacturer's recommendations prior to start-up.

H. Check, align, and certify base mounted pumps by pump manufacturer or qualified millwright prior to start-up.

3.2 FIELD QUALITY CONTROL

A. Perform field inspection and testing under provisions of Section 01400.

B. Perform hydrostatic flow test on entire system.

C. Testing to be witnessed by Engineer.

END OF SECTION

SECTION 11340

SOIL VAPOR EXTRACTION EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Vapor Extraction Manifold
B. Vacuum Blower
C. Air Filter
D. Water Extraction Manifold

1.2 RELATED SECTIONS

A. Section 02671 - Extraction Wells
B. Section 13200 - Shop Fabricated Tanks
C. Section 15060 - Piping and Appurtenances
D. Section 15980 - Instrumentation

1.3 SYSTEM DESCRIPTION

A. The SVE system will use a skid-mounted packaged vacuum system and other components to enhance the removal of groundwater from a well. The SVE system will be comprised of:

- Groundwater extraction wells
- Rotary-lobe type, positive-displacement vacuum pump system
- Vapor vacuum tank system
- Vapor extraction manifold
- Water suction tank system
- Water suction/transfer pump
- Water extraction manifolds
- Interconnecting above-ground, insulated/heat traced pipe manifold system
- Vapor-phase treatment system
- SVE control system
- Equipment shelter (Trailer)

B. The SVE system extracts groundwater and soil vapor in two separate streams from a well. Contaminated groundwater is hydraulically extracted through a straw in the well, while soil vapor is pneumatically extracted from unsaturated zone soils by applying vacuum directly to the well riser.

1.4 SUBMITTALS

CONTRACTOR shall submit the following documents to the ENGINEER.

A. Shop Drawings: Indicate layout, general assembly, components, dimensions, weights, clearances, and methods of assembly.

B. Product Data: Provide manufacturer's literature, including general assembly, vacuum blower curves, showing performance characteristics with blower an system, operating point indicated, controls, wiring diagrams, and service connections.

C. Manufacturer's Installation Instruction: Indicate support details, connection requirements, and include start-up instructions.

D. Manufacturer's Certificate: Certify that vacuum blower, air filter, and extraction manifolds meet or exceed specified requirements at specified operating conditions.

E. Operation Data: Include Manufacturer's instructions, start-up data, trouble-shooting checklists for vacuum blow, air filter, and extraction manifolds.

F. Maintenance Data: Include Manufacturer's literature, cleaning procedures, replacement parts lists, and repair data for vacuum blower, air filter, and extraction manifolds.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the products specified in this Section with minimum three years documented experience.

B. Installer: Company specializing in performing the work of this Section with minimum 3 years documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Delivery, store, protect and handle products to site under provisions of Section 01600.

B. Accept vacuum blower, air filter, extraction manifolds, and components on site in factory packing. Inspect for damage. Comply with Manufacturer's rigging and installation instructions.

C. Protect vacuum blower, air filter, extraction manifolds, and components from physical damage including effects of weather, water, and construction debris.

D. Provide temporary inlet and outlet caps, and maintain in place until installation.

1.7 MAINTENANCE SERVICE

A. Furnish service and maintenance of products specified in this section for one year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. J.E. Gasho & Associates; Product 5514 vacuum blower.
B. _____ Product _____
C. _____ Product _____

2.2 VAPOR EXTRACTION MANIFOLD

A.
B.
C.

2.3 VACUUM BLOWER

A. Casting: Iron (3 lobe)
B. Motor: 30 hp (23 KW), TEFC, 230/460/3/60 with slide base
C. Inlet Silencer: 6-inch
D. Discharge Silencer: 5 inch
E. Elevated base, V-Belt Drive, and OSHA Guard
F. The following items shall be supplied loose for field installation.

1. Inlet Filter
2. Pressure Gauge
3. Relieve valve set at 5 psig
4. Flange type flexible connector: 5-inch for discharge

G. Performance

1. Nominal rotative speed: 2629 rpm
2. Performance curves for pressure and vacuum attached.

2.4 AIR FILTER

A.
B.
C.
D. Performance

2.5 WATER EXTRACTION MANIFOLD

A.
B.
C.

D. Performance

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Provide access space around products specified in this section for service. Provide no less than minimum as recommended by manufacturer.

C. Insulate piping associated with products specified in this section. Refer to section 15260.

D. Provide for connection to electrical service. Refer to Section 16111.

E. Lubricate before start-up.

3.2 FIELD QUALITY CONTROL

A. Perform field inspection and testing under provisions of Section 01400.

B. Perform hydrostatic flow test on entire system.

C. Require test to be witnessed by Engineer.

END OF SECTION

SECTION 11350

VAPOR PHASE TREATMENT SYSTEM

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Thermal/Catalytic Oxidizer

1.2 RELATED SECTIONS

A. Section 11340 - Soil Vapor Extraction Equipment
B. Section 15060 - Piping and Appurtenances
C. Section 15975 - Direct Digital Control Systems
D. Section 15980 - Instrumentation

1.3 REFERENCES

1.4 SYSTEM DESCRIPTION

A. As required to meet vapor-phase discharge requirements, a thermal/catalytic oxidizer vapor phase treatment system (with exhaust heat exchanger to preheat the inlet air) will be installed to reduce the effluent contamination levels to the necessary limits. This device will be set-up to operate using natural gas or propane, and will have an integral inlet blower (i.e., no backpressure on the SVE discharge). The unit will be designed for ready changeover from thermal oxidation (LEL 60% maximum inlet concentration) to catalytic oxidation (LEL 30% inlet concentration), as the combustible vapor concentrations decrease with time. This system will be fitted with an on-line LEL meter and automatic dilution air control and high level shutdown alarm. The device will meet the explosionproof requirements of the equipment shelter. As a minimum, the motors will be explosionproof, and the controller will be air purged.

1.5 SUBMITTALS

A. Shop Drawings: Indicate layout, general assembly, components, dimensions, weights, clearances, and methods of assembly.

B. Product Data: Provide manufacturer's literature, including general assembly, controls, wiring diagrams, and service connections.

C. Manufacturer's Installation Instruction: Indicate support details, connection requirements, and include start-up instructions.

D. Manufacturer's Certificate: Certify that thermal/catalytic oxidizer meets or exceeds specified requirements at specified operating conditions.

1.6 OPERATION AND MAINTENANCE DATA

A. Operation Data: Include Manufacturer's instructions, start-up data, and trouble-shooting checklists.

B. Maintenance Data: Include Manufacturer's literature, cleaning procedures, replacement parts lists, and repairs data for vacuum blower, air filter, and extraction manifolds.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the products specified in this Section with minimum three years documented experience.

B. Installer: Company specializing in performing the work of this Section with minimum 3 years documented experience.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Delivery, store, protect and handle products to site under provisions of Section 01600.

B. Accept thermal/catalytic oxidizer and components on site in factory packing. Inspect for damage. Comply with Manufacturer's rigging and installation instructions.

C. Protect thermal/catalytic oxidizer and components from physical damage including effects of weather, water, and construction debris.

1.9 MAINTENANCE SERVICE

A. Furnish service and maintenance of thermal/catalytic oxidizer for one year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. _____ Product _____
B. _____ Product _____
C. _____ Product _____

2.2 THERMAL/CATALYTIC OXIDIZER

A. Skid: 60 in. x 147 in. (152.4 cm x 373.4 cm)
B. Stack: ID of 22 in. x 23 in. (55.9 cm x 58.4 cm)

C. Combustion Chamber: ID of 48 in. x 48 in. x 60 in. (121.9 cm x 121.9 cm x 152.4 cm)

D. Combustion Blower Motor: 3 hp (2.2 kw)

E. Burner: turndown ratio 20 to 1; maximum output capability 3,000,000 BTU/hour

F. SCFM Rating: 1000 SCFM (28.3 m^3/min)

G. Performance:

1. Thermal Data

• SCFM added by combustion blower when fired on ratio	383 SCFM (10.9 m^3/min)
• total ACFM @ 1400°F (760°c)	4872 ACFM (138.0 m^3/min)
• burner chamber volume required for 0.5 seconds retention time @ 1400°F (760°c)	40.6 ft^3 (1.15 m^3)
• burner chamber volume required for 1.0 seconds retention time @ 1500°F (815°c)	85.6 ft^3 (2.424 m^3/min)
• stack velocity	
@ 500 SCFM (14.2m^3.min) from process stream	11.6 ft/sec (3.54 m/sec)
@1000SCFM (28.3m^3.min) from process stream	23.1 ft/sec (7.04 m/sec)
• estimated weight, thermal unit only	2300 lbs (1043 Kg)

2. Catalytic Data

• SCFM added by combustion blower when fired on ratio	117 SCFM (3.3 m^3/min)
• total ACFM @ 600°F (315°c)	2242 ACFM (63.5 m^3/min)
• catalyst volume for 90% plus destructive efficiency	2.0 ft^3 (56,634 cm^3)
• inlet temperature	600°F (315°C)
• maximum concentrations	25% of the LEL
• stack velocity	
@ 500 SCFM (14.2m^3.min) from process stream	5.3 ft/sec (1.62 m/sec)
@1000SCFM (28.3m^3.min) from process stream	10.6 ft/sec (3.23 m/sec)
• estimated weight, thermal unit only plus catalytic module	2640 lbs (1198 Kg)

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Provide access space around thermal/catalytic oxidizer for service. Provide no less than minimum as recommended by manufacturer.

C. Insulate piping associated with thermal/catalytic oxidizer. Refer to Section 15260.

D. Provide for connection to electrical service. Refer to Section 16111.

3.2 FIELD QUALITY CONTROL

A. Perform field inspection and testing under provisions of Section 01400.

B. Perform flow test on entire system.

C. Require test to be witnessed by ENGINEER.

END OF SECTION

SECTION 13A

PLANT MONITORING AND CONTROL SYSTEM GENERAL REQUIREMENTS

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish, install, calibrate and place in operation a complete Plant Monitoring and Control System (PMCS). The system includes, but is not necessarily limited to the following major equipment:

1. Field Instruments.
2. Panels.

B. PMCS shall be designed to monitor, store, display and log process and equipment operating information and alarms and to perform various process control functions and generate various reports. The unit processes which the PMCS shall monitor and control are shown on the Drawings and described herein.

C. Process and Instrumentation Diagrams (P&ID's) and Specifications of this Section and the other 13A Sections illustrate and describe the overall PMCS functional and operational requirements.

1.2 QUALITY ASSURANCE

A. General:

1. The PMCS shall be furnished by a single supplier who shall assume responsibility for providing a complete and integrated system.

2. All equipment, components and materials required shall be furnished by the single supplier who shall assume the responsibility for adequacy and performance of all items.
3. The supplier shall identify those system components which are not of his manufacture.
4. The supplier shall supply his company's quality assurance plan. The plan shall include but is not necessarily limited to: method of testing, raw material criteria, methods of documentation, station control, "Burn-In", final tests and serialization coding and packaging. Said plans should be in accordance with M.I.L.-105D.

B. Supplier's Qualifications:

1. Shall be a financially sound firm having at least five years continuous experience in designing, implementing, supplying and supporting instrumentation and control systems which are comparable to the PMCS in terms of hardware, cost and complexity.
2. Shall have in existence at the time of bid advertisement, an experienced engineering and technical staff capable of designing, implementing, supplying and supporting the PMCS and handling the PMCS submittal and training requirements.
3. Shall have a thorough working knowledge of water treatment processes and control philosophy in accordance with standard practices of the water treatment industry.
4. Shall have a system of traceability of the manufactured units and purchased components through production, assembly and testing.
5. Shall have a system of "Burn-In" for all components and available supportive documentation.
6. Shall have a demonstrated record of prompt response to field failures.
7. Shall have a documented program of failure analysis.
8. Shall have a warranty covering parts and labor and in the case of microprocessor-based equipment and its appurtenances, a guaranteed availability clause.

9. Shall have proof of compliance with relevant N.E.C., O.S.H.A., M.I.L., N.R.C., I.S.A., S.A.M.A., N.F.P.A., U.L., A.P.I. Standards and all relevant state and local codes.

10. Shall have a record of prompt shipments in accordance with contract obligations required for previous projects.

C. Technical Proposal Requirements: The apparent low, responsive, responsible Bidder shall submit to OWNER a copy of a Technical Proposal from the supplier which he has selected to provide the PMCS. The proposal shall be complete and contain all information as specified below.

1. Financial Statement: Include the value of control systems delivered during the last two fiscal years. Also include the value of other process instrumentation and controls shipped during the period.

2. Experience:

   a. Provide evidence of compliance with the specific experience requirements listed in Paragraph 1.2.B. above in the form of an experience certification signed by an officer of the company.

   b. Describe at least three completed municipal projects utilizing instrumentation and control equipment identical to or similar to (indicate which) that specified. Indicate OWNER, value, completion date, names and phone numbers of OWNER's representatives familiar with each project. Letters of recommendation may be submitted.

   c. Furnish list of last ten projects completed.

3. Personnel: Provide a listing of those personnel expected to be assigned to the project. List is to include project manager, project engineer, field representative, local service representative, and sales representative. Indicate addresses of personnel not based at supplier's main office. Provide documentation including resumes of personnel experienced in wastewater treatment applications.

4. Exceptions: List all exceptions and deviations from the requirements of the Specifications. Reference section number, article, and paragraph of proposed variance and provide an explanation of why

the proposed substitution meets (or exceeds) the functional or equipment requirements specified.

D. Operating Experience or Bonding Alternative:

1. The wastewater treatment plant outlined in the Contract Documents included herein has been designed to meet stringent water quality standards. OWNER and Design Consultant have selected and designed a plant monitoring and control system to provide effective monitoring and control for the treatment facilities. The criteria for selection of this system includes, but is not limited to, the following:

   a. The use of standard, "non-custom" equipment.

   b. The ability of OWNER's personnel to make modifications and adjustments in the field to react to actual field conditions.

   c. The ability of OWNER to obtain training of OWNER's personnel in well established equipment manufacturer training program.

   d. The availability of factory service and a well stocked spare parts inventory which could be drawn upon by OWNER in emergency situations.

The requirements listed in Paragraph 1.2.B. include specific experience requirements. Should a supplier lack the aforementioned five years experience, it shall have the option of posting a performance bond in the amount of 100% of the system equipment price. This bond shall cover a period of time that a supplier is deficient from the five year experience requirement. For example, if a manufacturer has only two years experience, he must post along with an experience certification signed by an officer of the company, a bond in the amount of 100% of the system equipment price for a period of three years following acceptance of the system by OWNER. The purpose of this bond shall be to indemnify OWNER against all losses incurred by reason of the failure of any system or equipment in any aspect of the quality standards required or intended by these Specifications.

OWNER considers losses to include costs incurred to remove a defective system, modify structures as required, purchase and install replacement systems and costs involved with correcting, to OWNER's satisfaction, all system and equipment deficiencies to the quality standards required or intended by these Specifications. The premium cost of this bond shall be included in the price bid for this equipment. The bond shall be in addition to any other bonds specified in the Contract Documents. All manufacturers lacking the total five years operating experience shall submit as part of the Technical Proposal submittal specified in Paragraph 1.2.C., a copy of the bond from an acceptable surety along with a letter from the surety stating that it will issue the bond for the full value of the equipment price.

E. Supplier's Responsibility:

1. CONTRACTOR shall retain the plant monitoring and control system supplier to assume the responsibilities specified below. However, execution of these specified duties by the system supplier shall not relieve CONTRACTOR of the ultimate responsibility for the plant monitoring and control system.

   a. Preparation, assembly and correction of all plant monitoring and control system submittals in accordance with the Contract Documents.

   b. Proper interfacing of the plant monitoring and control system field devices and panels including required interfacing with package control systems furnished by other equipment suppliers and with the plant electrical system.

   c. Supervision of the installation of plant monitoring and control system, instruments, panels, consoles, cabinets, wiring and other components required.

   d. Calibration, testing and start-up of the plant monitoring and control system.

   e. Training of OWNER personnel in operation and maintenance of the monitoring and control system.

   f. Handling of all warranty obligations for the control system components.

F. Reference Standards:

1. The following organizations have generated standards that are to be used as guides in assuring quality and reliability of components and systems; govern nomenclature; define parameters of configuration and construction, in addition to specific details in this Specification and the Contract Drawings:

   a. I.S.A., Instrument Society of America.
   b. A.P.I., American Petroleum Institute.
   c. U.L., Underwriters' Laboratories, Inc.
   d. A.W.W.A., American Water Works Association.
   e. N.R.C., Nuclear Regulatory Commission.
   f. N.E.M.A., National Electrical Manufacturers Association.
   g. O.S.H.A., Occupational Safety and Health Administration.
   h. A.N.S.I., American National Standards Institute.
   i. M.I.L., Military Standards.
   j. N.F.P.A., National Fire Protection Association.
   k. S.A.M.A., Scientific Apparatus Manufacturers Association.
   l. J.I.C., Joint Industrial Council.
   m. I.E.E.E., Institute of Electrical and Electronic Engineers.
   n. N.E.C., National Electrical Code.
   o. F.M., Factory Mutual.

1.3 COORDINATION AND PROGRESS MEETINGS

A. CONTRACTOR shall be responsible for the scheduling and coordinating the system installation with regard to all other work on the site and in accordance with the provisions of the General Conditions. Said coordination shall be documented on the project schedule.

B. Routine progress and coordination meetings will be scheduled by ENGINEER.

C. The purpose of the meetings shall be to review the progress of the Work involving the Plant Monitoring and Control System and provide coordination for installation of the equipment to ensure construction schedules are met.

D. Representatives at the meetings shall have the competence and authority to make any and all necessary decisions. Decisions and statements made at the meetings shall commit CONTRACTOR and system supplier to agreed procedures and schedules.

1.4 SYSTEM SUPPLIER PROJECT PERSONNEL

A. CONTRACTOR shall require the system supplier to provide the following project personnel:

1. Project Manager:
   a. The system supplier shall appoint a project manager who shall coordinate and schedule all work and assure that project schedule is met.
   b. The project manager shall act as the liaison with CONTRACTOR for the installation of the monitoring and control system equipment and shall assist in all matters required for proper coordination and interfacing of the equipment and processes.
2. Field Engineer:
   a. The system supplier shall appoint a field engineer with responsibilities as follows:
      1) Provide advice and technical consultation relative to installation techniques and procedures for equipment furnished.
      2) Installed system checkout, calibration, adjustment and start-up including tuning of every control loop.
      3) Maintenance services during availability demonstration.
      4) Involvement in the on-site system training of plant personnel.
      5) Resolving of control problems encountered during initial start-up and testing of all plant monitoring and control equipment.
   b. The field engineer shall have a minimum of five years experience in systems engineering and start-up.

1.5 SUBMITTALS

A. Shop Drawings:

1. General:

   a. Shop Drawing submittals are to be in accordance with the requirements of the Contract Documents.

   b. Shop Drawing preparation shall not commence until after the pre-submittal conference specified below.

   c. Manufacture of the plant monitoring and control system shall not commence until related submittals have been approved by ENGINEER.

   d. Shop Drawings shall be submitted in complete packages grouped to permit review of related items as generally outlined in Paragraph 1.5.A.3, Submittal Requirements.

   e. Review of Shop Drawings will be for conformance with Contract Documents and with regard to functions specified to be provided.

2. Pre-Submittal Conference:

   a. CONTRACTOR shall arrange and conduct a pre-submittal conference on the control system within 45 days of notification of preliminary acceptance of the proposed PMCS and supplier by OWNER and CONTRACTOR.

   b. Pre-submittal conference shall be attended by representatives of CONTRACTOR, OWNER, the plant monitoring and control system supplier, and ENGINEER. CONTRACTOR shall allot one full working day for the conference and that time shall be included in the price of this Contract.

   c. Purpose of the pre-submittal conference shall be to review informally and approve the manner in which the control system supplier intends to respond to the Contract requirements before any submittals are prepared.

   d. CONTRACTOR shall prepare the items listed below for presentation at the pre-submittal conference. The information shall be submitted to ENGINEER three weeks prior to the date of the conference.

1) List of equipment and materials required for the control system and the brand and model which CONTRACTOR proposes to use for each item.

2) List of proposed exceptions to the plans and specifications along with a brief explanation of each. Approval shall be subject to a formal submittal.

3) Sample of each type of submittal specified herein. These may be submittals prepared for other projects.

4) A flow chart showing the steps to be taken in preparing and coordinating each control system submittal to ENGINEER, and a list of proposed submittals.

5) Bar chart type schedule for all plant monitoring and control system related activities from the pre-submittal conference through start-up and training. Particular emphasis shall be given to dates relative to submittals, design, fabrication, programming, factory testing, deliveries, installation and field testing. The schedule shall be subdivided to show activities relative to each major item or group of items when everything in a given group is on the same schedule.

6) General outline of the type of tests to be performed to verify that all sensors/transducers, instruments and digital processing equipment are functioning properly.

3. Submittal Requirements:

a. Product information for all sensors/transducers and field instruments. Include the following:

1) Manufacturer's product name and model number.

2) Instrument tag number from Contract Documents.

3) Manufacturers standard catalog product data.

4) Description of construction features.

5) Performance and operation data.

6) Installation and mounting details, instructions and recommendations.

7) Service requirements.

8) Dimensions.

b. Panels, Consoles and Cabinets Information:

1) Layout Drawings, include the following:

a) Front, rear, end and plan views to scale.

b) Dimensional information.

c) Tag number and functional name of components mounted in and on panel, console or cabinet.

d) Product information on all panel components.

e) Nameplate location and legend including text, letter size and colors to be used.

f) Location of anchoring connections and holes.

g) Location of external wiring and/or piping connections.

h) Mounting and installation details.

2)Wiring and/or piping diagrams, include the following:

a) Name of panel, console or cabinet.

b) Hiring sizes and types.

c) Piping sizes and types.

d) Terminal strip numbers.

e) Color coding.

f) Functional name and manufacturer's designation for components to which wiring and piping are connected.

3) Electrical control schematics in accordance with JIC standards.

4) Plan showing equipment layout in each area.

c. Field wiring and piping diagrams, include the following:

1) Wiring and piping sizes and types.

2) Terminal strip numbers.

3) Color coding.

4) Conduits in which wiring is to be located.

5) Location, functional name and manufacturer's designation of items to which wiring and/or piping are connected.

6) Point-to-point wiring diagrams.

d. Instrument loop diagrams for all analog display and control prepared using ISA standard symbols in accordance with ISA standard S5.4, include the following:

1) Instrument tag numbers from Contract Documents.

2) Functional name of each item.

3) Manufacturer's model, product, or catalog number for each item.

4) Location of each item.

B. Control System Operation and Maintenance Manuals:

1. Furnish O&M manuals for the Plant Monitoring and Control System in accordance with the Contract Specifications, and the supplemental requirements below:

2. The O&M manuals shall include the following:

a. Name, address and telephone number of the control system supplier's local service representative.

b. Complete list of supplied system hardware parts with full model numbers referred to system part designations, including spare parts and test equipment provided.

c. Copy of all approved submittal information and system shop drawings as specified herein with corrections made to reflect actual system as tested and delivered to the site for installation. Half-size black line reproductions shall be provided for all shop drawings larger than 11 by 17 inches.

d. Manuals shall include the following information:

1) General descriptive information covering the basic features of the equipment.

2) Physical description covering layout and installation requirements and all environmental constraints.

3. Principles of operation explaining the logic of operation; provide information covering operation to a component level.

4. Maintenance procedures covering checkout, troubleshooting, and servicing; checkout procedures shall provide the means to verify the satisfactory operation of equipment, troubleshooting procedures shall serve as a guide in determining faulty components and servicing procedure shall cover requirements and recommended time schedule for calibration, cleaning, lubrication and other housekeeping and preventive maintenance procedures.
5. Wiring, schematic and logic diagrams.
6. Safety considerations relating to operation and maintenance procedures.

C. Record Drawings and Documentation:

1. CONTRACTOR and system supplier shall revise all system shop drawings, submittals documentation to reflect as-built conditions in accordance with the requirements of the Contract Documents and the supplemental requirements below.
2. Six copies of all revised shop drawings and documentation shall be submitted to the CONTRACTOR to replace out-dated drawings and documentation contained in the System O&M Manuals. Half-size black line sets shall be provided for all drawings larger than llx17. Specific instructions for out-dated drawing removal and replacement shall be provided with the record drawing submittal.
3. Half-size black line prints of wiring diagrams applicable to each control panel shall be placed inside a clear plastic envelope and stored in a suitable print pocket or container inside each control panel.

D. Reports:

1. Two copies of the following reports shall be submitted to ENGINEER:
   a. Factory Test Reports if specified in Paragraph 1.8.
   b. Installation Inspection, Field Calibration, and Field Testing Reports as specified in Part 3.

1.6 EQUIPMENT DELIVERY, HANDLING AND STORAGE

A. CONTRACTOR shall make all arrangements for transportation, delivery and storage of the equipment and materials in accordance with the requirements of the Contract Documents, requirements of the system supplier, and requirements of equipment manufacturers.

B. Plant monitoring and control system equipment shall be packaged at the factory prior to shipment to protect each item from damage during shipment and storage. Containers shall be protected against impact, abrasion, corrosion, discoloration and/or other damages. Clearly label contents of each container and provide information on the required storage conditions necessary for the equipment. Keep OWNER and ENGINEER informed of equipment delivery.

C. All equipment shall be handled and stored in accordance with manufacturer's instructions and relevant organization standards. Equipment shall be protected from weather, moisture and other conditions which could cause damage. Items which require a controlled environment for storage such as panels and microprocessor units shall be stored in a climate controlled warehouse or facility. System supplier shall notify CONTRACTOR in writing with copies to OWNER and ENGINEER of the storage requirements and recommendations for the equipment prior to shipment.

1.7 GENERAL DESIGN REQUIREMENTS

A. Power Supplies:

1. All electrically powered equipment and devices shall be suitable for operation on 115 volt +10 percent, 60 Hz +2 Hz power. If a different voltage or closer regulation are required, a suitable regulator or transformer shall be provided.
2. Appropriate power supplies shall be furnished by SUBCONTRACTOR for all two wire transmitters. Power supplies

shall be mounted in enclosures and installed in the appropriate Control Room or field panel.

3. Design all power supplies for a minimum of 130 percent of the maximum simultaneous current draw.
4. A power on-off switch or an air circuit breaker shall be furnished for each item requiring electrical power.
5. Provide isolation transformers, line voltage regulators of the plant monitoring and control system to eliminate electrical noise and/or transients entering on the primary power line.

B. Signal Requirements:

1. The control system shall be designed to use 4 to 20 ma analog signals, unless otherwise specified.
2. Signal converters and repeaters shall be provided where required. Power supplies shall be sized adequately for signal convertor and repeater loads.
3. Signals shall be isolated from ground.
4. Signals shall not have a transient dc voltage exceeding 300 volts over one millisecond nor a dc component over 300 volts.
5. The system will be used in a plant environment where there can be high energy ac fields, dc control pulses, and varying ground potentials between the sensors/transducers or input contact locations and the system components. The system design shall be adequate to provide proper protection against interferences from all such possible situations.

C. Miscellaneous:

1. All instrumentation and plant monitoring and control system components shall be heavy duty types, designed for continuous service. The system is to contain products of a single manufacturer, when possible, and to consist of equipment models which are currently in production. All equipment provided is to be of modular construction and to be capable of field expansion through the installation of plug-in circuit cards and additional cabinets as necessary. Design all logic and control loops to fail safe.

2. All instrumentation and plant monitoring and control system components shall be designed to return automatically to accurate measurement within 15 seconds upon restoration of power after a power failure or when transferred to standby power supply.
3. Surge protection shall be provided for all instruments and all other control system components which could be damaged by electrical surges.
4. All field-mounted instruments and system components shall be designed for installation in humid and corrosive service conditions. All field mounted instrument enclosures, junction boxes and appurtenances shall conform to NEMA 4X requirements unless otherwise specified.
5. All relays with interconnections to field devices shall be wired through terminal blocks. Terminals as part of the relay base are not an acceptable alternate.
6. All panel mounted instruments, switches, and other devices shall be selected and arranged to present a pleasing coordinated appearance. All front of panel mounted devices shall be of the same manufacturer and model line.
7. All components furnished, including field and rear of panel instruments, shall be tagged with the item number and nomenclature indicated on the Contract Documents and/or approved Shop Drawings.
8. Ranges and scales specified herein shall be coordinated to suit equipment actually furnished.
9. Field-mounted devices shall be treated with an anti-fungus spray.
10. Field-mounted devices shall be protected from exposure to freezing temperatures.

D. Environmental Conditions:

1. The control system shall be designed and constructed for continuous operation under the following temperature and humidity conditions:
   a. Control Rooms:
      1) Ambient Temperature: 60 F to 80 F normal range; 40 F to 105 F occasional maximum extremes.

2) Relative Humidity: 80 percent, normal; 95 percent maximum.

b. Indoor locations for control panels and instruments:

1) Ambient Temperature: 40 F to 120 F.

2) Relative Humidity: 98 percent maximum.

c. Outdoor locations for instruments:

1) Ambient Temperature: -10 F to 120 F.

2) Relative Humidity: 100 percent maximum.

1.8 FACTORY TESTING

A. CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified and required to perform factory testing, before shipment at the manufacturer's facility to verify that system components are functioning properly and that they meet the functional and performance requirements of the Contract Documents.

B. CONTRACTOR shall submit information on factory testing procedures to verify that testing shall fulfill the requirements as specified herein. Submittal shall be made at least two months in advance of any scheduled testing and shall include dates of scheduled tests.

C. CONTRACTOR shall notify ENGINEER in writing at least four weeks before expected initiation of tests. ENGINEER may elect to be present at CONTRACTOR's facilities during operational test of system equipment, either for individual units or as an integrated system. Presence of ENGINEER during testing does not relieve CONTRACTOR from conforming to the requirements of the Contract Documents and shall in no way imply acceptance of the equipment.

1.9 SYSTEM CHECK-OUT AND START-UP RESPONSIBILITIES

A. CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish and install all equipment and coordinate all activities necessary to perform check-out and start-up of the equipment.

B. CONTRACTOR shall retain the services of the system supplier to supervise and/or perform check-out and start-up of all system components. As part of these services, the system supplier shall include for those equipment items not manufactured by him the services of an authorized manufacturers representative to check the equipment installation and place the equipment in operation. The manufacturers representative shall be thoroughly knowledgeable about the installation, operation and maintenance of the equipment. A minimum of 5-8 hour days shall be provided.

1.10 SYSTEM CHECKOUT AND START-UP

A. CONTRACTOR under the supervision of the plant monitoring and control system supplier, and other instrument suppliers as applicable, shall perform the following:

1. Check and approve the installation of all plant monitoring and control system components and all cable and wiring connections between the various system components prior to placing the various processes and equipment into operation.
2. Conduct a complete system checkout and adjustment, including calibration of all instruments, tuning of control loops, checking operation functions, and testing of final control actions. All problems encountered shall be promptly corrected to prevent any delays in start-up of the various unit processes.

B. CONTRACTOR shall provide all test equipment necessary to perform the testing during system checkout and start-up.

C. CONTRACTOR and system supplier shall be responsible for initial operation of monitoring and control system and shall make any required changes, adjustment or replacements for operation, monitoring and control of the various processes and equipment necessary to perform the functions intended.

D. CONTRACTOR shall furnish to the ENGINEER certified calibration reports for field instruments and panel mounted devices as soon as calibration is completed.

E. CONTRACTOR shall furnish ENGINEER an installation inspection report certifying that all equipment has been installed correctly and is operating properly. The report shall be signed by authorized representatives of both CONTRACTOR and the system supplier.

1.11 INTEGRATED SYSTEM FIELD TEST

A. Following the plant monitoring and control system checkout and initial operation, CONTRACTOR, under the supervision of the system supplier, shall perform a complete system test to verify that all equipment is operating properly as a fully integrated system, and that the intended monitoring and control functions are fully implemented and operational. Any defects or problems found during the test shall be corrected by CONTRACTOR and then retested to demonstrate proper operation.

B. Following the completion of the integrated system field test the Operational Availability Demonstration (OAD) begin for a continuous 48 hours period. If system failures have occurred will result in starting the OAD over again. During the OAD the system shall be available to plant operating personnel for use in normal operation of the plant.

PART 2 - PRODUCTS

2.1 MAGNETIC FLOWTUBES AND TRANSMITTERS

A. Functions:

1. Flowtube: Produce low level, high impedance pulsed dc signal proportional to the rate of fluid flow using the principle of electromagnetic induction.
2. Pulsed dc Magnetic Flow Transmitter: Drive the flowtube coils with pulsed dc power and convert the flowtube output signal into a dc current output linear to the flow rate.

B. System (Flowtube and Transmitter) Performance Requirements:

1. System Accuracy (with Analog Output): +0.5 percent of flow rate or better over range from 1 ft/s to 31 ft/s; +.005 ft/s or better at flows below 1 fps flow range.
2. System Repeatability: +0.15 percent of flow rate or +.0015 ft/s, whichever is greater.
3. Drift: Complete zero stability.
4. Minimum Fluid Conductivity Limit: 5 microsiemens per centimeter or less.
5. Minimum Pre-amp Input Impedance: 10,000,000,000,000 ohms.
6. Fluid Property Effects: Accuracy unaffected by changes in fluid velocity, density, pressure, temperature or conductivity (above minimum conductivity limits).
7. Transmitter Outputs:
   a. 4-20 made, direct acting and isolated, into 0-1000 ohms.
   b. High accuracy, field adjustable scaled pulse output (0.1 to 10 Hz or greater) to drive local totalizer.
8. Power Consumption: Not to exceed 50 watts for flowtube and transmitter combined.
9. Operating Temperature: Suitable for operation with process fluid temperature from 0 to 140 F.
10. Pressure Rating: Greater than or equal to test pressure specified in Section 15A2 for appropriate piping system.

C. Construction and Required Features:

1. Flowtube:
   a. Type: Lined metal flowtubes.
   b. Interchangeability: Ratio of flow velocity to voltage reference signals generated identical for all meter sizes to permit interchangeability with transmitter without requiring circuit modifications.
   c. System accuracy in Paragraph B.1. shall be proven by submittal of flow test curves of the actual meters being furnished.
   d. Test curves shall show a minimum of ten equally spaced flow points. Tests shall be performed using water and a

weight or volume tank. A "Master Meter" used as a reference standard is not acceptable. The test setup shall be submitted and approved prior to testing.

e. Tube Material:

1) Meter tubes 12-inch and smaller: Type 304 stainless steel.

2) Metering tubes 14-inch and larger: Type 304 stainless steel, .125-inch wall thickness.

f. Electrodes:

1) Conical or elliptical shaped.

2) Material: Type 316 stainless steel.

g. Lining: PFTE.

h. Enclosure:

1) Materials and Rating: Cast low-copper aluminum alloy or fabricated sheet steel, NEMA 6 rated and capable of withstanding accidental submergence in 30 feet of water for 48 hours.

2) Finish: Finish exterior, except for flange faces, with a high build epoxy paint.

i. End Connections: ANSI Class 150 suitable for mating with pipe specified.

j. Electrical Connections: 3/4-inch NPT tapped holes for power conduit fitting and signal conduit fittings.

2. Pulsed dc Magnetic Flow Transmitter:

a. Solid state construction.

b. Pulse and analog outputs galvanically isolated from input and earth ground.

c. Automatic zeroing feature making it unnecessary to zero the instrument before or after placing it in operation.

d. Precalibrated span adjustment providing continuous span adjustment over entire range.

e. Range adjustment: Direct reading thumbwheel switches or calibrated potentiometer, continuously adjustable for full scale settings from 1 to 31 feet per second.

f. Signal Conditioning: Adjustable damping circuit with response times of 1 to 25 seconds minimum.

g. Low Flow Cutoff: Provide automatic low flow cutoff circuitry to stop pulse output and local totalization when flow drops below 0.5 percent +0.2 percent of the calibrated upper range valve.

h. Enclosure:

1) Die cast, low-copper aluminum alloy, NEMA 4.

2) Finish: Epoxy coating.

i. Mounting:

1) All transmitter and driver electronics shall be remotely mounted from the flow tubes at locations shown on the Drawings.

2) Provide complete Type 316 stainless steel mounting hardware.

3) Type of mounting (wall, support frame or pipe stand) as required.

j. Local Indication:

1) 3-1/2 digit minimum LCD meter with field selectable engineering units or 0-100 percent display; or analog milliammeter with linear 0 to 100 percent scale for flow rate indication. Provide stainless steel tag indicating 100 percent value in engineering units as specified in the Instrument List.

2) 7-digit electromechanical totalizer or 8 digit electronic LCD totalizer with reset and lithium battery backup. Count scaling shall be as specified in the Instrument List. Totalizer shall be integral with transmitter and visible through viewing window, or shall be externally mounted in a separate NEMA 4X enclosure or condulet with viewing window and installed adjacent to the transmitter.

k. Power Requirements: Designed for operation on 120 VAC ±10 percent, 60 Hz, ±3 Hz power supply.

3. Accessories:

a. Shielded cable assemblies of sufficient length for connection between flowtube and transmitter electronics.

b. 316 stainless steel grounding rings for flowtubes.

c. 316 stainless steel grounding straps.

d. CONTRACTOR shall provide a NEMA 4X rated SPST ON-OFF manual disconnect switch for 120 vac input power to transmitter and driver electronics. See typical installation details on Drawings.

D. Product and Manufacturer: Provide one of the following:

1. 2800 Series magnetic flowtubes and 896 Pulsed dc Magnetic Flow Transmitter, as manufactured by Foxboro Company.
2. Altoflux M900 Series magnetic flowtubes and Model SC100 AS signal converters, as manufactured by Krohne America Incorporated.

2.2 PRESSURE SWITCHES

A. Type: Switch assembly with diaphragm piston actuator for sensing gauge or differential pressure.

B. Performance Specifications:

1. Adjustable Operating Range: See Instrument List.
2. Setpoint Accuracy: ±1 percent of span.
3. Actuating Setpoint: See Instrument List.
4. Adjustable Deadband Range and Setting:
   a. Maximum full scale, minimum 7 percent of full scale.
   b. Required Deadband Setting: Fixed 5%.
5. Switch: Snap action, SPDT rated not less than 5 amp resistive at 120 vac and 1/2 amp resistive at 125 VDC. Provide DPDT contacts and other optional switch configurations when so required.
6. Switch and Reset (Deadband) Action: Adjustable, Fixed, Manual Reset or Two Stage type.

C. Construction Features:

1. Pressure Transducer Housing and Diaphragm Materials:
   a. Air Service: Type 303 Stainless steel with Viton diaphragm.
   b. Other Services: Aluminum with Buna-N Diaphragm.

2. Set and Reset Point Adjustments: Adjustable external adjusting nuts and pressure setting scales.
3. Process Connection: 1/4-inch NPT.
4. Housing: Copper-free die cast aluminum, NEMA 4; NEMA 7 construction required for hazardous areas.
5. External Mounting Lugs.
6. Adjusting Nuts Metal Cover with Gasket on NEMA 4 and NEMA 7 rated units.
7. Electrical Connection: 3/4-inch NPT.
8. Provide diaphragm seal.

D. Product and Manufacturer: Provide one of the following:
1. Tri-point SA, SB, SC, SD, and SE Series, as manufactured by Automatic Switch Company.
2. Or equal.

2.3 LEVEL SWITCHES - CONDUCTANCE TYPE

A. Type: Complete level sensing system utilizing conductance type measuring techniques to energize and de-energize independent control relays when the monitored medium reaches the corresponding level electrode elevation.

B. Performance Requirements:
1. Level Setpoints: 2".
2. Total Number of Electrodes: 2.

C. Construction Features:
1. Electrodes:
   a. Type: Insulated, 1/4-inch diameter solid rod with bare end tip; cut to required length in field.
   b. Insulation: PVC.
   c. Rod Material: Type 316 stainless steel.
2. Electrode Holders:
   a. Type and Material: Flanged PVC; size as specified in Schedule.

3. Control Relays:

a. Type: Solid state with low fixed sensitivity resistance of 10K ohms. Sensitivity shall be field changeable to adjust for process fluid conductivity by means of external resistor replacement and relay shall be field convertible for direct or inverse operation.

b. Power Supply: 120 vac (-20, +10 percent), 60 Hz.

c. Power Required: 9 volt-ampere, 6 watts.

d. Sensing Circuit: 8 volt AC and less than 30 ma short circuit.

e. Contacts: Silver cadmium oxide.

f. Load Contact Arrangement: Three separate and isolated sets of Form C (SPDT) contacts; one set wetted for local use, two sets dry for remote monitoring or external load control.

g. Contact Ratings: 10 amps at 120 vac, 240 vac and 28 vdc.

h. Temperature Range Limitations: -40 F to 180 F.

i. Enclosure: NEMA 4X for field mounted locations; NEMA 1 for interior panel mounted installations.

j. Quantity: One control relay per control or alarm electrode. Ground common electrode to each relay.

D. Product and Manufacturer: Provide one of the following:

1. B/W Controls Division, McGraw-Edison Company:

a. Electrodes: Model 6013 Series.

b. Electrode Holders: 6012 Series, Type KF.

c. Control Relays: Series 52.

2.4 LEVEL TRANSMITTER - ADMITTANCE TYPE

A. Type: Two wire, continuous admittance type level transmitter system producing an output signal linear to level. System to consist of sensing probe, electronic transmitter and interconnecting cable and other components as necessary for proper operation of the system.

B. Performance Requirements:

1. System Performance: Suitable for use with conductive and insulating liquids, slurries and granulars.
2. System Accuracy: +1 percent of span.
3. Linearity: +1 percent of span.
4. Repeatability: +1 percent of span.
5. Ambient Temperature Range: -40 F to 160 F.

6. Transmitter Output: 4-20 ma isolated and direct acting into 0-550 ohms.

C. Construction Features:

1. Sensing Probe and Interconnecting Cable:
   a. Type: Provide the following type of sensing probe:
      1) Insulated solid rod.
   b. Sensing Probe Materials:
      1) Insulated Rods: Steel.
      2) Insulation: Teflon, Kynar, manufacturer's proprietary fluorocarbon-type, or other special insulation as required for process fluid compatibility and chemical resistance.
      3) Reference ground rod, bare metal section, metal fittings, weights, anchors and other process wetted or exposed parts: Type 316 or 304 stainless steel, Hastelloy C or other special materials as required for process fluid compatibility and chemical resistance.
   c. Probe Holder: Watertight condulet and fittings with corrosion resistant coating (NEMA 4X rating) for supporting the sensing probe and housing the connections to transmitter.
   d. Probe and Holder Mounting: Threaded NPT fitting, 3/4 or 1 inch depending on probe O.D. provided. Provide auxiliary Type 316 stainless steel or Teflon-faced CS mounting flange and/or support bracket and fasteners where required by application.

e. Interconnecting Cable: Three conductor coaxial cable driven shield type, length as required to connect to transmitters.

2. Transmitter:

a. Solid state electronics designed to measure both resistance and capacitance between the sensing probe and ground reference probe with circuitry designed to ignore errors generated by coating build-ups on the sensing probe.

b. Field adjustable zero and span adjustments.

c. Housing: NEMA 4X enclosure with viewing window for indicator.

d. Indicator: Integral 3-1/2 digit LCD meter, visible through transparent window on enclosure. Meter shall be capable of being field adjusted to indicate transmitter output in actual engineering units or 0-100 percent full scale.

e. Mounting: Suitable for wall, handrail, surface or frame mounting. Provide Type 316 stainless steel fasteners and hardware as required.

f. Power Supply: Suitable for operation on 115 VAC power. Provide intrinsically safe and fuse protected 115 VAC/24 VDC power supply mounted in transmitter enclosure.

g. Intrinsic Safety: Provide intrinsic safety barriers for sensing heads and probes located in hazardous areas.

h. RFI Protection: Provide RFI filters on sensing element input and signal output.

i. Surge Protection: Provide surge protection suppressors for power supply input and signal connections.

j. Damping: Field adjustable 0 to 30 second time delay.

k. Zero offset: Field adjustable by means of additional zero capacitors installed across probe signal input terminals.

l. Fail Safe Action: Field reversible Low Level or High Level (Low Level Fail Safe Standard).

3. Ground Reference: Provide reference ground as required for proper operation of the system. For non-metallic storage tank applications provide integral companion reference ground probe as specified in C.1. above.

D. Product and Manufacturer: Provide one of the following:

1. Universalevel Systems, as manufactured by Drexelbrook Engineering Company.

2.5 PRESSURE GAUGES

A. Bourdon Tube Pressure Element Type, Liquid Filled Gauges (for pressure ranges of 15 psi and greater and vacuum ranges to 30" Hg):

1. Performance Requirements:
   a. Accuracy: +0.5 percent of span (ANSI B40.1 Grade 2A).
2. Construction Features:
   a. Case:
      1) Solid front design constructed of glass filled polyester.
      2) Color: Black.
   b. Ring: Threaded, glass filled polyester.
   c. Full blowout back.
   d. Window: Glass.
   e. Dial: White with black marking; 270- scale.
   f. Bourdon Tube and Socket: Type 316 Stainless Steel, heliarc welded unless otherwise specified in the Instrument Schedule.
   g. Movement: Cam and roller movement, 300 series stainless steel.
   h. Size: 4-1/2-inch.
   i. Connection: 1/4-inch male NPT back or bottom as required.
   j. Mounting: Stem, flush panel or wall mounting as required.
   k. Adjustable pointer.
   l. Externally accessible zero adjustment.
   m. Built-in overload and underload movement stops.
   n. Pressure Snubber: Sintered stainless steel snubber threaded into gauge socket or in external stainless steel housing with 1/4 NPT male and female connections.

o. Filling Liquid: All applications except Chlorine and Fluoride Systems: Silicone Oil; Chlorine and Fluoride Systems: Flurolube Oil.

p. Process Isolation: Provide gauge cocks or ball valves for process isolation in accordance with the requirements of Article 2.1.

q. Provide diaphragm seal.

3. Product and Manufacturer: Provide one of the following:

a. Series 900, as manufactured by Helicoid.

2.6 DIAPHRAGM SEALS

A. General:

1. Furnish diaphragm seals for pressure gauges and switches at locations shown on the Drawings and as specified in other Articles and Sections.

B. Construction Features required for all seals:

1. Provide fill/bleed screw to permit filling of instrument and diaphragm seal.
2. Provide a clean-out ring which holds the diaphragm captive in the upper housing to allow the upper housing assembly to be removed for recalibration or cleaning of the process side housing without the loss of filling liquid or change in calibration.
3. Instrument Connection: 1/4-inch NPT.
4. Process Connection: 1/2-inch NPT.
5. Working Pressure Rating: Equal to or greater than the attached gauge or switch operating pressure range.
6. Bolting Materials: Type 316 stainless steel.
7. 1/4-inch NPT flushing connection.
8. Filling Fluid: Silicone.

C. Seal Construction Features:

1. Top Housing: Type 316 stainless steel.
2. Diaphragms, O-rings and Gaskets:

Process Fluid	Diaphragm	O-Ring	Gasket
Polymer	316 SS	Buna-N	Buna-S
Sulfuric Acid	Teflon	Teflon	Teflon
Hydrogen Peroxide	Teflon	Teflon	Teflon
Sodium Hydroxide	Teflon	Teflon	Teflon

3. Process Side Housing Material: 316 SS.

D. Assembly and Calibration:

1. The complete diaphragm seal assembly, including gauge or switch or transmitter, shall be factory assembled, filled and calibrated to the ranges and switch setpoints specified prior to shipment.
2. System Supplier Manufacturer shall be responsible for assuring that fill volumes and sensitivities of the supplied seals and diaphragms are suitable to provide the required gauge, switch or transmitter accuracy over the specified measurement range or at switch setpoints.
3. Location and orientation of the gauges, switches and seal assemblies shall be coordinated with the actual piping and equipment installations so that gauges and indicators shall be easily read and accessed for maintenance by plant personnel.
4. Where field mounting and orientation conflicts arise due to incomplete coordination with or field changes in the process piping and equipment installation, assemblies shall be relocated, re-oriented, re-assembled and re-calibrated as directed by the OWNER or OWNER's Representative.

E. Product and Manufacturer: Provide one of the following:

1. Type 100 HAC, as manufactured by Helicoid.
2. Mansfield & Green (for low pressures).

2.7 pH ANALYZER

A. Type: Continuous monitoring system consisting of pH sensor and a microprocessor-based analyzer/transmitter designed to measure pH of the sample and produce a proportional output signal linear to the pH.

B. Performance:

1. Sensor:

   a. Range: 0-14 pH/(-)500 to (+)500 or 0-1000 millivolts.

   b. Response Time: 95 percent of full scale in 5 seconds.

2. Analyzer/Transmitter:

   a. Range: 1 to 14.

   b. Sensitivity: 0.05 percent of span.

   c. Repeatability: 0.01 pH.

   d. Stability: 0.05 percent of span for 24 hours, non-cumulative.

   e. Outputs: 4-20 madc direct acting and isolated into 0 to 1000 ohms at 24 VDC power supply.

   f. Ambient Temperature Range (Transmitter): -15 to 135

   g. Ambient Relative Humidity: 0-90 percent RH non-condensing.

C. Construction Features:

1. Sensor:

   a. Body: Polyethersulfone.

   b. Electrodes: pH and reference electrodes to be contained in sensor body.

   c. Sensor to contain thermistor for process temperature correction.

   d. Sensor to be constructed to allow refurbishing of pH 7 buffer in the standard electrode chamber.

   e. Provide submersible, flow-through.

   f. Cable: PVC jacketed submersible type cable terminated in numbered spade lugs. Provide length as required to connect to remotely mounted transmitter (25 feet minimum length).

   g. Connection: 3/4-inch NPT female.

2. Analyzer/Transmitter:

   a. Microprocessor-based solid state circuitry designed for measurement of pH and transmission of proportional output signal linear to pH.

   b. Built-in simulator used in conjunction with front panel controls and display to simulate input parameters and to verify calibration, proper internal functioning of the

analog-to-digital conversion, processing, outputs and setting up alarms.

c. Front of panel membrane sealed keypad switches for display control and transmitter function control testing and calibration. Unit design and switches shall allow output expansion to 1 pH full scale span for any part of the range between 0 and 14 pH. Front panel switch shall also allow alternate display of readouts for pH, temperature mV and mA outputs.

d. Built-in Self Diagnostics: Error messages shall be presented on the display to indicate operational and equipment malfunctions. Operational errors shall include questionable calculation results, insufficient data, excessive input noise, input measurement, or calculated results out of range. Equipment problems shall include read-only memory fails check sum, random-access memory problem, identification error, card in wrong position, switch failure, wrong or no input card.

e. Indicator: 4-1/2 digit LCD indicator with measurement unit and configuration constant identifiers; 7/8 inch high digits.

f. Alarm Outputs: Dual alarm, Selectable Lo-Hi, Hi-Hi, Lo-Lo. NO and NC contacts rated 10 amp, 24 vdc/250 vac.

g. Housing: Thermoplastic, weatherproof, NEMA 4X enclosure with transparent vision panel for viewing the indicator and controls and equipped with brackets to allow for handrail, surface mounting or pipe stand mounting.

h. Power Supply: 120 VAC, 60 Hz, 15 watts.

D. Product and Manufacturer: Provide one of the following:

1. Model 1054 Analyzer/Transmitter and 381 pH sensor, as manufactured by Rosemount Analytical Division.

2.8 FLOW SWITCH

A. Type: Sleeve protection.

B. Performance Requirements:

1. Sleeve Material: Teflon.
2. Oil filled.
3. Temperature Limitations: 400- F.
4. Tee models supplied with internal sleeve.
5. Body: Steel.
6. Stem-paddle: Teflon.

C. Manufacturer: Provide one of the following:

1. Power Engineering & Equipment Co., Inc. (PEECO).

2.9 TELEMONITOR

A. Telemonitor:

1. General
   a. The Telemonitor shall respond to a change in condition by executing a series of telephone calls and repeating a pre-programmed human voice message. The unit shall be mounted where shown on the Drawings.
   b. The Telemonitor shall use standard telephone lines, detect a busy signal and automatically proceed to the next telephone number programmed for the fault.
   c. The Telemonitor shall detect a fault via normally open/normally closed contacts.
2. Required Features:
   a. 8 digital inputs.
   b. SPST dry contact for fault detection transmission.
   c. Auto-answer facility for receiving incoming telephone calls with 1-9 ring count.
   d. 4-line, 40-character, LCD display with clock.
   e. Power supply: 120VAC, 60 Hz.
   f. NEMA 4X enclosure
   g. Variable message length for each fault.
   h. 4-digit security code.
   i. 1-100 second delay for each fault.
   j. Internal clock.

k. Remote acknowledge.

l. 12 telephone numbers for each channel.

m. Status only indication.

n. Data entry via keyboard and audio input.

o. Automatic power failure detection.

p. Four hour automatically rechargeable battery back-up. Battery operation shall be automatic upon power failure.

3. Telephone Line:

a. The CONTRACTOR shall make all arrangements necessary to bring telephone service to the Telemonitor.

4. Manufacturer. Provide one of the following:

a. Capital Controls Company Inc., Series 2001V-PROM.

2.10 CONTROL RELAYS

A. Type: General purpose, plug-in type rated for continuous duty.

B. Construction Features:

1. Coil Voltages: 24 vdc and 120 vac as required.

2. Contacts:

a. Silver cadmium oxide, gold flashed except in cases for switching low energy circuits (200 ma) where fine silver, gold flashed contacts shall be provided.

b. Rating: Compatible with ac or dc throughout voltage and current of devices simultaneously operated by contacts but not less than the following:

1) Silver cadmium oxide, gold flashed not less than 5 amperes resistive at 120 vac or 28 vdc continuous.

2) Fine silver, gold flashed not less than 3 amperes resistive at 120 vac or 28 vdc continuous.

3. Relays to have clear plastic dust cover.

4. Relays to be UL recognized.

C. Product and Manufacturer: Provide one of the following:

1. Type R and/or Type K, as manufactured by Square D Company.

2.11 SELECTOR SWITCHES, PUSHBUTTONS AND INDICATING LIGHTS

A. General:

1. Selector switches, pushbuttons and indicating lights shall be supplied by one manufacturer and be of the same series or model type.
2. Type:
   a. Selector Switches Pushbuttons and Indicating Lights: Heavy duty, oiltight.
   b. Common, push to test circuitry shall be provided for each panel to simultaneously test all indicating lights on the panel using a single pushbutton.
3. Provide legend plate for indication of switch, pushbutton or light function (i.e., Open-Closed, Hand-Off-Auto).
4. Mounting: Flush mounted on control panel front, unless otherwise noted.
5. NEMA rated to match panel in which mounted.

B. Selector Switches:

1. Type: Provide selector switches with number of positions as required to perform intended functions specified and shown.
2. Contacts:
   a. Provide number and arrangement of contacts as required to perform intended functions specified but not less than one single pole, double throw contact.
   b. Type: Double break, silver contacts with movable contact blade providing scrubbing action.
   c. Rating: Compatible with ac or dc through-put current of devices simultaneously operated by the switch contacts but not less than 10 amperes resistive at 120 volts ac or dc continuous.
3. Switch Operator: Standard black knob.

C. Pushbuttons (Standard or Illuminated):

1. Type: Provide momentary lighted and/or unlighted, single and/or dual type pushbuttons as required to perform intended functions specified and shown.
2. Contacts: Comply with the requirements specified for selector switches.

D. Indicating Lights:
1. Type: Compact, integral transformer type.
2. Lamps: 6 volt, long life (20,000 hours minimum).

E. Button and Lens Colors:
1. Green for indication of open, on, running.
2. Red for indication of closed, off (ready), stopped.
3. Amber for indication of equipment malfunction, process trouble and alarms (i.e., high level, low level, etc.).
4. Blue for indication of electrical control power on.

F. Product and Manufacturer: Provide one of the following:
1. Square D, Types K and SK.
2. Allen-Bradley, Types 800T and 800H.

2.12 PANELS

A. General:
1. Provide all electrical and/or pneumatic components and devices, support hardware, fasteners, interconnecting wiring and/or piping required to make the control panels complete and operational units.
2. Locate and install all devices and components so that connections can be easily made and so that there is ample room for servicing each item.
3. Components for installation on panel exterior shall be located generally as shown. Layouts shall be submitted for approval as per Section 13A.
4. Approximately panel size shall be 72" W x 30" D x 84" H. Panels shall have full height rear access doors.

5. Adequately support and restrain all devices and components mounted on or within the panel to prevent any movement.
6. Provide sub-panels for installation of all relays and other internally mounted components. Main and distribution circuit breakers, metering pump power components and distribution panel shall be arranged separate from panel controls and electronic devices. A separate section within the panel shall be devoted for this purpose.
7. All wiring to panel connections from field instruments, devices, and other panels shall be terminated at master numbered terminal strips, unless otherwise specified.
8. Provide copper neutral bar and grounding studs for all panel equipment.
9. Provide the following convenience accessories inside of each control panel:
   a. One 120 VAC, 20A duplex, grounding type receptacle.
   b. One 120 VAC fluorescent light fixture with 40 watt lamp and protective plastic shield.
   c. One 120 VAC, 20A, snap switch, to turn on the light, mounted in an outlet box with a cover and located so that it is easily accessible from access door.
   d. The service light with switch and duplex receptacle shall have its own circuit breaker and separate power feed.
   e. The bottom 12 inches of free standing panels shall be free of all devices, including terminal strips, to provide ease of installation and testing.
   f. No device shall be mounted less than 36 inches above the operating floor level, unless otherwise specified.

B. Identification:
1. Provide laminated plastic nameplates for identification of panels and components mounted thereon as follows:
   a. Nameplates shall be of 3/32 thick laminated phenolic type with white matte finish surface and black letter engraving.
   b. Panel identification nameplates to have 1/2-inch high letter engravings.

c. Panel mounted component identification (i.e., control devices, indicating lights, selector switches, etc.) nameplates to have 1/4 inch high letter engravings.

d. Nameplates shall be attached to the panel face with two stainless steel self-tapping screws.

e. Nameplate engravings shall include the instrument or equipment tag number and descriptive title indicated on the Drawings and Specifications.

2. Tag all internally mounted components in accordance with the following requirements:

a. Tag numbers shall be as listed on the Contract Drawings and Instrument List.

b. The identifying tag number shall be permanently etched or embossed onto a stainless steel rivets or self tapping screws or appropriate size.

c. Where neither of the above fastenings can be accomplished, tags shall be permanently attached to the device by a circlet of 1/ l 6- inch diameter stainless steel wire rope.

d. Identification tag shall be installed so that the numbers are easily visible to service personnel.

e. Front of panel mounted instruments shall have the tag attached to rear of device

3. Tag all electrical components and devices mounted within control panels and enclosures with embossed plastic tape labels. Provide identifying nameplate for each circuit braker disconnect indicating equipment served.

4. Tag all pneumatic lines with plastic tags. Paper tags are not acceptable.

5. Numerically code terminals on terminal strips.

6. Color code and/or numerically code wiring as required by applicable standards. Wires shall be identified at each end with permanent number codes.

C. Construction Features:

1. Control panel shall be located inside control room area and shall be NEMA 12 rated.

a. Fabricate enclosures using minimum 14 gauge steel for wall or frame mounted enclosures and minimum 12 gauge for free standing enclosures. Steel shall be free of pitting and surface blemishes.

b. Continuously weld all exterior seams and grind smooth. Also, surface grind complete removal of corrosion, burrs, sharp edges and mill scale.

c. Reinforce sheet steel with steel angles where necessary to adequately support equipment and ensure rigidity and to preclude resonant vibrations.

d. Use pan type construction for doors. Door widths shall not exceed 36 inches.

e. Mount doors with full length heavy duty piano hinge with stainless steel hinge pins.

f. Provide oil resistant gasket completely around each door or opening.

g. Provide handle-operated, oil-tight, key-lockable three point stainless steel latching system with rollers on latch-rods for easy door closing.

h. Use stainless steel fasteners throughout.

i. Provide interior mounting panels and shelves constructed of minimum 12 gauge steel with a white enamel finish.

j. Provide steel print pocket with white enamel finish.

k. Provide enclosure mounting supports as required for floor, frame, or wall mounting.

l. Provide all holes and cutouts for installation of conduit and equipment. Cable and piping to enter the enclosure through the bottom unless otherwise noted. All conduit and piping openings and all conduits shall be sealed watertight.

m. Completely clean all interior and exterior surfaces so they are free of corrosive residue, oil, grease and dirt. Zinc phosphatize for corrosion protection.

n. One coat of primer shall be applied to all interior and exterior surfaces immediately. Exterior surfaces shall then be given sufficient coats of primer surfacer, applied with

sanding and cleaning between coats, until a Grade 1 finish can be produced on the finish coat.

o. All interior surfaces shall be painted with 2 coats of semi-gloss white enamel.

p. All exterior surface shall be painted with a minimum of 3 finish coats of enamel to ultimately produce a Grade 1 finish (super smooth; completely free of imperfections). Color to be selected from color charts furnished by the Contractor. Provide one extra quart of touch-up paint for each exterior finish color.

q. Primer and finish paint shall be compatible and shall be Sherwin-Williams "Polane T Polyurethane Enamel".

r. Provide one extra quart of touch-up paint for each exterior finish color.

D. Electrical Systems:

1. Indoor Panels:

a. Provide 120 Vac strip heaters as required to maintain temperature 10F above ambient for condensation prevention inside panels.

b. Provide automatically controlled closed loop ventilation fans or closed loop air conditioners with filtered air louvers if required to maintain temperature inside each enclosure below the maximum operating temperature rating of the components inside the enclosure.

2. Power Source and Internal Power and Metering Pump Distribution:

a. General: The control panel's power supply source shall consists of three 20 amp, 120 volt, single phase circuits. A main 3 pole circuit breaker disconnect shall be provided to remove the service supply's from the panel.

b. The panel's internal power distribution shall be arranged such that one circuit is utilized for each pair of metering pump power and control devices associated with each of the two chemical systems. Only one metering pump per system shall operate at a given time. The remaining circuit shall be utilized for the remaining panel components.

c. Each metering pump shall be provided with a circuit breaker disconnect, a magnetic contactor horsepower rated and a single pole melting alloy type overload relay. The relay shall be manual reset type with reset from the panel front by means of an insulated button. The relay shall be equipped with a SPDT contact for alarm purposes and a separate heater element sized for the full load amperes and service factor of the actual motors furnished. Each pump controls shall include separate overcurrent protection with provisions to supply 120 volt requirements for pump leak detection and positioner devices.

d. The panel shall be provided with an internal 120 Vac auxiliary power distribution panel with number of circuits and separate circuit breakers sized as required to distribute power to the remaining panel components. The distribution panel shall contain two spare breakers minimum.

3. Electrical Systems Description:

a. Internal wiring shall be Type THHN stranded copper wire with thermoplastic insulation rated for 600 V at 85 C for single conductors, color coded and labeled with wire identification.

b. For dc panel signal wiring, use No. 18 minimum AWG shielded. For dc field signal wiring, terminal strips shall be capable of handling No. 12 wiring (minimum).

c. For ac power wiring, use No. 12 minimum AWG. For ac signal and control wiring, use No. 16 minimum AWG. For wiring carrying more than 15 amps, use sizes required by NEC and JIC standards.

d. Separate and shield dc signal wiring from power and control wiring by a minimum of 6 inches.

e. Group or bundle parallel runs of wire using covered troughs. Maximum bundle size to be 1 inch. Troughs shall have 40 percent spare capacity.

f. Install wire troughs along horizontal or vertical routes to present a neat appearance. Angled runs are not acceptable.

g. Adequately support and restrain all wiring runs to prevent sagging or other movement.

h. Terminate all field wiring using forked, insulated, crimp-on connectors (soldered type not acceptable) at 600 V rated barrier type terminal strips with screwed connections and permanently affixed numeric identifiers beside each connection. Identifiers to be self-stick plastic tape strips with permanent type, machine printed numbers.

i. All wiring shall be installed such that if wires are removed from any one device, power will not be disrupted to any other device.

j. All alarms generated external to the panel, spare alarm, and repeat contacts shall be wired out to terminal blocks.

k. For internal component to component wiring only, compression type terminal blocks are acceptable.

l. Provide spare terminals equal in number to 20 percent of the terminals used for each type of wiring (i.e., dc signal and ac power).

m. Provide a separate terminal for grounding each shielded cable.

n. Use separate 5/16-inch diameter copper grounding studs for instrument signal cable shields and ac power.

o. Where wires pass through panel walls, provide suitable bushings to prevent cutting or abrading of insulation.

p. When dc power and/or low voltage ac power is required, provide and install the necessary power supplies and transformers in the panel.

q. Provide circuit breakers to protect each circuit, with no more than six instruments on a single circuit.

r. Provide complete wiring diagram showing "as built" circuitry. Diagram shall be enclosed in transparent plastic and placed in easily accessible pocket built into panel door.

2.13 PROGRAMMABLE LOGIC CONTROLLER (PLC)

A. General: The PLC shall be capable of performing both analog and discrete control functions required to operate the facility with the ability of allowing an operator to monitor, change, and be notified of process conditions in their normal or abnormal state.

The PLC shall be micro processor based and be programmed in written ladder logic, operated by software allowing online and offline operation and network communication.

B. Type: Modicon PLC Model A984-145 compact system with Mod Bus Plus, to be used locally at the recovery well houses.

C. Required Design and Construction Features:

1. System to consist of integral processor with 8K logic memory and 1920 registers, having a scan time of 5 ms/k with (1) one mod bus port and (1) one mod bus plus port, with a total of 256 I/O points of any mix and a MAXIMUM OF 4 LOCAL RACKS.
2. The System shall use Modicon Series A120 I/O Cards of the following type:
   BADU-206 - Analog input, 8 point, 4-20 MA
   BADU-202 - Analog output, 2 point, 4-20 MA
   BDEP-218 - Discrete input, 16 point, 115 Vac
   BDAP-208 - Discrete isolated relay output, 8 point, 115 Vac
3. The PLC permits bidirectional communication with other PLC's and a host computer utilizing the mod bus and mod bus plus ports.
4. Required Operational and Functional Capabilities:
   a. Processing capability for a minimum of one PID control loop with analog input signal conditioning, and remote setpoint and ratio control functions.
   b. Anti-reset windup.
   c. Ramp setpoint capability.
   d. Output limiting.
   e. Alarming (absolute process and deviation).
   f. Calculation Functions:

1) Addition.
2) Subtraction.
3) Multiplication.
4) Division.
5) Square Root.

g. Ratio Control
h. Lead/Lag.
i. Override control via remote inputs and/or internal program logic.
j. Totalization capability.
k. Digital logic operations.
l. On-Off digital output control
m. Configurable power fail-auto restart in previous mode at last output or in manual at a preset output.
n. Balanceless and pumpless control transfer between all operating modes.
o. Internal operating diagnostics to detect hardware malfunctions, memory error, loss of input and low memory battery backup voltage.

D. Type: Modicon PLC Model A984 system with Mod Bus Plus, to be used.

E. Required Design and Construction Features:

1. System to consist of integral processor with 8K logic memory and 1920 registers, having a scan time of 3 ms/k with (1) Mod Bus Port and (1) Mod Bus Plus Port with a total of 512 I/O points of any discrete mix and 32 analog I/O points.
2. The system shall use Modicon Series 800 I/O cards of the following type:
   B875-111 - Analog input, 8 points, 4-20 m2
   B872-100 - Analog output, 4 points, 4-20 m2
   B805-016 - Discrete input, 16 points, 115 vac
   B804-016 - Discrete output, 16 points, 115 vac
   B810-008 - Discrete isolated outputs, 8 points, 115 vac
3. The PLC permits bidirectional communication with other PLC's and a host computer utilizing the mod bus and mod bus plus ports.

4. Required Operational and Functional Capabilities:
   a. Processing capability for a minimum of one PID control loop with analog input/signal conditioning, and remote setpoint and ratio control functions.
   b. Anti-reset windup.
   c. Ramp setpoint capability.
   d. Output limiting.
   e. Alarming (absolute process and deviation).
   f. Calculation Functions:
      1) Addition.
      2) Subtraction.
      3) Multiplication.
      4) Division.
      5) Square Root.
   g. Ratio Control
   h. Lead/Lag.
   i. Override control via remote inputs and/or internal program logic.
   j. Totalization capability.
   k. Digital logic operations.
   l. On-Off digital output control
   m. Configurable power fail-auto restart in previous mode at last output or in manual at a preset output.
   n. Balanceless and pumpless control transfer between all operating modes.
   o. Internal operating diagnostics to detect hardware malfunctions, memory error, loss of input and low memory battery backup voltage.

PART 3 - INSTALLATION

3.1 INSTALLATION

A. CONTRACTOR shall require the system supplier to furnish the services of qualified factory-trained servicemen to assist in the installation of the instrumentation and control system equipment.

B. Install each item in accordance with manufacturer's recommendations and in accordance with the Contract Documents. Transmitters and instruments which require access for periodic calibration or maintenance shall be mounted so they are accessible while standing on the floor.

C. All items shall be mounted and anchored using stainless steel hardware unless otherwise noted.

D. All field instruments shall be rigidly secured to walls, stands or brackets as required by the manufacturer and as shown on the Contract Drawings.

E. Conform to all applicable provisions of the NEMA standards, NEC and local, State and Federal codes when installing the equipment and interconnecting wiring.

3.2 START-UP, CALIBRATION, AND TESTING

A. Comply with the requirements specified in Articles 1.8, 1.9 and 1.10 of this Section.

B. Prior to start-up CONTRACTOR shall furnish the following information as proof of readiness to begin.
   1. Calibration sheets for each installed instrument at 10, 25, 50, 75 and 100 percent of span.
   2. Approved checkout procedure.

C. Test equipment for check-out shall be of suitable quality so as not to mask performance deficiencies. All test equipment shall be traceable to National Institute for Standards and Technology. All equipment to be used for tests shall be subject to ENGINEER'S approval. Test equipment list and performance Specifications shall be submitted for the ENGINEER'S approval at least three months in advance of tests. The use of batteries for signal sources shall not be permitted. Testing shall be accomplished using simulated inputs. The overall accuracy of each loop shall be checked to insure that it is within acceptable

tolerance of +0.5%. The tolerance shall be the root mean square sum of the accuracy of each component in the loop from input to output.

END OF SECTION

SECTION 13J2

STEEL TANKS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified or required to design, fabricate, deliver, erect, test the tanks as shown and specified.

B. Related Sections:

1. Division 15, Piping.
2. Section 9L, Painting.

1.2 QUALITY ASSURANCE

A. Reference Standards:

1. Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified:
   a. AWWA D100, Standard for Welded Steel Tanks.
   b. SSPC-SP6, Steel Structures Painting Counsel Standard for Commercial Blast Cleaning.
   c. SSPC-SP10, Steel Structures Painting Counsel Standard for Near-White Blast Cleaning.

1.3 SUBMITTALS

A. Shop Drawings:

1. Submit for approval the following:
   a. Copies of detailed tank drawings. Drawings shall include all dimensions, sizes, plate thicknesses, anchorage, and piping details and details of all required accessories. Use

welding symbols recommended by American Welding Society.

PART 2 - PRODUCTS

2.1 TANK

A. pH Adjustment Tank:

1. Diameter: 11'-9"
2. Sidewall Height: 8'-1"
3. Nominal Capacity: 6,000 gallons
4. Tank Geometry: Flat bottom, closed top, vertical
5. Nozzles (150 lb flanges):
   a. Inlet: 6" on tank sidewall
   b. Caustic: 1/2" on top
   c. pH Probe: 2, 2" on top
   d. Exhaust: 6" on top
   e. Mixer: 6" on top
   f. Outlet: 6" on tank sidewall
6. Manway: 24" diameter on top
7. Vent: 4" diameter
8. Solution pH: 8-10
9. Temperature: Ambient
10. Solution SG: 1.0

B. Air Oxidation Tank:

1. Diameter: 11'-9"
2. Sidewall Height: 8'-1"
3. Nominal Capacity: 6,000 gallons
4. Tank Geometry: Flat bottom, closed top, vertical
5. Nozzles (150 lb flanges):
   a. Inlet: 3" on top with extended discharge to 12" above tank bottom
   b. Peroxide Feed: 1/2" on top
   c. Caustic Feed: 1/2" on top
   d. pH Probe: 2, 2" on top

e. Exhaust: 6" on top
f. Mixer: 6" on top
g. Air Sparger: 4" on top
h. Outlet: 6" on tank sidewall

6. Manway: 24" diameter on top
7. Vent: 4" diameter
8. Solution pH: 8-10
9. Temperature: Ambient
10. Solution SG: 1.0

C. Lift Station No. 1:

1. Diameter: 8'-0"
2. Sidewall Height: 9'-0"
3. Nominal Capacity: 3,000 gallons
4. Tank Geometry: Flat bottom, closed top, vertical
5. Nozzles:
   a. Inlet: 8" on top
   b. Exhaust: 6" on top
   c. Level Control: 6" on top
   d. Organic Return: 1" on top
   e. Pump Suction: 4" on sidewall
6. Manway: 24" diameter on top
7. Vent: 4" diameter
8. Solution pH: 8-10
9. Temperature: Ambient
10. Solution SG: 1.0

D. Lift Station No. 2:

1. Diameter: 8'-0"
2. Sidewall Height: 9'-0"
3. Nominal Capacity: 3,000 gallons
4. Tank Geometry: Flat bottom, closed top, vertical
5. Nozzles:
   a. Inlet: 6" on top
   b. Exhaust: 6" on top
   c. Level Control: 6" on top

d. Pump Suction: 4" on tank sidewall

6. Manway: 24" diameter on top
7. Vent: 4" diameter
8. Solution pH: 8-10
9. Temperature: Ambient
10. Solution SG: 1.0

E. Final pH Adjustment Tank:

1. Diameter: 8'-0"
2. Sidewall Height: 9'-0"
3. Nominal Capacity: 3,000 gallons
4. Tank Geometry: Flat bottom, open top, vertical
5. Nozzles:
   a. Outlet: 6" on tank sidewall
6. Solution pH: 8-10
7. Temperature: Ambient
8. Solution SG: 1.0

F. Sludge Holding Tank:

1. Diameter: 11'-9"
2. Sidewall Height: 12'-1"
3. Nominal Capacity: 6,000 gallons
4. Tank Geometry: Cone bottom, closed top, vertical
5. Nozzles:
   a. Inlet: 1-1/2" on tank top
   b. Exhaust: 6" on tank top
   c. Recycle: 1-1/2" on tank top
   d. Overflow: 1-1/2" on tank top
   e. Drain: 1-1/2" on cone
   f. Sludge Taps: (4) 1/2" on cone
6. Manway: 24" diameter on top
7. Vent: 4" diameter
8. Solution pH: 8-10
9. Temperature: Ambient
10. Solution SG: 1.0
11. Cone Angle (minimum): 45°

G. Minimum Steel Thickness:

1. The minimum thickness of any part of tank structure, shall be the larger of the following:

   a. Steel sheet ASTM A 570, Grade 33 with a minimum yield strength of 33,000 psi. Minimum thickness shall be 12 gauge.

   b. Steel plate shall conform ASTM A 36. Minimum yield strength shall be 36,000 psi.

   c. Rolled structure shapes - ASTM A 36.

   d. 1/8-inch greater than the minimum values specified in Section 3.10 of AWWA D100. Calculate minimum thickness values based on a wastewater Specific Gravity (SG) = 1.00.

2.2 ACCESSORIES

A. Provide the following accessories for each tank.

1. Ladder:

   a. Provide one steel ladder for each tank as shown and specified.

B. Mixer Bridge Support:

1. Provide a bridge support designed to carry the load, bonding moment and torque of the mixing equipment.

2.3 PAINT

A. General:

1. Both the interior and exterior of the tank shall be painted with an protective coating system, as per specification 9L. All paint and paint products used for each system shall be the product of a single paint manufacturer.

END OF SECTION

SECTION 13J3

BOLTED EQUALIZATION TANKS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all required labor, materials, equipment and incidentals as shown, specified or required to design, fabricate, deliver, erect, and install a 50,000 gallon equalization tank and a 12,000 gallon equalization tank.

B. Related Sections:

1. Division 15, Piping.
2. Section 2C, Demolition and Removal.
3. Section 9L, Painting.
4. Section 11C4, Mechanical Mixing Equipment.

1.2 QUALITY ASSURANCE

A. Reference Standards:

1. Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified:
   a. API 12B, Bolted Steel Tanks.
   b. SSPC-SP6, Steel Structures Painting Counsel Standard for Commercial Blast Cleaning.
   c. SSPC-SP10, Steel Structures Painting Counsel Standard for Near-White Blast Cleaning.

1.3 SUBMITTALS

A. Shop Drawings:

1. Submit for approval the following:

a. Copies of detailed tank drawings. Drawings shall include all dimensions, sizes, plate thicknesses, anchorage, support, piping details and details of all required accessories.

PART 2 - PRODUCTS

2.1 TANKS

A. General: The bolted equalization tank #1 (50,000 gallon capacity) shall be designed to meet the following general requirements.

1. Diameter: 21'-2"
2. Nominal Capacity: 50,000 gallons.
3. Height: 20'-4"
4. Type: Vertical.
5. Tank Cover: Dome shaped.
6. Tank Bottom: Flat.
7. Liquid S.G. ≅ 1.00.
8. Liquid to be Stored: Groundwater
9. Tank Material: Carbon Steel
10. Liquid Level: Will vary during operation.

The bolted equalization tank #2 (12,000 gallon capacity) shall be designed to meet the following requirements:

1. Diameter: 12'-0"
2. Nominal Capacity: 12,000 gallons
3. Height: 15'-3"
4. Type: Vertical
5. Tank Cover: Dome shaped
6. Tank Bottom: Flat
7. Liquid S.G.: ≅ 1.0
8. Liquid to be Stored: Groundwater (with toluene concentrations as high as 150 mg/L)
9. Tank Material: Carbon Steel
10. Liquid Level: Will vary during operation.

The equalization tanks shall be designed to be watertight and have zero (0) leakage of material. The tanks shall also be designed to support and carry the impact and vibration loads developed by the tank mixing equipment under all scenarios.

B. Materials:

1. Sheet. Steel sheets shall conform to, or be at least equal to, hot-rolled quality per ASTM A570 Grade 33 with a minimum yield strength of 33,000 psi. Minimum thickness shall be 12 gauge (0.0972" minimum).
2. Plate. Steel plates shall conform to, or at least be equal to, the requirements of ASTM A36 with a minimum yield strength of 36,000 psi.
3. Rolled Structural Shapes. Rolled structural shapes shall conform to ASTM A36.
4. The minimum thickness of any part of tank structure shall be 1/8-inch greater than the minimum values specified by API 12B.

C. Tank Bolts:

1. All bolts used in tank joints shall be 1/2 inch diameter and shall be encapsulated with Blue Kynar (polyvinylvidene fluoride PVDF). A sealing ring shall be molded under the head of each bolt. The bolts shall be mechanically zinc-coated and the coating shall conform to the requirements of Class 55 of ASTM B 454 or to the coating thickness, adherence, and quality requirements of Class C of ASTM A 153. Mechanically zinc-coated nuts for assembly with mechanically zinc-coated bolts shall be tapped oversize prior to coating and shall not be retapped afterwards.
2. All other bolts shall conform to ASTM A307.

D. Gaskets: All bolted connections shall incorporate a 1-3/4" minimum width gasket. All gaskets shall be continuous and shall be constructed of nitrile. Neoprene-backed, galvanized steel washers shall be provided for all bolts in contact with stored liquid.

E. Product and Manufacturer:

2.2 ACCESSORIES

A. Provide the following tank accessories:

Equalization Tank #1

Connection	Size	No.	Rating/Notes
Vent	6 in.	1	Goose-Neck
Manway	36 in.	1	Flanged (on side)
Influent	6 in.	1	150# F/F
Mixer	6 in.	2	150# F/F (with a lip seal) on tank sides
Effluent	6 in.	2	150# F/F
Baffles	24 in. (entire liquid depth)	4	@90° Apart
Exhaust Line	-	1	150# F/F (on top cover)

Equalization Tank #2 (12,000 gallons):

Connection	Size	No.	Rating/Notes
Vent	4 in.	1	Goose-Neck
Manway	24 in.	1	Flanged (on side)
Influent	2 in.	1	150# F/F
Mixer	4 in.	1	150# F/F (with a lip seal) on tank sides
Effluent	2 in.	2	150# F/F
Baffles	12 in.	4	@90° Apart
Exhaust Line	-	1	150# F/F (on top cover)

B. Piping Connections:

1. Provide influent, effluent piping connections and accessories as shown on the contract drawings. Pipe connections shall conform to requirements of Section 15A, Piping. The influent pipe shall be provided with a downcomer pipeline of 10" diameter (for equalization tank #1) and 6" diameter (for equalization tank #2).

2.3 PROTECTIVE COATING SYSTEM

A. General:

1. Both the interior and exterior of the tank shall be supplied with a protective coating system. All interior steel surfaces shall be protected by a two-coat thermally-cured epoxy coating system. The coating system shall be suitable for continuous contact with groundwater. Minimum dry film thickness shall be 5.0 mils/coat. All exterior steel surfaces shall be protected by two coats of a thermally cured amine epoxy primer and acrylic enamel. Dry film thickness shall be a minimum of 3.0 mils/coat.

B. Product and Manufacturer:

PART 3 - EXECUTION

3.1 INSTALLATION

A. Except as otherwise shown or specified, tank shall be erected in accordance with the requirements of API-12B.

3.2 CLEANING

A. Exposed surfaces shall be protected from blemishes and stains during tank construction. If discoloration of exposed concrete results from painting, rusting or any other aspects of tank construction, it shall be removed to the satisfaction of ENGINEER.

3.3 TESTING

A. Following erection and cleaning, the equalization tanks, shall be filled to capacity and tested for a 24-hr period to ensure liquid tightness and zero leakage of material.

B. Any leaks noted during the testing period shall be corrected in accordance with the manufacturer's recommendations at no additional cost to the OWNER.

END OF SECTION

SECTION 13200

SHOP FABRICATED TANKS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Vapor Vacuum and Water Extraction Tanks.

1.2 RELATED SECTIONS

A. Section 11340 - Soil Vapor Extraction Equipment

1.3 REFERENCES

A. ASME Boiler and Pressure Vessel Code, Section VIII, Division 1, "Pressure Vessels".

1.4 SUBMITTALS

A. Submit under provisions of Section 01300.

B. Product Data: Provide manufacturer data including but not limited to Operation and Maintenance instructions, coating and compatibility data.

C. Manufacturer's Installation Instructions: Indicate special procedures for assembly and testing of tanks and components.

D. Form U-1A "Manufacturer's Data Report for Pressure Vessels" certifying conformance to ASME Boiler and Pressure Vessel Code.

1.5 DESIGN REQUIREMENTS

A. Tanks shall be shop fabricated and furnished with all fittings and features as specified.

B. All tanks shall have suitable lifting lugs for handling and placement in intended installed orientation.

C. All Tanks shall have prefabricated structural steel legs with pre-drilled mounting plates for vertical installation.

D. PERFORMANCE:

Capacity: Vapor Vacuum and Water Extraction Tank - 120 gallons (nominal).

Type: Vapor Vacuum and Water Extraction Tank - Vertical, Cylindrical, ASTM, ASME Code, exterior Dished Heads (Top and Bottom) with removable, flanged, top head. Designed for vacuum service (Vapor Vacuum Tank = 0-15 inches Hg, Water Extraction Tank = 0-Full Vacuum) in conformance with the design methods, manufacturing procedures and testing requirements of ASME Boiler and Pressure Vessel Code.

Material: Carbon Steel.

E. Fitting Schedules:

1. VAPOR VACUUM TANK

QUANTITY	NOM. DIAMETER (inches)	TYPE	LOCATION
1	6	Flanged Fitting	Lower tank shell, Tangential (C.C. direction)
1	6	Flanged Fitting with 18" internal drop tube	Top Head, axially centered.
2	1	Screwed Fitting	Top Head, Vertical.
1	1	Screwed Fitting	Bottom Head, axially centered.

2. WATER EXTRACTION TANK

QUANTITY	NOM. DIAMETER (inches)	TYPE	LOCATION
1	2	Flanged Fitting	Upper tank shell
4	1	Screwed Fitting	Top Head, Vertical
1	2	Flanged Fitting	Bottom Head, axially centered..
1	1	Screwed Fitting	Lower Shell

PART 2 - PRODUCTS

2.1 MANUFACTURER/DISTRIBUTOR

A. Stoystown Tank & Steel Co., Inc./The John Wood Co. - MODEL NO. (Custom)

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install and Test in accordance with the manufacturer's instructions as well as ASME requirements.

END OF SECTION

SECTION 13121

PRE-ENGINEERED BUILDINGS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Pre-engineered, shop fabricated equipment trailer.

B. Exterior doors windows, wood stairs, louvers, interior lighting, heating, air supply, exhaust ventilation, and barrier wall.

1.2 RELATED SECTIONS

A. Section 03305 - Cast-in-Place Piles: Concrete Trailer Anchors.

B. Section 03405 - Precast Concrete Piers: Concrete Footings.

C. Section 10522 - Fire Extinguishers, Cabinets, and Accessories.

D. Section 15060 - Piping and Appurtenances: Treatment System Piping.

E. Section 15410 - Plumbing Piping: Potable Water Piping.

F. Section 16111 - Conduit.

G. Section 16470 - Panelboards.

H. Section 16482 - Motor Control Center.

1.3 REFERENCES

A. AISC - Specification for Structural Steel for Buildings - Allowable Stress Design and Plastic Design.

B. AISC - Quality Certification Program, Category MB.

C. ALSC - American Lumber Standards Committee: Softwood Lumber Standards.

D. AMCA 500 (AIR Movement Control Association) - Test Method for Louvers, Dampers, and Shutters.

E. ANSI/AHA A135.4 - Basic Hardboard.

F. APA: American Plywood Association.

G. ASTM A36/A36M - Structural Steel.

H. ASTM A526 - Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Commercial Quality.

I. ASTM C665 - Mineral Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.

J. ASTM C991 - Flexible Glass Fiber Insulation for Pre-Engineered Metal Buildings.

K. ASTM C1107 - Packaged, Dry, Hydraulic-Cement Grout (Non-shrink).

L. ASTM E 84 - Test Method for Surface Burning Characteristics of Building Materials

M. AWPA (American Wood Preservers Association) C20 - Structural Lumber Fire Retardant Treatment by Pressure Process.

N. AWS A2.0 - Standard Welding Symbols.

O. AWS D1.1 - Structural Welding Code - Steel.

P. FS TT-S-001657 - Sealing Compound, Single Component, Butyl Rubber Based, Solvent Release Type.

Q. FS TT-S-00230 - Sealing Compounds, Synthetic-Rubber Base, Single Component, Chemically Curing.

R. MBMA (Metal Building Manufacturers Association) - Metal Building Systems Manual.

S. NFPA: National Forest Products Association.

T. NFPA 80 - Fire Doors and Windows.

U. NFPA 101 - Code for Safety to Life from Fire in Buildings and Structures.

V. NFPA 252 - Fire Tests of Door Assemblies.

W. PS 1 - Construction and Industrial Plywood.

X. PS 20 - American Softwood Lumber Standard.

Y. RIS: Redwood Inspection Service.

Z. Sealant and Waterproofer's Institute - Sealant and Caulking Guide Specification.

AA. SPIB: Southern Pine Inspection Bureau.

AB. SSPC (Steel Structures Painting Council) - Steel Structures Painting Manual.

AC. SSPC - Paint 20 Zinc Rich Coating.

AD. UL 10B - Fire Tests of Door Assemblies.

AE. UL 305 - Panic Hardware.

AF. WCLIB: West Coast Lumber Inspection Bureau.

AG. WWPA: Western Wood Products Association.

1.4 SYSTEM DESCRIPTION

A. Shelter to house water and vapor extraction equipment, as indicated on the Drawings.

B. Louver: To permit passage of air at a velocity of [___] ft / min ([_____] L/sec) without blade vibration or noise, with maximum static pressure loss of [_____] inches ([_____] mm) measured at [___] ft / min ([_____] L/sec)

C. Louver: To permit [____] percent free area.

D. Barrier Wall: To provide continuous vapor and air barrier between hazardous and non-hazardous equipment areas as indicated on the Drawings.

1.5 SUBMITTALS FOR REVIEW

A. Product Data: Provide data on profiles and component dimensions. Provide data describing design characteristics for louvers, maximum recommended air velocity, design free area, materials and finishes. Provide data on fire retardant treatment materials and application instructions. Provide technical data on insulates sheathing, wood preservative materials, and application instructions.

B. Shop Drawings: Indicate assembly dimensions, materials, exact position of access doors, stairs, and barrier wall. Indicate louver layout plan and elevations, opening and clearance dimensions, tolerances; head, jamb and sill details; blade configuration, screens, blankout areas required, and frames.

C. Manufacturer's Certificate: Certify that Products meet or exceed specified requirements.

E. Manufacturer's Installation Instructions: Indicate special procedures, perimeter conditions requiring special attention, and rough in dimensions.

1.6 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Section 01700.

B. Maintenance Data: Include data on operating hardware, lubrication requirements, and inspection procedures related to preventative maintenance.

1.7 QUALITY ASSURANCE

A. Perform Work in accordance with MBMA - Metal Building Systems Manual.

B. Perform work in accordance with AMCA Certification for louvers.

D. Perform work in accordance with UL requirements.

E. Perform work in accordance with the following agencies:
   1. Lumber Grading Agency: Certified by ALSC.
   2. Plywood Grading Agency: Certified by APA.

E. In lieu of grade stamping exposed to view lumber and plywood, submit manufacturer's certificate under provisions of Section 01400 that products meet or exceed specified requirements.

F. Perform work in accordance with NHLA.

G. Perform work in accordance with the following requirements:
   1. NFPA 101.
   2. NFPA 80.
   3. NFPA 252.

H. Perform work in accordance with Sealant and Waterproofer's Institute - Sealant and Calking Guide Specification requirements for materials installation.

I. Maintain copy of each document on site.

J. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

K. Erector/Applicator Qualifications: Company specializing in performing the work of this section with minimum three years documented experience.

1.8 REGULATORY REQUIREMENTS

A. Conform to applicable code for closing operable louvers in conjunction with the fire and smoke alarm system.

B. Conform to applicable code for fire rated access units and fire retardant

requirements.

C. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories, Inc. as suitable for the purpose specified and indicated.

D. Cooperate with regulatory agency or authority and provide data as requested.

1.9 COORDINATION

A. Coordinate work under provisions of Section 01041.

B. Coordinate the work with installation of mechanical ductwork and electrical service to motorized devices.

C. Coordinate the work with plumbing, electrical, rough-in, and installation of associated and adjacent components.

1.10 WARRANTY

A. Provide a five-year warranty to include coverage for exterior pre-finished surfaces to cover pre-finished color coat against chipping, cracking or crazing, blistering, peeling, chalking, or fading. Include coverage for weather tightness of building enclosure elements after installation.

B. Provide three-year warranty under provisions of Section 01700 for barrier wall.

C. Warranty: Include coverage of installed sealant and sheet materials which fail to achieve air tight and watertight seal, exhibit loss of adhesion or cohesion, or do not cure.

1.11 DELIVERY, STORAGE, AND HANDLING

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

B. Protect work from moisture damage.

1.12 FIELD MEASUREMENTS

A. Verify that field measurements are as indicated on Drawings.

1.13 MAINTENANCE MATERIALS

A. Provide maintenance materials under provisions of 01700.

PART 2 - PRODUCTS

2.1 MANUFACTURERS - EQUIPMENT SHELTER (TRAILER)

A. Manufacturers:
1. [_____] Model [_____].
2. [_____] Model [_____].
3. [_____] Model [_____].
4. [_____] Model [_____].

2.2 CONSTRUCTION

A. Portable or mobile buildings, or buildings constructed with floors raised above ground, securely fixed to foundations, with steps and landings at entrance doors.

B. Construction: Structurally sound, secure, weather tight enclosures for office and storage spaces. Maintain during progress of work.

C. Temperature Transmission Resistance of Floors, Walls, and Ceilings: Compatible with occupancy and storage requirements.

D. Exterior Materials: Weather resistant, finished in one color acceptable to Engineer.

E. Lighting: 50 ft-C (538 1x) at desk top height, exterior lighting at entrance doors.

F. Fire Extinguishers: Appropriate type fire extinguisher at each storage area, as specified in Section 10522.

G. Interior Materials: As required to provide specified conditions for storage of products.

2.3 ENVIRONMENTAL CONTROL

A. Storage Spaces: Heating and ventilation as needed to maintain Products in accordance with Contract Documents; adequate lighting for maintenance and inspection of Products.

2.4 MATERIALS - LOUVERS

A. Steel Sheet: ASTM A526, galvanized to zinc coating, prefinished with shop applied finish.

B. Bird Screen: Interwoven wire mesh of steel 0.063-inch (1.6 mm) diameter wire, 1/2-inch (13 mm) open weave, diagonal design.

C. Insect Screen: 18 x 16 size steel mesh, set in steel frame.

D. Fasteners and Anchors: Galvanized steel type.

E. Primer: Zinc chromate, alkyd type.

F. Flashings: Of same material as louver frame.

G. Sealants: [_____] type, [_____] manufactured by [_____].

2.5 FABRICATION

A. Louver Panel Thickness: 4 inches (100 mm) deep, face measurements as indicated.

B. Louver Blade Design: Sloped at 45 degrees; inverted Y shape; material thickness of [_____] gage ([_____] mm) minimum integral and lateral rainwater stops positioned on blade.

C. Louver Frame: Channel shape, mechanically fastened corner joints, material thickness of [[_____] gage] ([_____] mm) minimum.

D. Intermediate Mullions: Exposed of formed steel, profiled to suit louver frame.

E. Head and Sill Flashings: Roll formed to required shape, single length in one piece per location.

F. Screens: Install screen mesh in shaped frame, reinforce corner construction shop install to louver with fasteners.

G. Blank-Out Sheet on Interior of Louver: Same material as louver and frame.

2.6 FINISHES - LOUVERS

A. Exterior Steel Surfaces, Screens and Blank-Out Sheeting: Shop coat of primer for field painting.

B. Interior Steel Surfaces, Screens and Blank-Out Sheeting: Unfinished.

C. Stainless Steel: No. 4 finish.

2.7 MATERIALS - ACCESS DOORS

A. Fire Rated Door and Frame Unit: Formed steel, finish; [[_____] hour] [[_____] label] fire rating:

1. In Gypsum Board on Steel Studs: Model [_____] manufactured by [_____].
2. In Plaster on Metal Furring: Model [_____] manufactured by [_____].

2.8 FABRICATION - ACCESS DOORS

A. Fabricate frames and flanges of 16 gage (1.5 mm) steel.

B. Fabricate door panels of 14 gage (1.8 mm) steel single thickness steel sheet.

C. Weld, fill, and grind joints to assure flush and square unit.

D. Hardware:
   1. Hinge: 175 degree steel hinges with removable pin.
   2. Lock: Cylinder lock with latch, two keys for each unit.

2.9 FINISHES - ACCESS DOORS

A. Base Metal Protection: Galvanized, wiped coat finish.

B. Finish: One coat baked enamel, color as selected.

2.10 KEYING

A. Door Locks: Key to existing keying system.

2.11 LUMBER MATERIALS

A. Lumber Grading Rules: NFPA

B. Non-structural Light Framing: [_____] species, [_____] grade, [_____] size classification, 19 percent maximum moisture content.

C. Softwood Lumber: Graded in accordance with AWI Economy; [_____] species, [_____] sawn, maximum moisture content of 6 percent; with mixed grain.

D. Hardwood Lumber: Graded in accordance with AWI Economy; [_____] species, [_____] sawn, maximum moisture content of 11 percent; with mixed grain.

E. Gypsum Wall Sheathing: Moisture resistant, Fire resistant, 5/8 inch (15 mm) thick, 24 x 96 inch (600 x 2 400 mm) sized sheets, tongue and groove edges, water repellant paper faces.

F. Fasteners: Of size and type to suit application.

2.12 WOOD TREATMENT PROCESS

A. Fire retardant (FR-S Type): Chemically treated and pressure impregnated; capable of providing a maximum flame spread/smoke development rating of [_____] / [_____] in accordance with ASTM E84; [_____] manufactured by [_____].

B. Wood Preservative by Pressure Treatment (PT Type): AWPA Treatment C2 using preservative with 0.25 percent retainage.

C. Wood Repellant Preservative Treatment by Dipping Method: NWWDA I.S.4, with 0.25 percent retainage.

D. Wood Preservative (Surface Application): Clear [_____] type, [_____] manufactured by [_____].

2.13 SHOP TREATMENT OF WOOD MATERIALS

A. Shop pressure treat treatment to wood materials requiring UL fire rating.

B. Provide UL approved identification on fire retardant treated material.

C. Deliver fire retardant treated materials cut to required sizes. Minimize field cutting.

D. Redry wood after pressure treatment to maximum percent moisture content.

2.14 MATERIALS - BARRIER WALL

A. Sheet Barrier: Black polyethylene film for above grade application, 20 mil (0.50 mm) thick; [_____] manufactured by [_____].

B. Adhesive: Compatible with sheet barrier and substrate, permanently non-curing; [_____] manufactured by [_____].

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify site conditions under provisions of Section 01041.

B. Verify that prepared openings are ready to receive work and opening dimensions are as instructed by the louver manufacturer.

C. Verify that piers and placed anchors are in correct position.

D. Verify that rough openings for door and frame are correctly sized and located.

E. Verify electrical and building items affecting work of this section are placed and ready to receive this work.

F. Verify that electric power is available to power operated devices and of the correct characteristics.

3.2 INSTALLATION - EQUIPMENT SHELTER (TRAILER)

A. Install 15 days after date fixed in Owner-Contractor Agreement.

B. Parking: Two hard surfaced parking spaces for use by the Owner, connected to trailer by walk.

3.3 INSTALLATION - LOUVERS

A. Install louver assembly in accordance with manufacturer's instructions.

B. Install louvers level and plumb.

C. Align louver assembly to ensure moisture shed from flashings and diversion of moisture to exterior.

D. Secure louvers in opening framing with exposed fasteners.

E. Install bird and insect screen and frame to exterior of louver.

F. Adjust and clean work under provisions of Section 01700.

G. Adjust operable louvers for freedom of movement of control mechanism. Lubricate operating joints.

3.4 INSTALLATION - ACCESS DOORS

A. Install units in accordance with manufacturer's instructions.

B. Install frames plumb and level in opening. Secure rigidly in place.

3.5 INSTALLATION - BARRIER WALL

A. Construct framing members full length without splices.

B. Install work in accordance with AWI Economy Quality Standard.

C. Set and secure materials and components in place, plumb and level.

D. Secure wall sheathing with long dimension perpendicular to wall studs, with ends over firm bearing.

E. Carefully scribe work abutting other components, with maximum gaps of 1/32 inch (1 mm). Do not use additional overlay trim to conceal larger gaps.

F. Install vapor/air barrier sheet materials in accordance with manufacturer's instructions.

G. Secure sheet barrier to wall vapor and air barrier with adhesive. Calk with sealant

to ensure complete seal.

3.6 TOLERANCES

A. Framing Members: 1/4 inch (6 mm) from true position, maximum.

B. Surface Flatness of Floor: 1/4 inch in 10 feet (2 mm/m) maximum, and 1/2 inch (12 mm) maximum in 30 feet.

C. Finish Carpentry: Maximum Variation from True Position: 1/16 inch (1.5 mm).

D. Maximum Offset from True Alignment with Abutting Materials: 1/32 inch (0.7 mm).

END OF SECTION

SECTION 15A1

EXPOSED PIPING INSTALLATION

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified and required to design, furnish, and install each specified piping system, and test all exposed piping, fittings, specials, and appurtenances once installed. The Work includes but is not limited to the following:
   a. All types and sizes of piping except those specified under other Sections of this Specification.
   b. Supports and restraints.
   c. Work on or affecting existing piping.
   d. Cleaning and testing.
   e. Also included are installation of all joints, specials, couplings, flexible couplings, mechanical couplings, harnessed and flanged adapters, sleeves, jointing and gasketing materials and all other Work required to complete installation of exposed piping.
   f. Provide all valves, specials, hangers and supports specified or required and incorporate them into the piping systems. Valves, specials, hangers and supports shall be as specified under the appropriate Sections of Division 15.
   g. Constructing connections to services required by the Fluid Bed Combustor System. These services include fuel oil, plant effluent water, building drains and process drains.

B. Coordination:

1. Review services required for the Fluid Bed Combustor System.Coordinate with Subcontractor who will be providing these services.

C. Related Sections:
1. Section 9L, Painting.
2. Section 15A1, Buried Pipe Installation.
3. Section 15A3, Ductile Iron Pipe.
4. Section 15A4, Steel Pipe.
5. Section 15A5, Stainless Steel Pipe.
6. Section 15A7, Copper Pipe.
7. Section 15A12, Fiberglass Reinforced Plastic Pipe.
8. Section 15C3, Pipe Hangers and Supports.
9. Section 15C4, Wall Pipes, Floor Pipes, and Pipe Sleeves.
10. Section 15C5, Piping Specialties.
11. Section 15D, Valves and Appurtenances.

1.2 QUALITY ASSURANCE

A. Requirements of Regulatory Agencies:
1. Comply with applicable requirements of UL and other authorities having jurisdiction.

B. Reference Standards: Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.
1. AWWA C206, Field Welding of Steel Water Pipe.
2. AWWA M11, Steel Pipe - Design and Installation.
3. AWS D1.1, Structural Welding Code.
4. ANSI B2.1, Pipe Threads.
5. ANSI B16.3, Malleable Iron, Threaded Fittings.
6. ANSI B16.5, Steel Pipe Flanges and Flanged Fittings.
7. ANSI B16.9, Factory-Made Wrought Steel, Butt Welding Fittings.
8. ANSI B16.11, Socket Welded and Threaded Forged Steel Fittings.
9. ANSI B16.21, Nonmetallic Gaskets for Pipe Flanges.
10. ANSI B16.25, Buttwelding Ends.
11. ANSI B16.34, Valves, Flanged, Threaded and Welding Engineer.

12. ANSI B16.39, Malleable Iron Threaded Pipe Unions.
13. ANSI B18.2, Square and Hex Bolts and Screws.
14. ANSI B31.1, Code for Pressure Piping.
15. ANSI B31.2, Fuel Gas Piping.
16. ASME B31.1, Power Piping Code.
17. NFPA 54, National Fuel Gas Code.

1.3 SUBMITTALS

A. Shop Drawings: Submit for approval the following:

1. All piping detailed drawings in plan and profile, and installation schedules. Show full details of piping, specials, and connections to equipment. Show standard piping designations.

B. Tests: Submit description of proposed testing methods, procedures and apparatus. Submit copies of all test reports.

C. Certificates: Submit certificates of compliance with referenced standards.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Handle all pipe, fittings and accessories carefully with approved handling devices. Do not drop or roll pipe off trucks. Do not otherwise drop, roll or skid pipe. Materials that are cracked, chipped, gouged, dented or otherwise damaged will not be approved.

B. Store pipes and fittings on heavy wood blocking or platforms so they are not in contact with the ground.

C. Maintain the interior areas of pipe, fittings and accessories completely free from dirt and foreign material.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Pipe materials required are listed in the Piping Schedule. Refer to applicable Sections for detailed material Specifications.

B. General:

1. Pipe Marking:
   a. Class designation shall be cast or painted on each piece of pipe and fitting 4 inches in size and larger.
   b. Each piece of pipe and fitting shall be clearly marked with a designation which shall conform with designations shown on the Shop Drawings.
   c. Piping, smaller than 4-inch diameter, shall be clearly marked by manufacturer as to material, type and rating.

C. Pipe Identification Markers and Arrows: Provided under Section 9L, Painting.

2.2 PIPING SCHEDULE

A. Attached at the end of this Section is the "Piping Schedule".Conform to the requirements of the Schedule, unless otherwise specified or approved by ENGINEER.

2.3 RESTRAINED JOINT SCHEDULE

A. Use restrained joints and thrust protection for all pressure piping including the following systems:

1. Plant effluent water piping.
2. Potable water piping.
3. Air piping.
4. Fuel oil piping.
5. Sludge cake piping.
6. All other pressure piping.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:

1. Install piping as specified and as recommended by the manufacturer.
2. Request instructions from ENGINEER before proceeding, if there is a conflict between the manufacturer's recommendations and the Specifications.
3. Pipe, fittings and accessories that are cracked, damaged or in poor condition or with damaged linings will be rejected.
4. Conflicts between piping systems and equipment or structures shall be presented to ENGINEER for determination of corrective measures required before proceeding.
5. CONTRACTOR shall be responsible for the accurate detailed layout of the Work so that it will function as intended.

B. Manufacturer's Installation Specialist:

1. CONTRACTOR shall provide the services of a competent manufacturer's installation specialist when pipe installation begins for the FRP Pipe.
2. Retain specialist on the job until competency of the pipe installation crew has been satisfactorily demonstrated.

C. Piping:

1. Install piping in straight runs true to line and elevation unless otherwise shown on the Drawings.
2. Install vertical pipe truly plumb in all directions.
3. Install piping parallel or perpendicular to building walls. Piping at angles and 45 degree runs across corners will not be accepted unless specifically approved or otherwise is shown on the Drawings.
4. Install small diameter piping as required to avoid ducts, equipment, beams, etc.
5. Install piping so as to leave all corridors, walkways, work areas, and like spaces unobstructed. Unless otherwise approved provide a

minimum headroom clearance under all piping of 7 feet and 6 inches.

6. Provide temporary caps or plugs over all pipe openings at the end of each day's work, and when otherwise required or directed by ENGINEER.
7. Cutting: Cut pipe from measurements taken at site, not from Drawings.
8. Do not bend pipe; use fittings only for change in alignment.
9. Piping sub-assemblies shall be fabricated to a tolerance which shall not exceed +1/8 inch on overall dimensions. All flanges in horizontal, vertical or angular planes must be parallel to their respective planes so that the angularity shall be within one-half the width of a bubble on a level.
10. Sub-assemblies and fabrication of piping shall take into account equipment tolerances, both as to fabrication and installation.
11. Provide vents and drains in all water piping. These shall be 3/4 inch for all piping 1 inch and larger, and line size for all piping 3/4 inch and smaller. Locate vents at all high points in each line or branch connection; locate drains at all low points. Piping materials shall conform to those specified for the pipeline to which they are installed.
12. Do not cut or otherwise impair the structural integrity of any structural member without ENGINEER'S prior approval.
13. Install dielectric unions wherever dissimilar metals are connected except for bronze or brass valves in ferrous piping.
14. Provide a union downstream of each valve with screwed connections.
15. Provide screwed or flanged unions at each piece of equipment, where shown, and where necessary to install or dismantle piping.
16. Additional Requirements for FRP Piping:
    a. Support all valves independently of the piping system.
    b. Utilize wide band supports as recommended by manufacturer and approved by ENGINEER to minimize localized stresses.
    c. Provide piping passing through walls with a sleeve of wearing material to prevent abrasion damage to piping.

d. When anchors are required at locations other than equipment or tanks they shall be placed at elbows, valve locations and at bends in pipe line.

e. Spacing of supports shall be in accordance with the manufacturer's published values at the maximum design operating temperature of the pipe.

f. Use "U" clamps with wide band circumferential contact. Avoid all pressure contact with piping.

g. Use guides on long runs of piping to maintain alignment and reduce chance of elastic failure of pipe. Space guides as recommended by manufacturer.

C. Joints:

1. General:

a. Make joints in accordance with the pipe manufacturer's recommendations and the requirements specified below.

b. Cut piping accurately and squarely and install without forcing or springing.

c. Ream out all pipes and tubing to full inside diameter after cutting. Remove all sharp edges on end cuts.

d. Remove all cuttings and foreign matter from the inside of pipes and tubing before installation. Thoroughly clean all pipe, fittings, valves, specials, and accessories before installing.

2. Flanged Joints:

a. Assemble flanged joints using flat ring-type gaskets for raised face flanges and full face gaskets for flat face flanges. Gaskets shall be suitable for the service intended in accordance with the manufacturer's ratings and instructions. Gaskets shall be properly centered.

b. Bolts shall be tightened in a sequence which will insure equal distribution of bolt loads.

c. The length of bolts shall be uniform, and they shall not project beyond the nut more than 1/4 inch or fall short of the nut when fully taken up. The ends of bolts shall be

machine cut so as to be neatly rounded. No washers shall be used.

d. Bolt threads and gasket faces for flanged joints shall be lubricated.

3. Welded Joints:

a. Joints shall be butt welded unless otherwise specified.

b. Welding of steel pipe and fittings shall conform with all applicable requirements of Code for Pressure Piping, ANSI B31.1.

c. All welders shall qualify in accordance with Chapter V requirements of ANSI B31.1, and shall have a current certificate available for ENGINEER'S inspection.

d. A file of the welding operators' qualification records shall be maintained showing the dates and results of the tests and the identification mark assigned to each welder. These records shall be certified by the CONTRACTOR and shall be available to the OWNER and Governing Code Inspector.

e. All field welding will be subject to inspection by the ENGINEER. Each joint shall be subject to visual inspection as follows:

1) Before welding - alignment to fit-up bevel, root spacing, backing rings and tack welding.

2) During welding - porosity, cracks, undercutting, bead contour, and interbead cleaning.

3) After welding - reinforcement, undercutting, surface irregularities, and bead contour.

f. Welding machines shall be of a type which allow the control of voltage and amperage and with adequate capacity for any welding technique which may be used. The welding machines shall be located as near as possible to the weld.

g. The CONTRACTOR shall have at the beginning of each shift sufficient materials, such as welding electrodes, backing rings, and chipping tools, to carry through the operations without interruption.

h. All butt joints shall be lined up and welded to assure 100 percent weld penetration of the wall thickness of the piping being jointed.

i. All welding shall be accomplished by the shielded metal arc process using coated electrodes in accordance with filler metal requirements and/or the tungsten inert gas process (TIG).

j. Prior to welding, the welding groove and adjacent surfaces shall be thoroughly cleaned of all scale, rust, grease, oil and other foreign matter. All joints shall be positioned and properly clamped before welding to assure alignment of the faces involved in the joint.

k. Each bead of welding shall be thoroughly cleaned by a power driven wire brush to remove all slag, scale and flux. Any cracks, blowholes, cavities, undercutting or improperly fused weld metal shall be removed by chipping, grinding or arc gouging and each deposit shall be properly prepared for the deposition of the next bead.

l. Welding of stainless steel shall be accomplished by tungsten inert gas (TIG) or metal inert gas (MIG). Helium or argon gas shall be used.

m. Welding shall be conducted in still atmosphere, free from drafts. Gas cap shall be of proper size and flow of gas ample to cover work during movement of electrode. After arc is broken, gas shield shall be maintained until work has dropped below its heat tinting temperature.

n. Welds on stainless steel shall be thoroughly cleaned of all weld spatter and discoloration after welding, by use of stainless steel wire brush or stainless steel wool. Grinding, before or after welding shall be done with a clean stone free of any other metal. Interior of pipe shall be ground and polished to its original finish insofar as possible.

o. Lugs shall be welded to the pipe where required for harnessing of flexible couplings or flanged coupling adaptors.

4. Flexible Coupling Joints:

a. Installation and assembly of couplings shall conform to the coupling manufacturer's recommendations.

b. Prior to assembly, the last 8 inches of the outside of each pipe end shall be cleaned thoroughly with a wire brush to remove foreign matter.

c. Following cleaning, lubricant shall be applied to each joint end.

d. Immediately after application of the lubricant, the coupling shall be slipped over each pipe end.

e. All bolts shall be inserted and all nuts made up tightly with a wrench in accordance with the coupling manufacturer's recommendations.

f. Nuts spaced 180 degrees apart shall be tightened alternately in order to produce an equal pressure on all parts of the coupling.

5. FRP Pipe Joints:

a. Follow manufacturer's instruction.

6. Copper Tubing Joints:

a. Assemble copper tubing with soldered joints. Solder shall be 95-5 tin-antimony.

b. Ream or file pipe to remove burrs.

c. Clean and polish contact surfaces of joints.

d. Apply flux to both male and female ends.

e. Insert end of tube into full depth of fitting socket.

f. Heat joint evenly.

g. Form continuous solder bead around entire circumference of joint.

h. Runs shall contain unions at connections to equipment and at reasonable distances along the lengths of runs to permit convenient disassembly of piping and removal of equipment.

E. Unions:

1. Install all pipelines with frequently placed unions or flanges to permit easy disassembly where applicable.

2. Install dielectric unions wherever dissimilar metals are connected except for bronze or brass valves in ferrous piping. When the joint

is made the gasket shall not project into the internal opening. The pipeline shall be connected so that electric current is below 1 percent of the galvanic current.

3. Provide a union downstream of each valve with screwed connections.
4. Provide screwed or flanged unions at each piece of equipment where shown, and where necessary to install or dismantle piping.

F. Eccentric Reducers: Use eccentric reducers where air or water pockets would otherwise occur in mains because of a reduction in pipe size.

G. Valves and Accessories:
1. Provide supports for large valves, meters and other heavy items.
2. Install floor stands as recommended by the manufacturer of the equipment.
3. Position valve operators so that they can be conveniently operated and as approved by ENGINEER. Avoid placing operators at angles to floors or walls.
4. Position flow measuring devices in pipe lines so that they have the amount of straight upstream and down stream runs recommended by the manufacturer.

H. Transitions from One Type of Pipe to Another:
1. Provide all necessary adapters, specials and connection pieces required when connecting different types and sizes of pipe or connecting pipe made by different manufacturers.
2. Whenever changes in pipe size occur, changes shall be made with reducing fittings. The use of bushings is not acceptable unless specifically approved by ENGINEER.

I. Additional Requirements for Copper Tubing:
1. Joints shall be made with clean bright ends, properly fluxed, using 95 percent tin, 5 percent antimony solder conforming to ASTM B 32.

2. Runs shall contain unions at connections to equipment and at reasonable distances along the lengths of runs to permit convenient disassembly of piping and removal of equipment.
3. All horizontal lines shall be properly pitched to facilitate draining and all low points shall be provided with 3/4 inch hose bibbs properly located so that the entire system may be drained.

J. Restrained Joint Requirements:
1. Install restrained joints as specified or required and as recommended by manufacturer. Assembly shall be in accordance with manufacturers recommendations.
2. Provide restraints, supports and collars of sufficient size to prevent expansion and contraction forces from reaching valves, pumps or equipment.
3. All joints shall be restrained to provide for thrust protection along the entire length of each pipe, fitting or special including connections to valves and equipment.

K. Taking Existing Pipelines Out of Service:
1. Do not take pipelines out of service unless specifically approved by OWNER.
2. Notify OWNER at least 48 hours prior to the need for taking pipeline out of service.

L. Work on Existing Pipelines:
1. Cut pipes as shown or required with machines specifically designed for this work.
2. Install temporary plugs to keep out all dirt, water and debris.
3. Provide all necessary adapters, fittings, pipe and appurtenances required.

3.2 TESTING OF PRESSURE PIPING

A. General:
1. All testing of pressure piping is to be performed prior to installation of any external insulation.

2. Test all piping as specified below unless otherwise authorized by ENGINEER.
3. Notify ENGINEER 72 hours in advance of testing.
4. Provide all testing apparatus including pumps, piping, valves, hoses, gages, and fittings.
5. Pipelines shall hold the specified test pressure for a period of two hours unless otherwise specified.
6. Pipelines which fail to hold specified test pressure or which exceed the allowable leakage rate shall be repaired and retested until full compliance with specification requirements can be demonstrated.
7. Test pressures required are at the lowest elevation of the pipeline section being tested, unless otherwise specified.
8. Unless otherwise approved, conduct all tests in the presence of ENGINEER. Repeat tests in the presence of local authorities having jurisdiction if required by them.

B. Schedule of Pipeline Tests:
1. For pressure test values see "Piping Schedule" at the end of this Section.
2. Piping not in Schedule shall be tested at 1.5 times the maximum working pressure or 15 psi, whichever is greater.

C. Pressure Test Procedure:
1. Insure that all supports and restraint protection are securely in place.
2. For process water piping, fill the section to be tested slowly with water and expel all air. Install cocks, if necessary, to ensure removal of air.
3. Test only one section of pipe at a time.
4. Apply test pressure required for the required period and observe pressure gage. Check carefully for leaks while test pressure is being maintained.
5. Fuel oil, plant air, combustion air, and instrument air systems shall be tested with air for no less than one hour without loss of pressure.

6. Natural gas piping systems shall be tested with air for 4 hours with no pressure loss.
7. OWNER will supply water required for testing and cleaning operations.

D. Leakage Test Procedure:
1. Conduct leakage test for all process water piping after satisfactory completion of pressure test.
2. Maintain test pressure constantly for a 2 hour period. No leakage will be permitted.
3. All visible leaks shall be made tight. If the pipes tested do not meet the leakage requirements of the leakage tests, they shall be repaired and retested as necessary until the leakage requirement is met.
4. All Work found defective shall be repaired or replaced.
5. Leakage Test Procedure:
   a. Examine exposed pipe, joints, fittings and valves. Repair visible leakage or replace the defective pipe, fitting or valve.
   b. Refill the line under test to reach the required test pressure.
   c. Provide a test container filled with a known quantity of water at the start of the test. Attach the test pump suction to the test container.
   d. Pump water from the test container into the line with the test pump to hold the specified test pressure for the test period. Water remaining in the container shall be measured and the amount used during the test shall be recorded on the test report.
   e. Perform all repair, replacement, and retesting required because of failure to meet testing requirements.
   f. Leakage shall be less than rate specified above.

3.3 CLEANING

A. All piping shall be thoroughly cleaned prior to placing in service in a manner approved by ENGINEER.

1. In addition to cleaning, all water, ash slurry, and caustic soda piping shall be flushed.
2. Remove dirt, dust, rust, etc. from piping in preparation for surface painting and insulating as described in Section 9L.
3. Clean lenses on all thermometers, gages and similar equipment, where required.

3.4 DISPOSAL OF WATER

A. CONTRACTOR shall provide suitable means for disposal of test and flushing water so that no damage results to facilities or waterways.

B. Means for disposal of test and flushing water shall be subject to the approval of ENGINEER, local governing authorities and regulatory agencies.

C. CONTRACTOR shall be responsible for any damage caused by his water disposal operations.

3.5 IDENTIFICATION

A. All pipeline material shall be stamped, marked or identified with the following:
   1. Name or manufacturer.
   2. Pipe size.
   3. Pipe material.
   4. Wall thickness.
   5. Rating.

3.6 SURFACE PREPARATION AND SHOP PAINTING

A. Clean and prime coat ferrous metal surfaces of piping in the shop in accordance with the requirements of Section 9L.

B. Field painting is under Section 9L.

SECTION 15A2

PIPING SMALLER THAN 4 INCHES IN DIAMETER

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. This Section includes all piping smaller than 4 inches in diameter as shown and specified.
   a. PVC piping shall be used for the sodium hydroxide and polymer transfer systems.
   b. Kynar (PVDF) piping shall be used for the acid transfer system.
   c. Steel piping shall be used for the air supply line.
2. In general, schematic diagrams for the small piping systems are shown on the Drawings. It is the intention of the Drawings and of these Specifications that CONTRACTOR shall provide complete and workable small piping systems and any miscellaneous valves and fittings required for proper completion of the work shall be considered as having been included.
3. The Drawings show the general layout of small piping diagrammatically and do not necessarily reflect the exact location of the various items. Accordingly, CONTRACTOR should not scale the Drawings but shall acquaint himself fully with the extent and character of the work required and its relation to the work under other sections.
4. All bolts, nuts, gaskets, wall sleeves, hangers, brackets, and other supports required for piping and equipment furnished under this Section shall be provided by CONTRACTOR.
5. The piping schedule for all pipe is included at the end of Section 15A4.

1.2 QUALITY ASSURANCE

A. Reference Standards: Comply with applicable provisions and recommendations of the standards listed hereinafter under 2.3 - MATERIALS".

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Tapped holes or tee fittings shall be provided in piping where required for connection of gages, switches, sample lines, and similar items. Where wall thickness is insufficient for the tap size required, a boss, tee or tapping saddle shall be provided.

2.2 PIPING SCHEDULE

A. Polyvinyl Chloride (PVC) Pipe: Caustic soda and polymer transfer piping system.

B. Kynar (PVDF) Pipe: Acid Transfer piping system.

2.3 MATERIALS

A. Polyvinyl Chloride (PVC) Pipe: PVC pipe shall meet ASTM D-1784. Thickness Class shall be Schedule 80. All special sections and fittings shall be made with component parts having the dimensions. ends, and other details as shown and specified. All fittings shall have the same minimum wall thickness as the pipe. Each piece of pipe and all fittings shall be completely cleaned before installation.

B. PVDF pipe shall meet ASTM D-1434 Thickness Class shall be Schedule 80. All special sections and fittings shall be made with component parts having the dimensions, ends, and other details as shown and specified. All fittings shall have the same minimum wall thickness as the pipe. Each piece of pipe and all fitting shall be completely cleaned before installation.

C. Air Supply Pipe: Steel, schedule 80, threaded.

2.4 MANUFACTURERS

A. Polyvinyl Chloride (PVC) & Kynar (PVDF) Piping:
   1. Plastic Engineered Products, Inc.

PART 3 - EXECUTION

3.1 INSTALLATION

A. CONTRACTOR shall take special care in the arrangement of piping secure a neat and workmanlike appearance and true alignment and grade. All pipe and fittings shall be thoroughly cleaned before erection, and all burrs, scale, fins and obstructions shall be moved. The CONTRACTOR shall make ample provision to allow for expansion of piping without undue strain.

B. All piping shall be assembled accurately from measurements established at the job site and worked into place without springing or forcing.

C. All drain lines shall slope a minimum of one (1) percent in the direction of flow unless otherwise noted.

D. Bolts, nuts, gaskets and studs for all pipe materials shall be provided as required, and shall conform to the applicable requirements of Section 15A4 - "PIPING 4 INCHES IN DIAMETER AND LARGER".

E. Piping supports, guides and anchors shall be provided for the piping as otherwise required, and shall conform to the applicable requirements of Section 15A4 - "PIPING 4 INCHES IN DIAMETER AND LARGER".

F. Valves shall be installed, in accordance with the manufacturer's specifications.

G. The exterior of exposed pipe, shall receive surface preparation and field painting in accordance with the requirements of Section 9L, Painting.

3.2 TESTING OF PRESSURE PIPING

A. Refer to Section 15A4.

END OF SECTION

SECTION 15A3

VALVES AND SPECIALS SMALLER THAN 4 INCHES IN DIAMETER

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. This Section includes valves and specials for the sizes and types designated on the Drawings, for the small piping systems provided under Section 15A2, Piping Smaller Than 4 Inches in Diameter or as otherwise required.

1.2 QUALITY ASSURANCE

A. Reference Standards: CONTRACTOR shall comply with applicable provisions and recommendations of the standards listed hereinafter under Article 2.1.

PART 2 - PRODUCTS

2.1 MATERIALS

A. PVC Ball Valves:

1. Body: PVC, true union, w/socket fittings, Sch 80.
2. Drive Shaft: stainless steel.
3. Ball: PVC.
4. Seals: Teflon.
5. O-ring: Teflon.

B. PVDF Ball Valves:

1. Body: PVDF, true union ball valve w/socket fusion fitting.
2. Drive shaft: Stainless steel.
3. Ball: PVDF.

4. Seals: Teflon.
5. O-ring: Teflon.

C. Quick Disconnects:
1. Body: PVC.
2. Cam Arms: 316 stainless steel.
3. Gasket: Teflon.
4. Ends:
a. Female: Socket.
b. Male: Hose Shank.

2.2 MANUFACTURERS

A. PVC, PVDF Ball Valves, Plug Valves and Quick Disconnects.
1. Plastic Engineered Products, Inc.

PART 3 - EXECUTION

3.1 VALVES AND SPECIALS

A. CONTRACTOR shall install all valves and specials in a neat and workmanlike manner. Heavy units shall be handled by mechanical equipment. Valves or specials which are inadvertently dropped or otherwise damaged prior to OWNER'S representative's final certificate shall be checked by a representative of the manufacturer and replaced or repaired, if required, at CONTRACTOR'S expense.

END OF SECTION

SECTION 15C7

PIPE HANGERS, SUPPORTS AND RESTRAINTS

PART 1 - DESCRIPTION

1.1 GENERAL

A. Scope:

1. CONTRACTOR shall furnish all labor, material, equipment and incidentals as shown on the Contract Drawings, specified and required to provide an acceptable system of support, guidance and anchorage for all piping, valves and specials.

B. Coordination:

1. Review installation procedures under other appropriate Sections and coordinate the Work that must be installed with or attached to the hangers and supports.
2. CONTRACTOR shall coordinate the location and placement of any concrete inserts, and any cutting or drilling of structural members required.
3. CONTRACTOR shall coordinate installation of the new structural piping supports as required with the existing structures, equipment and supports. The SUB-CONTRACTOR shall be responsible for cutting, re-welding or other modifications required to install and position such supports satisfactorily.

C. Related Work Specified Elsewhere:

1. Section 9L, Painting.
2. Division 15, Sections on Piping, Valves and Specials.

1.2 QUALITY ASSURANCE

A. General: The manufacturer shall conform to the following general criteria:

1. Materials and systems using stock or production parts shall be utilized unless otherwise shown or approved.
2. Accurate weight balance calculations shall be made to determine the required supporting force at each hanger location and the pipe weight load at each equipment concentration.
3. Pipe hangers shall be capable of supporting the pipe in all conditions of operation. They shall allow free expansion and contraction of the piping, and prevent excessive stress resulting from transferred weight being induced into the pipe or connected equipment.
4. Hangers shall be installed so that they cannot become disengaged by movements of the supported pipe.
5. Conform to the recommendations of MSS-SP-58 and 69 except where requirements of this Section 15C7 are more stringent.

B. Source Quality Control:
1. Obtain each type of pipe hanger or support from no more than one manufacturer.

C. Reference Standards: Comply with applicable provisions and recommendations of the following except as otherwise shown or specified:
1. The Manufacturers Standardization Society of the Valve and Fittings Industry:
   a. MSS SP-58, Pipe Hangers and Supports - Materials and Design.
   b. MSS SP-69, Pipe Hangers and Supports - Selection and Application.
2. FS WW-H-171, Hangers and Supports, Pipe.
3. Underwriters' Laboratories, Inc., Standard UL-203-Pipe Hanger Equipment.
4. ANSI B1.1, Unified Inch Screw Threads.
5. ANSI B31, Codes for Pressure Piping.
6. ASTM A 36, Structural Steel.
7. ASTM A 47, Malleable Iron Castings.
8. ASTM A 276, stainless and Heat-Resisting Steel Bars and Shapes.

9. ASTM A 307, Carbon Steel Externally Threaded Standard Fasteners.
10. ASTM A 320, Alloy-Steel Bolting Materials for Low-Temperature Steel.
11. ASTM A 575, M-Grades Merchant Quality Hot-Rolled Carbon Steel Bars.
12. ASTM A 666, Austenitic Stainless Steel, Sheet, Strip, Plate and Flat Bar for Structural Applications.
13. ASTM A 668, Carbon and Alloy Steel Forgings for General Industrial Use.

1.3 SUBMITTALS

A. Shop Drawings: Submit for approval Shop Drawings showing the following:
   1. All hangers and supports for piping system specified.
   2. Location, installation, material, loads or forces, and deflection of all hangers and supports.
   3. Manufacturers' catalogs, literature, and engineering data on all hangers and supports.
   4. Load ratings, materials and installation shall be consistent with the recommendations of the MSS SP-58 and MSS SP-69.

1.4 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Delivery of Materials: All materials shall be inspected for size, quality, and quantity against approved Shop Drawings.

B. Storage of Materials: All materials shall be packaged, labeled, and stored in a covered dry location until time of installation.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Unless otherwise noted or shown, SUB-CONTRACTOR is responsible for designing and supplying supports for all piping systems.

B. The hangers and supports shall meet with the following requirements:

1. Standard and fabricated hangers and supports shall be furnished complete with necessary inserts, bolts, nuts, rods, washers, and other accessories.
2. Run piping in groups and parallel to building walls where practicable. Provide minimum clearance of one inch between pipe and other work.
3. Install hangers or supports at all locations where piping changes direction. Horizontal valves 6-inches and larger shall be supported by a hanger on each side of valve.
4. All hangers and supports shall be capable of adjustment after placement of piping.
5. Types of hangers or supports shall be kept to a minimum.
6. All suspended or supported ductile iron pipe shall have a hanger or support adjacent to each hub.
7. Vertical piping shall be supported at each floor and between floors by stays or braces to prevent rattling and vibration.
8. Hanger rods shall be straight and vertical. Chain, wire, strap or perforated bar hangers shall not be used. Hangers shall not be suspended from piping.
9. Prevent contact between dissimilar metals by use of copper plated, rubber, vinyl coated, or stainless steel hangers or supports.
10. Hangers and supports shall provide for expansion throughout the full operating temperature range.
11. All plastic piping shall be supported by plastic coated steel pipe attachments.
12. Vertical struts and horizontal members shall be of a size suitable for the service intended and be compatible with frame inserts as specified in Section 5E3, Miscellaneous Metal Fabrications.

2.2 HANGERS AND SUPPORTS

A. Components of hangers and supports shall conform to the following where applicable:

1. Materials:
   a. Bolts: ASTM A 307, Grade A, unless otherwise specified below.
   b. Anchor and Expansions Bolts: Type 316 stainless steel, including nuts and washers.
   c. Forgings: ASTM A 235.
   d. Malleable Iron: ASTM A 47.
   e. Rods and Bars: ASTM A 107.
   f. Threads: Unified Screw Threads, Class 2A and 2B, ANSI B1.1. 9. Structural Steel: ASTM A 36.
2. Finish:
   a. Steel Items: Galvanized unless otherwise specified or shown on the Drawings.
   b. All plastic piping shall be supported by plastic coated (PVC) steel pipe attachments.

B. Pipe Attachments: The following types of pipe attachments are acceptable:

1. Adjustable Steel Clevis: FS WW-H-171E, Type 1.
2. Steel Double Bolt Pipe Clamp: FS WW-H-171E, Type 3.
3. Riser Clamp: FS WW-H-171E, Type 8.
4. Pipe Stanchion Saddle: FS WW-H-171E, Type 38.
5. Adjustable Pipe Saddle Support: FS WW-H-171E, Type 39.
6. Adjustable Pipe Roll and Base: FS WW-H-171E, Type 47.
7. Insulation Protection Shield: FS WW-H-171E, Type 41.
8. Insulation Protection Saddle: FS WW-H-171E, Type 40A and 40B.
9. Adjustable Roller Hanger: FS WW-H-171E, Type 44.
10. Pipe Slide Assembly:
    a. Material: Carbon steel tee with stainless steel slide plate; carbon steel base with filled teflon pad.
    b. Type: Suitable for field welding to steel pipe. Modify with clamps and U-bolts for use with ductile iron pipe.

c. Product and Manufacturer:

1) ITT Grinnell, Figure 257, Type 3.

2) Piping Specialties, Incorporated.

C. Structural Attachments: The following types of structural attachments are acceptable:

1. Welded Steel Bracket: FS WW-H-171E, Type 33.
2. Side Beam Bracket: FS WW-H-171E, Type 35.
3. Malleable Concrete Insert: FS WW-H-171E, Type 18.
4. Center I-Beam Clamp with Eye Nut: FS WW-H-171E, Type 28.

D. Hanger Rod Attachments: Use as required to complete assembly:

1. Forged Steel Clevis: FS WW-H-171E, Type 14.
2. Adjustable Turnbuckle: FS WW-H-171E, Type 15.
3. Forged Steel Weldless Eye Nut: FS WW-H-171E, Type 17.

E. Anchorage Items: All anchor or expansion bolts, nuts and washers for anchoring pipe hangers and supports shall be Type 316 stainless steel where stainless steel piping is installed and Type 304 stainless steel in all other locations.

F. All other hangers and supports shall be in accordance with MSS SP-58.

G. Product and Manufacturer: Provide hangers and supports as manufactured by one of the following:

1. ITT Grinnell Company.
2. Elcen Metal Products Company.
3. Or equal.

2.3 SURFACE PREPARATION AND PAINTING

A. All pipe supports except stainless steel and plastic coated steel for all piping listed in the Schedule to be painted shall be prepared and painted in accordance with the requirements of Section 9L, Painting.

PART 3 - EXECUTION

3.1 GENERAL

A. Locate hangers, supports, and accessories to support piping, valves, and at all concentrated loads.

B. Locate hangers, supports, and accessories within maximum span lengths specified to support continuous pipeline runs unaffected by concentrated loadings.

C. Install hangers or supports at all locations where piping changes direction.

D. Locate hangers and supports to prevent vibration or swaying and to provide for expansion and contraction.

E. Hangers rods shall be straight and vertical. Chain, wire, strap or perforated bar hangers shall not be used. Hangers shall not be suspended from piping.

F. Install items to be embedded before concrete placement.

G. Fasten embedded items securely to prevent movement during concrete placement.

H. Hanger and support units installations methods shall be in accordance with manufacturer's recommendations.

I. Adjust hangers and supports and place grout for concrete supports to bring pipelines to specified elevations. Grout shall be as specified in Section 3K, Concrete.

J. Prevent contact between dissimilar metals by use of copper plated, rubber, vinyl coated, or stainless steel hangers or supports.

3.2 INSTALLATION

A. Supports and Hangers for Horizontal Pipes:

1. Space supports and hangers for all piping no farther apart than shown below unless otherwise noted:

   a. Copper Tube:

      1) Pipes up to 2-inch: 6 feet-O inch center to center.

      2) Pipes 2-1/2-inch and larger: 8 feet-O inch center to center.

   b. Steel, Ductile Iron and Stainless Steel Pipe:

      1) Pipes up to 1-inch: 6 feet-O inch center to center.

      2) Pipes 1-1/2-inch to 6-inch: 8 feet-O inch center to center.

      3) Pipes 8-inches and larger: 10 feet-O inch center to center.

      4) In addition, ductile iron pipe shall have a minimum of two supports per length and shall have a hanger or support adjacent to each hub.

   c. Plastic Pipe:

      1) Maximum support spacing for plastic pipe at ambient temperature shall be one-half the above values for steel pipe except that support spacing shall not exceed 4 foot-O inches.

2. Additional supports shall be placed immediately adjacent to any change in piping direction, and on both sides of valves, expansion joints, and couplings.

3. Hanger Rods shall be sized for maximum pipe loads and according to the schedule herein for minimum rod diameters:

Nominal Pipe (Inches)	Minimum Rod Diameter (Inches)
1/2 through 3	1/2
4 through 5	5/8
6	3/4
8 through 12	7/8
14 through 18	1
20 through 30	1-1/4

4. Hangers and supports for pipe 3-inch diameter and larger shall be adjustable.

B. Supports for Vertical Piping:

1. Provide riser clamp placed under hub, fitting or coupling with approved solid bearing on steel sleeve.
2. Where riser clamps are used with plastic piping they shall be modified so as not to exert any compressive forces on the pipe.
3. Vertical piping shall be supported at each floor and between floors by stays or braces to prevent rattling and vibration.
4. Vertical plastic piping riser clamps shall be PVC coated.

C. Expansion Anchors:

1. Use to fasten all base supports to floors.
2. Use at hangers and brackets to support piping 1-inch diameter and smaller and only if the anchor is designed to carry 200 percent of the load.

3.3 ACCEPTANCE AND SERVICE

A. Acceptance: All pipe systems shall be brought up to operating pressures and temperatures. Systems shall be cycled to duplicate operating conditions. All malfunctions shall be corrected. SUB-CONTRACTOR shall furnish all labor and materials to readjust and correct faults with hangers and supports for the piping systems.

END OF SECTION

SECTION 15060

VES SYSTEM PIPING AND APPURTENANCES

1 PART 1 GENERAL

1.1 SECTION INCLUDES

A. This Specification and all applicable specifications, Drawings, standards, and codes referenced herein shall apply to the fabrication and erection of all piping, pipe fittings, valves, supports, etc., and any prefabrication for the following systems:

1. Inlet Extraction Manifolds (VES Trailer).
2. Vapor Extraction Piping (Extraction Wells to Vapor Extraction Manifold).
3. Water Extraction Piping (Extraction Wells to Water Extraction Manifold).
4. Water Discharge Piping (Water Discharge Pumps to Equalization Tank #2.)
5. Interconnecting piping through entire SVE system train (SVE Trailer).
6. Water service piping system (VES Trailer).
7. Natural gas piping service connection (Vapor Phase Treatment Unit).

B. Conformance

1. All work within the scope of this Specification shall be performed in accordance with this Specification and all applicable referenced documents. No deviations shall be made from this Specification or any applicable referenced documents without prior written authorization of the Engineer for each deviation. the application for each deviation shall completely and specifically define the location of, the nature of, and the reason for the proposed deviation.

C. Specifications

1. All specifications, standards, codes, etc., referred to and designated herein, together with all addenda, revisions, and supplements, shall be considered part of this Specification. Specifications, standards, codes, etc., referred to shall be of the latest edition.

2. All materials, fabrication, assembly, testing, and inspection of the piping systems within the scope of this Specification shall be in accordance with the ANSI Code for Pressure Piping B31.3; and the Contract Piping Materials Specification.

3. All conflicts between the requirements of this Specification, related specifications, standards, purchase orders, design drawings or models shall be referred to the Engineer before proceeding with work of the affected parts.

4. Nothing in this Specification shall be interpreted as in any way relieving a Contractor of the responsibility for complete compliance with the referenced codes wherever they apply.

1.2 RELATED SECTIONS

A. Section 02225 - Trenching.

B. Section 15140 - Supports and Anchors.

C. Section 15260 - Piping Insulation.

1.3 REFERENCES

A. ANSI B31.1 - Power Piping.

B. ANSI B31.2 - Fuel Gas Piping.

C. ANSI B31.9 - Building Service Piping.

D. ANSI B16.5 - 1981 - Steel Pipe Flanges and Flanged Fittings "American Class 150, 300, 400, 600, 900, 1,500, 2,500 Steel Flange Standards".

E. ASME - Boiler and Pressure Vessel Code.

F. ASME Sec. 9 - Welding and Brazing Qualifications.

G. ASME B16.3 - Malleable Iron Threaded Fittings.

H. ASTM A47 - Ferritic Malleable Iron Castings.

I. ASTM A53 - Pipe, Steel, Black and Hot-Dipped Zinc Coated, Welded and Seamless.

J. ASTM A120 - Pipe, Steel, Black and Hot-Dipped Zinc Coated (Galvanized), Welded and Seamless, for Ordinary Uses.

K. ASTM D1785 - Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.

L. ASTM D2241 - Poly (Vinyl Chloride) (PVC) Plastic Pipe (SDR-PR).

M. ASTM D2466 - Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
ASTM D2513 - Thermoplastic Gas Pressure Pipe, Tubing and Fittings.

N. ASTM D2564 - Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings.

O. ASTM D2855 - Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings.

P. AWS A5.8 - Brazing Filler Metal.

Q. NCPWB - Procedure Specifications for Pipe Welding.

R. ANSI B2.1 - Pipe Threads.

S. ANSI B16.3 - Malleable Iron Threaded Fittings.

T. ASTM B16.9 - Factory-Made Wrought Steel Buttwelding Fittings.

U. ASTM B16.11 - Forged Steel Fittings, Socket-Welding and Threaded.

V. ASTM B16.21 - Nonmetallic Gaskets for Pipe Flanges.

W. ASTM B16.25 - Buttwelding Ends.

X. ASTM B31.3 - Pressure Piping Code.

Y. ASTM D-2146 - Polypropylene Pipe Manufacturing.

Z. ASTM D-2837 - Hydrostatic Design Basis for Polypropylene Pipe.

AA. ASTM D-4101 - Material for Polypropylene Pipe and Fittings.

AB. ASME Section IX - Welding and Brazing Qualifications.

AC. ASTM A 105 - Specification for Forging, Carbon Steel for Piping Components.

AD. ASTM A 234 - Specification for Forging, Carbon Steel for General Purposes Piping.

AE. DIN 8077 - Hydrostatic Design Basis for Polypropylene Pipe.

AF. DIN 16962 - Dimensions and Tolerances for Polyproplylene Socket Fusion Fittings.

AG. ISO 7279 - Dimensions and Tolerances for Polyproplylene Socket Fusion Fittings.

1.4 SUBMITTALS

A. Submit under provisions of Section 01300.

B. Product Data: Provide data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalog information. Indicate valve data and ratings.

B. Product Data: Provide data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturer's catalog information. Indicate valve data and ratings.

C. Evidence of Fusion Training and Certification for polypropylene piping installation, by polypropylene piping manufacturer.

1.5 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Section 01700.

B. Record actual locations of valves.

1.6 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Section 01700.

B. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.

1.7 QUALITY ASSURANCE

A. Valves: Manufacturer's name and pressure rating marked on valve body.

B. Welding Materials and Procedures: Conform to ASME Code and applicable state labor regulations.

C. Welders Certification: In accordance with ASME Sec 9.

D. Maintain one copy of each document on site.

1.8 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

B. Installer: Company specializing in performing the work of this section with minimum 3 years documented experience.

C. Polypropylene Piping Installer: Installer(s) shall be factory trained and certified for polypropylene piping installation and fusion welding.

1.9 REGULATORY REQUIREMENTS

A. Perform Work in accordance with State of Rhode Island plumbing code.

B. Conform to applicable code for installation of backflow prevention devices.

C. Provide certificate of compliance from authority having jurisdiction indicating approval of installation of backflow prevention devices.

1.10 DELIVERY, STORAGE, AND HANDLING

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

B. Accept valves on site in shipping containers with labelling in place. Inspect for damage.

C. Provide temporary protective coating on cast iron and steel valves.

D. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

E. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.11 ENVIRONMENTAL REQUIREMENTS

A. Do not install underground piping when bedding are wet or frozen.

1.13 EXTRA MATERIALS

A. Furnish under provisions of Section 01700.

B. Provide two repacking kits for each size valve.

2 PART 2 PRODUCTS

2.1 GROUNDWATER AND VAPOR EXTRACTION SYSTEM AND WATER DISCHARGE PIPING

A. Steel Pipe: ASTM A53 or A120, Schedule 40 black.

1. Fittings: ASME B16.3, malleable iron, or ASTM A234, forged steel welding type.

2. Joints: NFPA 54, threaded or welded to applicable portion of ANSI B31and ASME Sec 1.

B. Grooved End Steel Pipe - black schedules 10, 40, 80 steel (as indicated on the contract drawings), ASTM, A-135 OR A-53, Grade B, 3/4 to 1-1/2" Type F and 2-24" Type E or S, or hot-dip galvanized as indicated.

1. Fittings: shall be Victaulic full flow cast fittings, steel fittings or segmentally welded fittings with grooves or shoulders designed to accept Victaulic grooved end couplings(designate specific style numbers).

a. Standard Fittings - Shall be cast of ductile iron conforming to ASTM A-536 (Grade 65-45-12), or malleable iron conforming to ASTM A-47, Grade 32510, painted with alkyd enamel or hot-dip galvanized to ASTM A-153 or zinc electroplated to ASTM B-633 or cadmium plated to ASTM A-165, as required.

b. Standard Steel Fittings - Include large size elbows (16-24") shall be forged steel conforming to ASTM A-234 Grade WPB (0.375" wall), painted with alkyd enamel or hot-dip galvanized to ASTM A-153.

c. Standard Segmentally Welded Fittings - Shall be fabricated of Schedule 40 carbon steel pipe as follows: 3/4 to 1-1/2" conforming to ASTM A-53, Type F; 2-10" Schedule 40 conforming to ASTM A-53 Type E or S, Grade B; 12-24" 0.375" wall conforming to ASTM A-53, Type E or S, Grade B, painted with rust inhibiting modified vinyl alkyd enamel or hot-dip galvanized to ASTM A-153.

2. Joints: grooved, prepared in accordance with (ANSI/AWWA C-606), (CSA B242-M1980), (MIL-P-11087C Grooved End Pipe) or Victaulic (manufacturer's) published specifications as appropriate according to pipe material, wall thickness, size and method of joining. In the event of conflict, Victaulic data shall prevail.

C PVC Pipe: ASTM D1785, Schedules 40 and 80.

1. Fittings: ASTM D2466, PVC.

2. Joints: ASTM D2855, solvent weld with ASTM D2564 Solvent cement.

D. Polypropylene Pipe: Manufactured from a Type II copolymer meeting ASTM D-4101 in accordance with ASTM D-2146. Shall conform to requirements of DIN 8077 and ASTM D-2837.

1. Fittings: Socket fusion type in accordance with ISO 7279 and DIN 16962 dimensions and tolerances. Type I homopolymer meeting ASTM D-4101 in accordance with ASTM D-2146.

2. Joints: Heat fusion in accordance with pipe manufacturer recommendations.

2.2 WATER SERVICE PIPING, BURIED

A. PVC Pipe: ASTM D1785, Schedule 40, or ASTM D2241, SDR-26 for not less than 150 psig pressure rating.
1. Fittings: ASTM D2466, PVC.
2. Joints: ASTM D2855, solvent weld with ASTM D2564 Solvent cement.

2.3 WATER SERVICE PIPING, ABOVE GRADE

A. PVC Pipe: ASTM D1785, Schedules 40 and 80.
1. Fittings: ASTM D2466, PVC.
2. Joints: ASTM D2855, solvent weld with ASTM D2564 Solvent cement.

2.4 NATURAL GAS PIPING, BURIED

A. N/A (Gas Service provided and installed by Providence Gas Company)

2.5 NATURAL GAS PIPING, ABOVE GRADE

A. Steel Pipe: ASTM A53 or A120, Schedule 40 black.
1. Fittings: ASME B16.3, malleable iron, or ASTM A234, forged steel welding type.
2. Joints: NFPA 54, threaded or welded to [ANSI B31.1] [ANSI B31.2] [ANSI B31.9] [ASME Sec 1].

2.6 FLANGES, UNIONS, AND COUPLINGS

A. Grooved Piping Systems

1. Couplings - shall consist of a one or more piece ductile or malleable iron cast housing, a synthetic rubber gasket of a central cavity pressure-responsive design, with nuts, bolts, locking toggle or lugs to secure unit together.

a. Coupling Housings - Shall be cast of ductile iron conforming to ASTM A 536 (Grade 65-45-12) or malleable iron conforming to

ASTM A-47 (Grade 32510), hot dip galvanized to ASTM A-153, or zinc electroplated to ASTM B-633, as manufactured by Victaulic Company of America.

b. Coatings - Shall consist of an alkyd enamel paint, or hotdip galvanizing to ASTM A-153, or zinc electroplating to ASTM B-633, as specified.

c. Couplings for Grooved End Steel Pipe - Shall be Victaulic couplings for grooved end steel pipe.

d. Line and Fitting Joints - Shall be Victaulic flexible (Style 77) or rigid (Style 07), as indicated on the contract drawings.

e. Reducing Joints - Shall be Victaulic Style 750 Reducing Couplings for pipe to pipe joints or to create reducing fittings using straight fitting configurations.

f. Flanged Connections - Shall be Victaulic Style 741 (2-24") Vic-Flange adapters, engaging directly into grooved pipe and bolting directly to ANSI Class 150 steel flanged components.

g. Quick Disconnects - Shall be Victaulic Style 78 Snap-Joint Couplings or Style 780/781 for double grooved pipe.

2. Gaskets - shall be molded of synthetic rubber in a central cavity, pressure-responsive configuration conforming to the pipe outside diameter and coupling housing, of elastomers having properties as designated in ASTM D-2000. Reference shall always be made to the latest published Selection Guide for Victaulic Gaskets for proper gasket selection for the intended service.

a. Special Chemical Service (grooved piping handling extraction well vapor and groundwater (including water discharge piping) - gasket supplied for special chemical services from +20°F to +300°F, shall be a Grade "O" fluoroelastomer (Viton) compound, with blue color code, molded of materials conforming to ASTM D-2000, designation 2HK714A110B27EF31Z, recommended for many oxidizing acids, petroleum oils, halogenated hydrocarbons, lubricants, hydraulic fluids, organic liquids and air with hydrocarbons to +300°F.

b. Vacuum Service - Gasket supplied for vacuum service shall be Victaulic Flush-Seal® style or standard gaskets with internal metal liner.

3. Fasteners

a. Bolts and Nuts - Bolts and nuts shall be heat treated carbon steel, track head, conforming to physical properties of ASTM A-183 minimum tensile 110,000 psi, black, or zinc electroplated to ASTM B-633.

b. Other Fasteners - Fasteners for certain products may vary from this specification, as noted with each project.

B. Pipe Size 2 Inches (50 mm) and Under:

1. Ferrous pipe: 150 psig (1 034 kPa) malleable iron threaded unions.

C. Pipe Size Over 2 Inches (50 mm):

1. Ferrous pipe: 150 psig (1 034 kPa) forged steel slip-on flanges; 1/16 inch (1.6 mm) thick preformed neoprene gaskets.

D. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

2.7 GLOBE VALVES

A. Up to and including 2 Inches (50 mm): Bronze body, bronze trim, rising stem, handwheel, inside screw, renewable composition disc, screwed ends, with back seating capacity (repackable under pressure).

2.8 BALL VALVES

A. Up to and including 2 Inches (50 mm): Bronze body, chrome plated steel ball, teflon seats and stuffing box ring, lever handle and balancing stops, threaded ends. Water Extraction Ball Valves shall be rated to no less then 29" HG as required for intended service.

B. Over 2 Inches (50 mm): Cast steel body, chrome plated steel ball, teflon seat and stuffing box seals, lever handle, flanged, threaded or grooved. Water Extraction Ball Valves shall be rated to no less then 29" HG as required for intended service.

2.9 PLUG VALVES

C. Up to and including 2 Inches (50 mm): Bronze body, bronze tapered plug, non-lubricated, teflon packing, threaded ends. Vacuum rated to no less then 29" Hg if required for intended service.

D. Over 2 Inches (50 mm): Cast iron body and plug, non-lubricated, teflon packing, flanged ends. Vacuum rated to no less then 29" HG if required for intended service.

2.10 MOTOR ACTUATED BUTTERFLY VALVES

A. Bronze body, stainless steel disc, resilient replaceable seat, threaded ends, extended neck, infinite position lever handle with memory stop.

B. Cast or ductile iron body, chrome plated ductile iron disc, resilient replaceable EPDM seat, wafer or lug ends, extended neck, infinite position lever handle override operator with memory stop.

C. Electric Rotary Actuator shall be rated 120 lb. in. torque at 2 seconds/90^0 turn (drawing .75 amps), with declutching manual override. Shall have 0^0 to 90^0 travel limit switches, integral, 120 VAC, 60 Hz, single phase, reversible capacitor run motor, 1/2" conduit entry provision and NEMA-7 Hazardous location enclosure.

2.11 SOLENOID ACTUATED VACUUM VALVES

A. Aluminum body, viton seals and discs, 305 s.s. core tube, 430F s.s core and plugnut, 302 s.s. springs, copper shading coil, acetal core guide and Teflon filled rider ring. Nominal ambient temperature ranges (32^0 F to 125^0 F).

B. Combination explosion proof and raintight enclosure, 120 volts, AC, 60 Hz. Coil shall be continuous duty molded Class F.

C. Shall be mounted with solenoid vertical and upright.

2.12 SPRING LOADED CHECK VALVES

A. Iron body, bronze trim, stainless steel spring, renewable composition disc, screwed, wafer, or flanged ends. Groundwater extraction line check valves shall be rated for no less then 29 " HG vacuum service.

2.13 EXTRACTION WELL FOOT VALVE

A. Manufacturer/Model: Red Valve Company, Inc., Series 2633, In-Line check Valve.

B. Shall be 1" nominal size, stainless steel body, viton check sleeve material (duck bill style), threaded stainless steel end connections. 100% shutoff on flow reversal.

2.13 BACKFLOW PREVENTER

A. Provide type as required by local water utility authority and/or health department.

2.14 PRESSURE RELIEF/BY-PASS CONTROL VALVES

A. Bronze body, teflon seat, steel stem and springs and/or diaphragm compatible with Toluene (if applicable), automatic, direct pressure actuated, and field adjustable.

2.15 VACUUM RELIEF SAFETY VALVES

A. Bronze body, teflon seat, steel stem and springs, automatic, direct vacuum actuated, set at 15" Hg vacuum.

3 PART 3 EXECUTION

3.1 EXAMINATION

A. Verify excavations under provisions of Section 01041.

B. Verify that excavations are to required grade, dry, and not over-excavated.

3.2 PREPARATION

A. Ream pipe and tube ends. Remove burrs. [Bevel plain end ferrous pipe.]

B. Remove scale and dirt, on inside and outside, before assembly.

C. Prepare piping connections to equipment with flanges or unions.

3.3 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Provide non-conducting dielectric connections wherever jointing dissimilar metals.

C. Route piping in orderly manner and maintain gradient.

D. Install piping to conserve building space and not interfere with use of space.

E. Group piping whenever practical at common elevations.

F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

G. Provide clearance for installation of insulation and access to valves and fittings.

H. Provide access where valves and fittings are not exposed.

I. Establish elevations of buried piping outside the building to ensure cover of not less than the minimum frost depth in the project area.

J. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.

K. Support for utility meters shall be provided by Providence Gas Company.

L. Prepare pipe, fittings, supports, and accessories (not prefinished), ready for finish painting.

M. Excavate in accordance with Section 02225 for work in this Section.

N. Backfill in accordance with Section 02225 for work of this Section.

O. Install bell and spigot pipe with bell end upstream.

P. Install valves with stems upright or horizontal, not inverted.

3.4 APPLICATION

A. Use grooved mechanical couplings and fasteners only in accessible locations.

B. Install unions downstream or grooved fittings both up and downstream of valves and at equipment or apparatus connections .

C. Install brass male adapters each side of valves in copper piped system. Sweat solder adapters to pipe.

D. Install ball valves for shut-off and to isolate equipment, part of systems, or vertical risers or as otherwise indicated on the contract drawings.

E. Install globe or butterfly valves for throttling, bypass, or manual flow control services or as otherwise indicated on the contract drawings.

F. Provide spring loaded check valves on discharge of water discharge pumps.

G. Provide plug valves in Natural Gas System for shut-off service.

3.5 ERECTION TOLERANCES

A. Establish invert elevations, slopes for vapor extraction pipe condensate drainage to 1/8 inch per foot (1 percent) minimum, towards extraction wells. Maintain gradients.

B. Slope water piping and arrange to drain at low points.

3.6 DISINFECTION OF WATER SERVICE PIPING SYSTEM

A. Prior to starting work, verify system is complete, flushed and clean.

B. Ensure PH of water to be treated is between 7.4 and 7.6 by adding alkali (caustic soda or soda ash) or acid (hydrochloric).

C. Inject disinfectant, free chlorine in liquid, powder, tablet or gas form, throughout system to obtain 50 to 80 mg/L residual.

D. Bleed water from outlets to ensure distribution and test for disinfectant residual at minimum 15 percent of outlets.

E. Maintain disinfectant in system for 24 hours.

F. If final disinfectant residual tests less than 25 mg/L, repeat treatment.

G. Flush disinfectant from system until residual equal to that of incoming water or 1.0 mg/L.

H. Take samples no sooner than 24 hours after flushing, from 2 percent of outlets and from water entry, and analyze in accordance with AWWA C651.

3.7 SERVICE CONNECTIONS

A. Provide new water service to VES Trailer complete with double check backflow preventer (or otherwise as approved by the City of Cranston Health Department).

1. Provide 18 gage (1.20 mm) galvanized sheet metal sleeve around service main to 6 inch (150 mm) above floor and 6 feet (1800 mm) minimum below grade. Size for minimum of 2 inches (50 mm) of loose batt insulation stuffing.

B. Provide new gas service piping from gas meter, corrector and regulators (provided by Providence Gas Co.) to gas cock provided with the vapor phase treatment unit

END OF SECTION

SECTION 15975

SVE DIGITAL CONTROL SYSTEMS

1 PART 1 GENERAL

1.1 SECTION INCLUDES

A. Control equipment.

B. Software.

1.2 RELATED SECTIONS

A. Section 11340 - Soil Vapor Extraction Equipment.

B. Section 15980 - Instrumentation: Thermometer sockets, gage taps.

C. Section 16111 - Conduit.

1.3 REFERENCES

A. ASME MC85.1 - Terminology for Automatic Control.

B. NEMA EMC1 - Energy Management Systems Definitions.

1.4 DEFINITIONS

A. Ensure terminology used in submittals conforms to ASME MC85.1.

1.5 SYSTEM DESCRIPTION

A. Automatic temperature control field monitoring and control system using field programmable micro-processor based units.

B. Central and remote hardware, software, and interconnecting wire and conduit.

C. Terminal unit controls for variable air volume terminals, radiation, reheat coils, unit heaters, fan coils, electric unless indicated otherwise.

D. Damper Motors and Valve Operators: Electronic.

1.6 SUBMITTALS

A. Submit under provisions of Section 01300.

B. Shop Drawings:
   1. Trunk cable schematic showing programmable control unit locations, and trunk data conductors.
   2. List of connected data points, including connected control unit and input device.
   3. System graphics indicating monitored systems, data (connected and calculated) point addresses, and operator notations.
   4. System configuration with peripheral devices, batteries, power supplies, diagrams, modems, and interconnections.
   5. Descriptive data and sequence of operation of operating, user, and application software.

C. Product Data: Provide data for each system component and software module.

D. Samples: Submit 2 samples [___x___] inches ([___x___] mm) in size of each exposed control component illustrating [_____].

E. Manufacturer's Installation Instructions: Include for all manufactured components.

1.7 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Section 01700.

B. Accurately record actual location of control components, including panels, thermostats, and sensors.

C. Revise shop drawings to reflect actual installation and operating sequences.

D. Include data specified in "Submittals" in final "Record Documents" form.

1.8 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Section 01700.

B. Include interconnection wiring diagrams complete field installed system with identified and numbered, system components and devices.

C. Include keyboard illustrations and step-by-step procedures indexed for each operator function.

D. Include inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.

1.9 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the products specified in this Section with minimum 3 years documented experience.

B. Installer: Company specializing in applying the work of this Section 3 years documented experience.

C. Design system software under direct supervision of a Professional Engineer experienced in design of this work and licensed in the State of Rhode Island.

1.10 COORDINATION

A. Coordinate work under provisions of Section 01041.

B. Ensure installation of components is complementary to installation of similar components in other systems.

C. Coordinate installation of system components with installation of mechanical systems equipment such as air handling units and air terminal units.

D. Ensure system is completed and commissioned.

1.11 WARRANTY

A. Provide 5 year warranty under provisions of Section 01700.

B. Warranty: Include coverage for field programmable micro-processor based units.

1.12 MAINTENANCE SERVICE

A. Furnish service and maintenance of energy management and control system for 2 years.

B. Provide complete service of systems, including call backs. Make minimum of [_____] complete normal inspections of approximately [_____] hours duration in addition to normal service calls to inspect, calibrate, and adjust controls, and submit written reports.

1.13 EXTRA MATERIALS

A. Submit maintenance materials under provisions of Section 01700.

B. Provide 2 of each type of exposed sensor under provisions of Section 01700.

1.14 PROTECTION OF SOFTWARE RIGHTS

A. Prior to delivery of software, the Owner and the party providing the software will enter into a software license agreement with provisions for the following:
   1. Limiting use of software to equipment provided under these specifications.
   2. Limiting copying.
   3. Preserving confidentiality.
   4. Prohibiting transfer to a third party.

2 PART 2 PRODUCTS

2.1 MANUFACTURERS

A. [_____] Product [_____.]

B. [_____] Product [_____.]

C. [_____] Product [_____.]

D. Substitutions: Under provisions of Section 01030.

2.2 LOCAL OPERATOR ACCESS AND DISPLAY PANEL

A. Provide local display and adjustment panel. Panels shall be integral to programmable control unit. Panel contains a six character digital display, and a numerical keyboard. Display and adjust:
   1. Input/output point information.
   2. Controller set points.
   3. Controller tuning constants.
   4. Program execution times.
   5. High and low limit values.
   6. Limit differential.
   7. Time, date, year.

B. Provide 2 auxiliary keyboard pushbuttons for custom programming special functions. Provide dedicated pushbuttons for manual/auto override, system test, and enter functions.

C. Provide status lights to annunciate controller test, trouble, alarm, auto control, override, and auxiliary button operation.

2.3 OPERATOR STATION

A. Operator Input/Output Devices:

1. Utilize ASCII (American Standard Code for Information Interchange) Code.
2. Interface with standard EIA (Electronic Industries Association) hardware through EIA RS-232-C communications port over telephone lines through a 1200 baud modem interface, or via dial-up network with auto-answer modems.
3. System loading shall be through floppy disk.
4. Communication between the central processing unit and programmable control units, and between programmable control units shall be normally 9600 baud, by block mode transmission with cyclical redundant error checking, supervised for system integrity and for monitoring field point status.
5. Station includes multiple input/output devices which can be used simultaneously, having on-line definable characteristics.
6. Provide Building Environmental Control Center consisting of video display terminal, hard copy printer, and audible alarm horn.

B. Printer:

1. Wide carriage with output of 15 characters per inch and 132 characters per line of paper, capable of using fan-fold paper.
2. Minimum operating speed of 120 characters per second.

C. Terminal:

1. 300 mm diagonal display with adjustable tilt.
2. 24 line, 80 character, mono-chrome screen.
3. Automatic screen blanking after timed inactivity.
4. Low profile, detachable, keyboard having standard typewriter layout plus a 10 key numeric keypad, dedicated function keys.

2.4 CONTROL UNITS

A. Units: Modular in design and consisting of processor board with programmable RAM memory, local operator access and display panel, and integral interface equipment.

B. Battery Backup: For minimum of 100 hours for complete system including RAM without interruption, with automatic battery charger.

C. Provide the following functions:
   1. Mathematical: Absolute value, calculate, square root, power, sign, average, totalize.
   2. Logic: OR, AND, compare negate.
   3. Fixed Formula: High and low select, span, rate, ramp, enthalpy, wet bulb, dewpoint, relative humidity, humidity ratio, filter.
   4. Data Manipulation: Store, file and set.
   5. Display Panel: Display adjust, override, time, day, date, year, alarm scan, override scan.
   6. Control Routines: Proportional, integral, lead lag, hysteresis correction and incremental control.
   7. Energy Management: Duty cycling, load shed, optimal run time, holiday and daylight savings time correction.

D. Provide self-test procedure for checking digital display and computer. Display advisories for maintenance, performance, or software problems. Identify variables as reliable or unreliable. Variables identified as unreliable will flash when displayed and calculation will use default.

E. Indicate alarms and deviations. Alarm scan shows alarms and identification. Continue alarm indication until acknowledged and alarm condition is corrected.

F. Provide two communication interface ports permitting communication between processor, process interface equipment, other processors, and central processing unit.

2.5 DATA INTERFACE UNITS

A. Provide equipment required to connect all sensors, transducers and interface relays required to monitor and control equipment in sequence of operation.

B. Provide each data interface equipment module with minimum of [_____] binary and [_____] analog inputs, and [_____] binary and [_____] analog outputs.

2.6 INPUT/OUTPUT SENSORS

A. Temperature:
   1. Resistance temperature detectors with resistance tolerance of plus or minus 0.1 percent at 21 degrees C, interchangeability less than plus or minus 0.2 percent C, time constant of 13 seconds maximum for fluids and 200 seconds maximum for air.
   2. Measuring current maximum 5 MA with maximum self-heat of 0.017 degrees C/MW in fluids and 0.008 degrees C/MW in fluids and 0.008 degrees C/MW in air.
   3. Provide 3 lead wires and shield for input bridge circuit.
   4. Use insertion elements in ducts not affected by temperature stratification or smaller than one square meter. Use averaging elements where larger or prone to stratification sensor length 2.5 m or 5 m as required.
   5. Insertion elements for liquids shall be with brass socket with minimum insertion length of 2-1/2 inches (60 mm).
   6. Supply room sensors with locking cover.
   7. Provide outside air sensors with watertight inlet fitting, shielded from direct rays of sun.

B. Humidity Sensors:
   1. Elements: Accurate within 5 percent full range with linear output.
   2. Room Sensors: With locking cover, span of [10 to 60 percent relative humidity .] [30 to 80 percent relative humidity.]
   3. Duct and Outside Air Sensors: With element guard and mounting plate, range of 0 - 100 percent relative humidity.

C. Static Pressure Sensors:
   1. Undirectional with ranges not exceeding 150 percent of maximum expected input.
   2. Temperature compensated with typical thermal error or 0.06 percent of full scale in temperature range of 40 to 100 degrees F (5 to 40 degrees C).
   3. Accuracy: One percent of full scale with repeatability 0.3 percent.
   4. Output: 0 - 5 vdc with power at 12 to 28 vdc.

D. Equipment Operation Sensors:
   1. Status Inputs for Fans: Differential pressure switch with adjustable range of 0 to 5 inches wg (0 to 1250 Pa).
   2. Status Inputs for Pumps: Differential pressure switch piped across pump with adjustable pressure differential range of 8 to 60 psi (50 to 400 kPa).

3. Status Inputs Where Differential Pressure Sensing is Impractical: Current sensitive relay with current transformers, adjustable and set to 175 percent of rated motor current.

E. Digital to Pneumatic Transducers: Convert [plus or minus 12 vdc pulse width modulation outputs] [continuous proportional current or voltage] to 0 to 20 psi (0 to 138 kPa).

F. Damper Position Indication: Potentiometer mounted in handbox enclosure with adjustable crankarm assembly connected to damper to transmit 0 - 100 percent damper travel.

G. Carbon Monoxide Detectors:
1. Single or multichannel dual level detectors, using solid state sensors with three year minimum life. Sensor replacement shall take maximum 15 minutes. Suitable over temperature range of 23 to 130 degrees F (-5 to 55 degrees C).
2. Provide individual indicators and contactors for each level, initially calibrated for 50 ppm and 100 ppm.
3. Maximum response time to 100 ppm CO calibration gas shall be two minutes.

2.7 OPERATING SYSTEM SOFTWARE

A. System Format:
1. Divide points of control or monitoring by system.
2. Identify points with unique, structured point identifier reflecting "specific area" or "specific system", and "specified point".

B. Input Process:
1. Select, from menu, one of four general types of commands based upon password clearance, command points, information points, build parameters, and modify parameters. Commands not available by password clearance shall be deleted from video display.
2. Enter memory changes through keyboard.
3. Select entry modes, Aid or Direct, based on operator's degree of capability and familiarity with system.
4. Aid Mode shall prompt operator through each step indicating available options.
5. Direct Mode shall allow experienced operator to input command string directly.
6. Enter commands as alpha/numeric character strings. Where commands require data for limits, setpoint, and time, enter value in same engineering units as controlled variable.

7. Operator input shall not inhibit alarm reporting. Echo input on associated output device, to either execute or abort.

C. Operator Access Control: Restrict any operator commands through use of software password.

D. Information Access: Obtain point status information from any designated output device with access command. Point status consists of point identification, numerical value (analog points) and associated engineering units, and individual function label indicating that point is on or off or in Alarm Normal condition. Output includes date and time of execution.

E. Point Display: Video display includes status of single point or group of points with high and low limits (if applicable). Refresh display at least every 20 seconds.

F. Alarm summary includes status of points in Alarm condition.

G. Off-normal summary includes status of points in Off-Normal condition.

H. Alarm Reporting:
1. Alarm outputs contain descriptor, point identification, point data, engineering units, and date and time.
2. Print on line changeable message, up to 60 characters in length, for each alarm point specified, immediately.
3. Display alarm reports on video. Display multiple alarms in order of occurrence.
4. Inhibit reporting of associated analog and binary alarms upon HVAC system shutdown. Upon restart, inhibit alarm reporting for operator pre-determined time.
5. Operator specifies if alarm required acknowledgement.

I. Advisories:
1. Lockout summary which contains status of points in locked out condition.
2. Continuously interrogate system hardware and programmable control units for failure or tampering and report if operational or not operational.
3. Power failure detection, time and date.
4. System communication failure with operator device, field interface unit, point, programmable control unit.

J. Data Base Save/Restore:
   1. Provide program which allows saving or restoring of operating data.
   2. Floppy disk unit shall save or restore system operating data.
   3. Data includes:
      a. Analog limits and differentials
      b. Start-stop times
      c. Access/secure times
      d. Lockout/unlock times
      e. Setpoint values and adjustment times
      f. Limits and differential values
      g. Totalization points, limits, and current values
      h. Alarm messages and their assignments
      i. Load control program operational parameters
      j. HVAC control program operational parameters

K. Power Failure Motor Restart: Provide program to restore systems to normal operating conditions following power outage, and to enforce emergency operating conditions during power outage. Automatically restart loads to correct operating condition if normal or emergency power is available.

2.8 BASIC OPERATING FEATURES

A. Binary Capabilities:
   1. Monitor binary sensors, continuously storing present contact condition in memory.
   2. Indicate if point is off-normal, in alarm, or off-line.
   3. Program output points for Open/Closed, Test/Reset, Start/Stop.
   4. Feedback Start/Stop points. Employ point unique, feedback delay timer to temporarily suppress alarm reporting after input to allow time for response.
   5. Output advisory message if response is not as commanded.
   6. Hold points in present operating condition if controls power failure occurs.

B. Analog Capabilities:
   1. Measure, transduce, transmit and display analog values.
   2. Express analog point values in proper engineering units, displaying with up to six significant digits.
   3. Have sensor to readout accuracy of plus or minus 1 degree F (0.56 degrees C).
   4. Use English system of measurement.
   5. Provide for operator designated ranges either linear, series of linear approximations, split ranges, or square root extractions of exponential functions.

6. Compare analog read to high and low limits and annunciate Alarm or Off-Normal condition.
7. Output alarm, including point identification current value and associated engineering units, high or low value, and time and date.
8. Automatically disable alarm reporting upon associated system shutdown. Allow sufficient time to return to normal operating conditions before allowing alarm reporting.
9. Provide limit and differential summary.

C. Analog Point Adjust:
1. Remotely adjust controller set points or dampers. Automatically adjust points based upon preselected time or value.
2. Employ feedback so that if point fails to respond, responds with wrong value, or drifts from set point value by plus or minus 2 percent, output alarm message. Employ feedback delay timer to temporarily suppress alarm reporting after input to allow time for response.
3. Hold points in present operating condition if controls power failure occurs.

D. Automatic Alarm Lockout: Automatically inhibit alarm reporting of analog and binary points upon associated system shutdown. Inhibit reporting for operator predetermined time, upon restart of systems.

2.9 LOAD CONTROL PROGRAMS

A. General:
1. Provide means to reduce electrical energy usage, using control algorithms designed for electrical energy control.
2. Apply algorithms to other energy sources, such as steam or natural gas.
3. Support English units of measurement.

B. Demand Limiting:
1. Monitor total power consumption per power meter and shed associated loads automatically to reduce power consumption to an operator-presettable maximum demand level.
2. Use floating window type demand determination to monitor demand and compare to target value.
3. Automatically shed loads throughout the demand interval selecting loads with independently adjustable on and off time of between one and 255 minutes.
4. Output advisory if loads are not available to satisfy required shed amount, advise shed requirements.

5. Operator commands:
   a. Add/delete demand meter point.
   b. Define load point.
   c. Define load priority target.
   d. Define control target.
   e. Begin new billing period.
   f. Lock/unlock program.
   g. Activate/inactivate/restore load.
   h. Request load control system control summary.
   i. Request load control system load summary.
6. Load control system summary:
   a. Demand interval
   b. Current kW power and measured demand.
   c. Projected load limit.
   d. Total energy available from HVAC system
   e. Maximum, average, and current expendable load.
   f. Maximum, average and current deferrable load.
   g. Demand limit status, target value, and recent control action.
   h. Duty cycle status, target value, and recent control action.
   i. Convergence time.
   j. Restore band width.
7. Load summary:
   a. Load priority.
   b. Expendable/deferrable load type.
   c. Point type, ID, status.
   d. Load rating.
   e. Minimum off, maximum off, and minimum on times.

C. Duty Cycling:
   1. Periodically turn selected loads off to evenly reduce power consumption to target value, selecting loads with independently adjustable on and off time of between one and 255 minutes.
   2. Operator commands:
      a. Define load point.
      b. Define control target.
      c. Activate/inactivate/restore load.
      d. Request load control system load summary.

2.10 PROGRAMMING APPLICATION FEATURES

A. Trend Point:
   1. Sample up to [_____] points, real or computed, with each point capable of collecting [_____] samples at intervals specified in minutes, hours, days, or

month.

2. Output trend logs as line graphs or bar graphs. Output graphic on terminal, with each point for line and bar graphs designated with a unique [pattern] [color], vertical scale either actual values or percent of range, and horizontal scale time base. Print trend logs up to 12 columns of one point/column.

B. Alarm Messages:
   1. Allow definition of minimum of [_____] messages, each having minimum length of [_____] characters for each individual message.
   2. Assign alarm messages to system messages including point's alarm condition, point's off-normal condition, totalized point's warning limit, hardware elements advisories.
   3. Output assigned alarm with "message requiring acknowledgement".
   4. Operator commands include define, modify, or delete; output summary listing current alarms and assignments; output summary defining assigned points.

C. Weekly Scheduling:
   1. Automatically initiate equipment or system commands, based on preselected time schedule for points specified.
   2. Provide program times for each day of week, per point, with one minute resolution.
   3. Automatically generate alarm output for points not responding to command.
   4. Provide for holidays, minimum of 366 consecutive holidays.
   5. Operator commands:
      a. System logs and summaries.
      b. Start of stop point.
      c. Lock or unlock control or alarm input.
      d. Add, delete, or modify analog limits and differentials.
      e. Adjust point operating position.
      f. Change point operational mode.
      g. Open or close point.
      h. Enable/disable, lock/unlock, or execute interlock sequence or computation profile.
      i. Begin or end point totalization.
      j. Modify totalization values and limits.
      k. Access or secure point.
      l. Begin or end HVAC or load control system.
      m. Modify load parameter.
      n. Modify demand limiting and duty cycle targets.

6. Output summary: Listing of programmed function points, associated program times, and respective day of week programmed points by software groups or time of day.

D. Interlocking:
   1. Permit events to occur, based on changing condition of one or more associated master points.
   2. Binary contact, high/low limit of analog point or computed point shall be capable of being utilized as master. Same master may monitor or command multiple slaves.
   3. Operator commands:
      a. Define single master/multiple master interlock process.
      b. Define logic interlock process.
      c. Lock/unlock program.
      d. Enable/disable interlock process.
      e. Execute terminate interlock process.
      f. Request interlock type summary.

3 PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install electrical work in accordance with Section 16180. Electrical material and installation shall be in accordance with appropriate requirements of Division 16.

C. Provide with 120v AC, 15 amp dedicated emergency power circuit to each programmable control unit.

3.2 MANUFACTURER'S FIELD SERVICES

A. Prepare and start systems under provisions of Section 01600.

B. Start-up and commission systems. Allow sufficient time for start-up and commissioning prior to placing control systems in permanent operation.

C. Provide service engineer to instruct Owner's representative in operation of systems plant and equipment for 3 day period.

D. Provide basic operator training for 2 persons on data display, alarm and status descriptors, requesting data, execution of commands and request of logs. Include a minimum of 40 hours dedicated instructor time.

3.3 DEMONSTRATION

A. Provide systems demonstration.

B. Demonstrate complete and operating system to Owner.

3.4 INPUT/OUTPUT SCHEDULE

POINT DESCRIPTION	POINT	POINT	POINT
Digital Input			
Demand Meter (kw)			
Auxiliary Contact			
Switches			
Switch Closing			
Flow Switch			
Optical			
Current			
Pressure			
Digital Output			
Control Relay			
Solenoid			
Contactor			
Analog Input			
Temperature Sensors			
Outdoor Air Space			
Pipe Supply			
Pipe Return			
Duct Supply			
Duct Return			
Duct Mixed Air			
Stack Temperature			
Humidity Sensors			
Outdoor			
Space			
Duct			
Pressure/Vacuum			
Filter			
Flow			
Current			
Liquid Level			
Photocell			
Alarm			

3.5 ALARM SCHEDULE

TYPE	DESCRIPTION
A1	High Limit
A2	Low Limit
A3	Run Time
A4	Maintenance
A5	Status
A6	Override
A7	Freeze
A8	Low Pressure

END OF SECTION

SECTION 15980

SVE INSTRUMENTATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Positive displacement meters.

B. Flow meters.

C. Pressure gages and pressure gage taps.

D. Thermometers and thermometer wells.

E. Static pressure and filter gages.

1.2 RELATED SECTIONS

A. Section 11340 - Soil Vapor Extraction Equipment

B. Section 15975 - Direct Digital Control Systems.

1.3 REFERENCES

A. ASME B40.1 - Gages - Pressure Indicating Dial Type -Elastic Element.

B. ASME MFC-3M - Measurement of Fluid Flow in Pipes Using Orifice, Nozzle and Venturi.

C. ASTM D2458 - Method of Flow Measurement by The Venturi Motor Tube.

D. ASTM E1 - Specification for ASTM Thermometers.

E. ASTM E77 - Verification and Calibration of Liquid-in-Glass Thermometers.

F. AWWA C700 - Cold Water Meters - Displacement Type.

G. AWWA C701 - Cold Water Meters - Turbine Type for Customer Service.

H. AWWA C702 - Cold Water Meters - Compound Type.

I. AWWA C706 - Direct Reading Remote Registration Systems for Cold Water Meters.

J. AWWA M6 - Water Meters - Selection, Installation, Testing, and Maintenance.

K. FS-GG-G-76 - Gages, Pressure and Vacuum, Dial Indicating (for Air, Steam, Oil, Water, Ammonia, Chloro- Fluorohydrocarbon Gases, and Compressed Gases).

L. ISA RP 3.2 - Flange Mounted Sharp Edged Orifice Plates for Flow Measurement

1.4 SUBMITTALS

A. Submit under provisions of Section [01300.] [01340.]

B. Product Data: Include list which indicates use, operating range, total range and location for manufactured components.

C. Samples: Submit two of each type of instrument specified.

D. Submit manufacturer's installation instructions under provisions of Section 01300.

1.5 PROJECT RECORD DOCUMENTS

A. Submit documents under provisions of Section 01700.

B. Accurately record actual locations of instrumentation.

1.6 ENVIRONMENTAL REQUIREMENTS

A. Do not install instrumentation when areas are under construction, except for required rough-in, taps, supports and test plugs.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. [_____] Model [_____.]

B. [_____] Model [_____.]

C. [_____] Model [_____.]

D. Substitutions: Under provisions of Section 01030.

2.2 POSITIVE DISPLACEMENT METERS (LIQUID)

A. [AWWA C700,] [AWWA C701,] [AWWA C702,] positive displacement disc type suitable for fluid with hermetically sealed register, [remote reading to AWWA C706.]

B. Provide water meters with bronze case with cast iron frost-proof, breakway bottom cap.

C. Where metering service downstream of utility company meter, meter provided shall be same manufacture as utility company meter.

M. Model [_____] manufactured by [_____.]

2.3 AIR FLOW METERS

A. Calibrated venturi orifice plate and flanges with valved taps, chart for conversion of differential pressure readings to flow rate, with pressure gage in case.

B. Annular element flow stations with meter set.

1. Measuring Station: Stainless steel nipple section or weld insert type, rated to 275 psig (1 896 kPa) at 400 degrees F (204 degrees C), with safety shut-off valves and quick coupling connections, and permanent metal tag indicating design flow rate, reading for design flow rate, metered fluid, line size, station or location number. Accuracy of flow measuring elements shall be plus or minus 0.55 to minus 2.30 percent.

2. Portable Meter Set: Dry single diaphragm type pressure gage with 6 inch (150 mm) dial pointer, stainless steel wetted metal parts, variable pulsation damper, equalizing valve, two bleed valves, and master chart for direct conversion of meter readings to flow rate, mounted in rust-proof carrying case with two ten foot (3 m) long rubber test hoses with brass valves or quick connections for measuring stations.

C. Model [_____] manufactured by [_____.]

2.4 PRESSURE GAGES

A. ASME B40.1, FS-GG-G-76 [2- inch (50 mm)] [2-1/2 inch (65 mm)] [3-1/2 inch (90 mm)] [4-1/2 inch (115 mm)] diameter drawn steel case, phosphor bronze bourdon tube, rotary brass movement, brass socket, with front recalibration adjustment, black scale on white background, one percent mid-scale accuracy, scale calibrated in both psi and kPa, Model [_____] manufactured by [_____.]

B. ASME B40.1, FS-GG-G-76 [3-1/2 inch (90 mm)] [4-1/2 inch (115 mm)] [6 inch (150 mm)] diameter cast aluminum case, phosphor bronze bourdon tube, rotary brass movement, brass socket, front recalibration adjustment, black figures on white background, one percent mid-scale accuracy, scale calibrated in both psi and kPa, Model [_____] manufactured by [_____.]

2.5 PRESSURE GAGE TAPS

A. Gage Cock: Tee or lever handle, brass for maximum 150 psig (1034 kPa), Model [_____] manufactured by [_____.]

B. Needle Valve: [Brass] [Steel] [Stainless Steel] for maximum [_____] psig ([_____] kPa), Model [_____] manufactured by [_____.]

C. Pulsation Damper: Pressure snubber, brass with 1/4 inch (6 mm) connections, Model [_____] manufactured by [_____.]

D. Syphon: Steel, Schedule 40, 1/4-inch (6 mm) angle or straight pattern, Model [_____] manufactured by [_____.]

2.6 STEM TYPE THERMOMETERS

A. ASTM E1, [7 inch (175 mm)] [9 inch (225 mm)] [12 inch (300 mm]) scale, red appearing mercury, lens front tube, cast aluminum case with enamel finish and clear glass or polycarbonate window, [_____] inch ([_____] mm) brass stem, 2 percent of scale accuracy [to ASTM E77] scale calibrated in both degrees F and degrees C, Model [_____] manufactured by [_____.]

B. ASTM E1, [7 inch (175 mm)] [9 inch (225 mm)] [12 inch (300 mm)] scale, adjustable angle, red appearing mercury, lens front tube, cast aluminum case with enamel finish and clear glass window, [_____] inch ([_____] mm) brass stem, cast aluminum adjustable joint with positive locking device, 2 percent of scale accuracy [to ASTM E77], scale calibrated in both degrees F and degrees C, Model [_____] manufactured by [_____.]

2.7 DIAL THERMOMETERS

A. ASTM E1, [2 inch (50 mm)] [2-1/2 inch [60 mm)] [3 inch (75 mm)] [3-1/2 inch (90 mm)] [5 inch (125 mm)] [_____] diameter dial in stainless steel case, bimetallic helix actuated with silicone fluid damping, white with black markings and black pointer hermetically sealed glass lens, stainless steel stem, one percent of full scale accuracy, calibrated in both degrees F and degrees C, Model [_____] manufactured by [_____.]

B. ASTM E1, [3 inch (75 mm)] [5 inch (125 mm)] [_____] diameter dial in stainless steel case, adjustable angle with front recalibration, bimetallic helix actuated with silicone fluid damping, white with black markings and black pointer hermetically sealed glass lens, stainless steel stem, one percent of full scale accuracy, calibrated in both degrees F and degrees C, Model [_____] manufactured by [_____.]

C. ASTM E1, [2-1/2 inch [60 mm)] [3-1/2 inch (90 mm)] [4-1/2 inch (115 mm)] [6 inch (150 mm)] [_____] diameter dial in [stainless steel] [drawn steel with enamel finish] case, vapor or liquid actuated with brass or copper bulb, [5 feet (1 500 mm)] [6 feet (1 800 mm)] (10 feet (3 000 mm)] copper or bronze braided capillary, white with black markings and black pointer glass lens, 2 percent mid-scale accuracy, calibrated in both degrees F and degrees C, Model [_____] manufactured by [_____.]

2.8 THERMOMETER SUPPORTS

A. Socket: Brass separable sockets for thermometer stems with or without extensions as required, and with cap and chain.

B. Flange: 3 inch (75 mm) outside diameter reversible flange, designed to fasten to sheet metal air ducts, with brass perforated stem.

2.9 TEST PLUGS

A. Test Plug: 1/4 inch (6 mm) or 1/2 inch (13 mm) brass fitting and cap for receiving 1/8 inch (3 mm) outside diameter pressure or temperature probe with Viton core for temperatures up to 400 degrees F (204 degrees C), Model [_____] manufactured by [_____.]

B. Test Kit: Carrying case, internally padded and fitted containing two [2-1/2 inch (60 mm)] [3-1/2 inch (90 mm)] diameter pressure gages, two gage adapters with 1/8 inch (3 mm) probes, two [one inch (25 mm)] [1-1/2 inch (38 mm)] dial thermometers, Model [_____] manufactured by [_____.]

2.10 STATIC PRESSURE GAGES

A. [3-1/2 inch (90 mm)] [_____] diameter dial in metal case, diaphragm actuated, black figures on white background, front recalibration adjustment with tubing, static pressure tips, Model [_____] manufactured by [_____.]

D. Inclined manometer, red liquid on white background with black figures, front recalibration adjustment with tubing, static pressure tips, Model [_____] manufactured by [_____.]

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install positive displacement meters with isolating valves on inlet and outlet. Provide full line size valved bypass with globe valve for liquid service meters.

C. Provide one pressure gage per pump, installing taps before strainers and on suction and discharge of pump. Pipe to gage.

D. Install pressure gages with pulsation dampers. Provide [gage cock] [needle valve] to isolate each gage.

E. Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than 2-1/2 inch (60 mm) for installation of thermometer sockets.

F. Install thermometers in air duct systems on flanges.

G. Install thermometer sockets adjacent to controls system thermostat, transmitter, or sensor sockets. Refer to Section 15975. Where thermometers are provided on local panels, duct or pipe mounted thermometers are not required.

H. Locate duct mounted thermometers minimum 10 feet (3 m) downstream of mixing dampers, coils, or other devices causing air turbulence.

I. Coil and conceal excess capillary on remote element instruments.

J. Provide instruments with scale ranges selected according to service with largest appropriate scale.

K. Install gages and thermometers in locations where they are easily read from normal operating level.

L. Locate test plugs [adjacent to thermometers and thermometer sockets.] [adjacent to pressure gages and pressure gage taps.] [adjacent to control device sockets.] [where indicated.]

3.2 POSITIVE DISPLACEMENT METER SCHEDULE

LOCATION	SCALE RANGE
Domestic cold water	

3.3 FLOW METER SCHEDULE

LOCATION	SCALE RANGE

3.4 PRESSURE GAGE SCHEDULE

LOCATION	SCALE RANGE
Pumps	
Pressure tanks	
Standpipe, highest points	
Pressure reducing valves	
Backflow preventers	

3.5 PRESSURE GAGE TAP SCHEDULE

LOCATION	SCALE RANGE
Control valves 1 inch (25 mm) & larger - inlets and outlets	

3.6 STEM TYPE THERMOMETER SCHEDULE

LOCATION	SCALE RANGE
Headers to central equipment	
Water zone supply and return	
Domestic hot water supply and recirculation	

3.7 THERMOMETER SOCKET SCHEDULE

LOCATION	SCALE RANGE
Control valves 1 inch (25 mm) & larger - inlets and outlets	

3.8 DIAL THERMOMETER SCHEDULE

LOCATION	SCALE RANGE
Each supply air zone	
Outside air	
Return air	
Mixed air	

3.9 STATIC PRESSURE AND FILTER GAGE SCHEDULE

LOCATION	SCALE RANGE

END OF SECTION

SECTION 16A

GENERAL PROVISIONS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope: CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified, and required to complete the electrical Work.

B. Coordination:

1. Review installation procedures under other Sections and coordinate the installation of items that must be installed with the formwork, walls, partitions, ceilings and panels.
2. Coordinate the electrical Work with the work by others including electrical work furnished as part of the sludge incineration system as specified in Sections 13A and 13F3.

C. General:

1. Dimensions shown on the Drawings that are related to equipment are based on one manufacturer's equipment. Coordinate the dimensions of the equipment furnished with the space allocated for that equipment.
2. The Drawings show the principal elements of the electrical installation. They are not intended as detailed working drawings for the electrical Work but as a complement to the Specifications to clarify the principal features of the electrical systems.
3. It is the intent of this Section that all equipment and devices, furnished and installed under this and other Sections, be properly connected and interconnected electrically with other equipment so as to render the installations complete for successful operation, regardless of whether all the connections and interconnections are

specifically mentioned in the Specifications or shown on the Drawings.

4. Mounting heights of switches, receptacles, fixtures and other devices noted in the Specifications and on the Drawings are to the bottom of the device.

D. Temporary Power:

1. Temporary light and power for construction purposes to be utilized by all trades on the project shall be provided in accordance with Section 1G1, Temporary Construction Facilities.

1.2 QUALITY ASSURANCE

A. Requirements of Regulatory Agencies:

1. Permits: Obtain all permits required to commence Work and, upon completion of the Work, obtain and deliver to the ENGINEER a Certificate of Inspection and Approval from the State Board of Fire Underwriters or other authority having jurisdiction.
2. Codes: Material and equipment shall be installed in accordance with the current standards and recommendations of the National Electrical Code, the National Electrical Safety Code and with local codes which apply. Where discrepancies arise between codes, the most restrictive regulation shall apply.
3. Tests by Independent Regulatory Agencies: Electrical material and equipment shall be new and shall bear the label of the Underwriters' Laboratories, Inc., or other nationally-recognized, independent testing laboratory, wherever standards have been established and label service regularly applies.

B. Reference Standards: Electrical material and equipment shall conform in all respects to the latest approved standards of the following:

1. National Electrical Manufacturers Association (NEMA).
2. The American National Standards Institute (ANSI).
3. The Institute of Electrical and Electronic Engineers (IEEE).
4. Insulated Power Cable Engineers Association (IPCEA).

5. National Electrical Code (NEC).
6. National Electrical Safety Code (NESC).

1.3 SUBMITTALS

A. General: Conform to requirements of Section 1E4.

B. Shop drawings shall include the following information to the extent applicable to the particular item:
   1. Manufacturer's name and product designation or catalog number.
   2. Electrical ratings.
   3. Conformance to applicable standards or specifications of ANSI, ASTM, ICEA, IEEE, ISA, NEC, NEMA, NFPA, OSHA, UL, or other organizations.
   4. Dimensioned plan, section, and elevations showing means for mounting, conduit connection, and grounding.
   5. Materials and finish specification, including paints.
   6. List of components including manufacturer's names and catalog numbers.
   7. Internal wiring diagram indicating all connection to components and numbered terminals for external connections.
   8. Manufacturer's instructions and recommendations for installation, operation, and maintenance.
   9. Manufacturer's recommended list of spare parts.

1.4 PROJECT CLOSEOUT

A. Operation and Maintenance Data: Conform to requirements of Section 113.

B. Provide certificate of compliance from State Board of Fire Underwriters or other authorities having jurisdiction upon job completion prior to submission of final payment.

C. Record Drawings: In addition to the requirements of Section 1E4 the record drawings shall include the following:

1. One line wiring diagrams of the 277/480 volt and 120/208 volt distribution systems.
2. Actual in place conduit and cable layouts with schedule of conduit sizes and number and size of conductors.
3. Layouts of the lighting arrangements.
4. Control wiring diagrams with terminal numbers and all control devices identified.

1.5 PRODUCT DELIVERY

A. Delivery of Materials: CONTRACTOR shall instruct the manufacturers and vendors as to the maximum shipping sizes of equipment that can be accommodated at the site.

B. Storage: Electrical equipment and material shall be stored and protected in accordance with Sections 1G17, "Storage of Material".

1.6 IDENTIFICATION OF EQUIPMENT

A. All electrical items shall be identified. Identification shall be in addition to the manufacturer's nameplates and shall serve to identify the item's function and the equipment or system which it serves or controls.

B. All new equipment shall be identified by means of laminated phenolic nameplates incised to show one-inch high, white letters on a black background. Labels shall be fastened by means of 3/16-inch diameter, round-head, stainless steel, self-tapping screws. Equipment whose designation has been changed shall be relabeled accordingly.

C. Wires and cables shall be color coded and identified by means of wire markers.

D. Raceways shall be identified by means of brass tags.

E. Pull and junction boxes shall be identified with laminated phenolic nameplates showing the names of the feeders or system wires and cables passing through them.

F. The text, size, and type of lettering, and the location of identifying labels or tags, shall be submitted for approval.

1.7 JOB CONDITIONS

A. CONTRACTOR shall examine the site and existing facilities in order to compare them with the Drawings and Specifications with respect to the conditions of the premises, location of and connection to existing facilities and any obstructions which may be encountered.

B. CONTRACTOR is cautioned to perform his work with due regard to safety and in a manner that will not interfere with the existing equipment or in any way cause interruption of any of the functions of the plant.

C. Work shall be carried out with a minimum amount of disruption to the operation of the existing plant and with prior approval of OWNER. The CONTRACTOR shall submit, for approval, a detailed written procedure for work which affects operation of the existing plant, a detailed procedure for modifying any existing electrical equipment, and anticipated time required to complete the work and the required shutdown time, if any.

D. Where the work of the CONTRACTOR ties in with existing installations, the CONTRACTOR shall take prior precautions and safeguards in connecting the new work with the existing operating circuits so as to prevent extended interruption to the normal operation of the existing equipment or existing operating circuits. The tying in of new work, installed under this Contract, with the existing circuits shall be performed only in the presence of the OWNER. Advance notice will be required before any equipment is removed from service. The CONTRACTOR shall notify OWNER in writing of his intention to do such work, giving full details.

1.8 AREA CLASSIFICATIONS

A. Wet Locations: The following areas shall be considered wet locations:

1. All outdoor areas.
2. All indoor areas below grade unless otherwise specified.
3. Indoor areas above grade where designated on the Drawings. Materials, equipment and incidentals in areas identified as wet locations shall meet NEC and NEMA requirements for wet locations. Enclosures installed in wet locations shall meet NEMA 4 requirements as a minimum and NEMA 4X requirements where specified. Conduits shall be terminated at enclosures with watertight, threaded hubs.

END OF SECTION

SECTION 16B1

RIGID CONDUIT

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish and install conduits, fittings, and pullboxes to form complete, coordinated and grounded raceway systems.
2. The types of conduit required include the following:
   a. Rigid steel conduit for exposed indoor conduit runs in non-corrosive areas.
   b. PVC coated rigid steel for exposed exterior conduit runs.
3. Unless otherwise shown, all interior conduits and wireways shall be run exposed.

B. Coordination:

1. Conduit runs shown are diagramatic. Coordinate conduit installation with piping, ductwork, lighting fixtures and other systems and equipment and locate so as to avoid interferences.

C. Related Work Specified Elsewhere:

1. Section 16B2, Flexible Conduits.

1.2 QUALITY ASSURANCE

A. Reference Standards: Comply with applicable provisions and recommendations of the following except where otherwise shown or specified:

1. NEC Article 346, Rigid Metal Conduit.
2. NEC Article 347, Rigid Nonmetallic Conduit.

3. UL Standard No. 6, Rigid Metal Electrical Conduit.
4. UL Standard No. 514, Electrical Outlet Boxes and Fittings.
5. UL Standard No. 651, Schedule 40 and 80 PVC Conduit.
6. UL Standard 1242, Intermediate Metallic Conduit.
7. ANSI C80.1, Specification for Zinc Coated Rigid Steel Conduit.
8. ANSI C80.4, Specification for Fittings for Rigid Metal Conduit and Electrical Metallic Tubing.
9. NEMA TC2, Electrical Plastic Tubing, Conduit and Fittings.
10. NEMA TC3, PVC Fittings for Use with Rigid PVC Conduit and Tubing.

1.3 SUBMITTALS

A. Shop Drawings: Submit for approval the following:
   1. Manufacturer's catalog cuts and technical information for the conduit, fittings and supports proposed for use.
   2. Layout drawings showing proposed routing of exposed conduits. Drawings shall show locations of pull and junction boxes and all penetrations in walls and floor slabs.

B. Record Drawings: Include the actual routing of exposed conduit runs on record drawings.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Rigid Steel Conduit, Elbows and Couplings:
   1. Material: Rigid, heavy wall, mild steel, hot dip galvanized, inside and out smooth interior, tapered threads and carefully reamed ends; 3/4-inch NPS minimum size.
   2. Manufacturers: Provide material manufactured by one of the following:
      a. Allied Tube and Conduit Corporation.
      b. Republic Steel Corporation.

B. PVC Coated Rigid Steel Conduit, Elbows and Couplings:

1. Material: Rigid, heavy wall, mild steel, hot dip galvanized inside and out, smooth interior, tapered threads, carefully reamed ends, 3/4-inch NPS minimum size with a factory coating of 40 mil thick polyvinyl chloride, outside, 3 mil phenolic coating inside.
2. Color: Color of coating shall be the same on all conduit and fittings.
3. Manufacturers: Provide material manufactured by one of the following:
   a. Robroy Industries.
   b. Republic Steel Corporation.

C. Conduit Fittings and Outlet Bodies:

1. Material and Construction: Cast gray iron alloy or cast malleable iron bodies and covers. Outdoor units to be gasketed and watertight. Gaskets to be of an approved type designed for the purpose. Improvised gaskets not acceptable. All units to be threaded type with five full threads. Material to conform to ANSI C80.4 and be listed by UL. Fittings and bodies in or on PVC coated conduit runs to have a factory-applied coating of 40 mil thick polyvinyl chloride.
2. Manufacturers: Provide material manufactured by one of the following:
   a. Crouse-Hinds Company.
   b. Appleton Electric Company.
   c. Robroy Industries.

D. Conduit Hubs:

1. Material: Threaded conduit hub, vibration proof, weather proof with captive o-ring seal, zinc metal with insulated throat. Hubs used on PVC cated conduit systems shall have a factory applied PVC coating.
2. Use: Provide for all conduit terminations to boxes, cabinets and other enclosures located in areas designated as wet locations.

3. Manufacturer: Provide material manufactured by Myers Electrical Products Company.

E. Conduit Tags:

1. Material: 19 gauge, 1-1/2-inch diameter round brass with back-filled legend, Style #250-BL as manufactured by Seton Nameplate Corporation.

F. 1. Wireway: Oil tight, lay in type, JIC complete with all connections and fittings as manufactured by Square D Co.

PART 3 - EXECUTION 3.1 INSTALLATION

A. Install in conformance with National Electrical Code requirements.

B. Dissimilar Metals:

1. Take every action to prevent the occurrence of electrolytic action between dissimilar metals.
2. Do not use copper products in connection with aluminum work, and do not use aluminum in locations subject to drainage of copper compounds on the bare aluminum.

C. Supports:

1. Rigidly support conduits by clamps, hangers, channels or conduit racks.
2. Support single conduits by means of one-hole pipe clamps in combination with one-screw back plates, to raise conduits from the support surface. Support multiple runs of conduits on trapeze type hangers with steel horizontal members and threaded hanger rods, Kindorff or equal. Rods shall be not less than 3/8-inch diameter, and shall be cadmium coated.
3. For PVC coated rigid steel conduit runs, supports and hardware shall be PVC coated or stainless steel.
4. One-piece Nylon 12 corrosion resistant supports or clamps similar to "Clic" devices by Litchfield International Inc. may be used.

D. Fastenings: Fasten raceway systems rigidly and neatly to supporting structures by the following methods:

1. To Wood: Wood screws.
2. To Hollow Masonry Units: Toggle bolts.
3. To Brick Masonry: Price expansion bolts, or equal.
4. To Concrete: Phillips; Hilti Corporation; or equal, anchors.
5. To Steel: Welded threaded studs, beam clamps or bolts with lockwashers or locknuts.
6. In corrosive areas metallic bolts, screws, clips, etc. shall be stainless steel.
7. To any of the above: Nylon 12 "Clic" devices by Litchfield International Inc.

E. Plug or cap conduit ends at the time of installation to prevent the entrance of moisture and foreign materials.

F. Empty Conduits:

1. Install nylon pull wire in each empty conduit and cap conduits not terminating in boxes with permanent fittings designed for the purpose.
2. Identify each empty conduit with a durable tag showing the conduit number indicated on the Drawings.

G. Orientation:

1. Install parallel or perpendicular to structural members or walls, unless concealed.
2. Wherever possible, run in groups.
3. Install on structural members in protected locations.
4. Locate clear of interferences.
5. Locations on Drawings are approximate.

H. Clearance: Maintain 6 inches from hot fluid lines and 1/4 inch from walls.

I. End Cuts: Square and ream to prevent damage to wire and cable.

J. Field Bends: No indentations. Diameter of conduit shall not vary more than 15 percent at any bend.

K. Threads:

1. Apply conductive compound, Kopr-Shield by T&B Corporation to all joints before assembly.
2. Make up joints tight and ground thoroughly.
3. Conduit and fitting threads to be standard tapered pipe threads. Standard straight thread conduit couplings permitted only on exposed indoor conduit runs. Running threads not permitted.
4. Use strap wrenches and vises to install conduit. Conduit with wrench marks shall be replaced.

L. Insulated Bushings:

1. Provide insulated bushings on all conduits entering boxes or cabinets.
2. Provide locknuts on both inside and outside of enclosures except where threaded humbs are provided.
3. Bushings not to be used in lieu of locknuts.

M. Vertical Drops:

1. Rigidly support from equipment or building.
2. Unsecured drop length not to exceed 12 feet.
3. Install vertical runs plumb. No diagonal runs.

N. Thruwall Seals: Install for conduits passing through exterior subsurface walls or base slabs of buildings.

O. Drainage:

1. Pay particular attention to drainage for conduit runs.
2. Wherever possible, install conduit runs so as to drain to one end and away from buildings.
3. Take extreme care to avoid pockets or depressions in conduit.

P. Conduit Curb:

1. In concrete slabs or floors, provide a two inch high curb extending two inches from the outer surface of the conduit penetrating the floor, to prevent corrosion.
2. Terminate conduit stub-ups in couplings, slightly above the finished concrete curb.

Q. Couplings: Provide full threaded conduit couplings. Split couplings shall not be permitted.

R. For individual exposed conduits passing through walls, install nonmetallic sleeves to protect the conduit against action of alkaline substances which may be present.

S. Before concrete is placed, make the necessary location measurements of the conduit to be embedded so that the information is available to prepare record drawings.

T. PVC Coating: Field apply a 40 mil thick polyvinyl chloride coating to metallic supports and fasteners for PVC coated conduit runs, or use Nylon 12 "Clic" supports.

U. Core drill for individual conduits passing through existing concrete walls or slabs. Obtain authorization from OWNER prior to core drilling. Seal spaces around conduit with epoxy grout.

V. Conduit Racks: Provide galvanized conduit racks of suitable width, length and height and arranged to suit field conditions. Support shall be provided at every ten feet minimum.

U. Signal Conduits: Provide separate steel conduits for 4-20 mA signal cables. Route conduits separate from power conduits and from equipment such as motors, transformers, and inverters, etc. which may generate electrical noise.

3.2 TESTING

A. Test conduits by pulling through each conduit a cylindrical mandrel not less then two pipe inside diameters long, having an outside diameter equal to 90 percent of the inside diameter of the conduit.

B. Maintain a record, by number, of all conduits testing clear.

3.3 IDENTIFICATION

A. Tag all conduits at the ends and in all intermediate boxes, chambers, handholes and other enclosures. Fasten tags to conduits with No. 14 AWG insulated copper wire. Where this method is not practicable, fasten to the adjacent masonry by means of approved expansion screws.

B. Assign serial numbers to all conduits and a record of the conduit numbers and the cable content by cable designation, size, quantity, origin of conductors, and name of equipment served. Submit conduit identification numbering system for approval. Enter the approved conduit identification numbers on as-built drawings.

END OF SECTION

SECTION 16B2

FLEXIBLE CONDUITS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope: CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish and install flexible metallic conduit and fittings.

1.2 QUALITY ASSURANCE

A. Reference Standards: Comply with applicable provisions and recommendations of the following except where otherwise shown or specified.

1. NEC Article 351, Liquid-Tight Flexible Metal Conduit.
2. UL Standard No. 360, Liquid-Tight Flexible Steel Conduit.

1.3 SUBMITTALS

A. Shop Drawings: Submit for approval the following:

1. Manufacturer's catalog literature, specifications and technical data for flexible conduit and fittings proposed for use.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Flexible Conduit:

1. Material: Flexible galvanized steel core with smooth, abrasion-resistant, liquid-tight, polyvinyl chloride cover. Continuous copper ground built in for sizes 3/4-inch through 1-1/4 inch. Material shall be UL listed.

2. Product and Manufacturer: Provide one of the following:
   a. Sealtite UA by Anaconda Metal Hose Division, Anaconda American Brass Company.
   b. Liquatite Type L.A. by Electric-Flex Company.

B. Flexible Conduit Fittings:
   1. Material and Construction: Malleable iron with cadmium finish. Fittings shall adapt the conduit to standard threaded connections, shall have an inside diameter not less than that of the corresponding standard conduit size and shall be UL listed.
   2. Manufacturers: Provide products of one of the following:
      a. Crouse-Hinds Company.
      b. Appleton Electric Company.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install at motors and equipment which are subject to vibration or require movement formaintenancepurposes- Provide necessary reducer where equipment furnished cannot accept 3/4-inch size flexible conduit. Limit flexible conduit length to three feet maximum and install only where required as noted above.

B. Install in conformance with National Electrical Code requirements.

END OF SECTION

SECTION 16B3

PULL AND JUNCTION BOXES

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope: CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish and install pull and junction boxes.

1.2 QUALITY ASSURANCE

A. Reference Standards: Comply with applicable provisions and recommendations of the following except where otherwise shown or specified:

1. NEC Article 370, Outlet, Switch and Junction Boxes, and Fittings.
2. UL Standard No. 50, Electrical Cabinets and Boxes.

1.3 SUBMITTALS

A. Shop Drawings: Submit for approval the following:

1. Manufacturer's technical information for pull and junction boxes proposed for use.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Junction and Pull Boxes:

1. Material and Construction:
   a. Cast gray iron alloy or cast malleable iron bodies and covers. Cadmium finish.

b. Neoprene gaskets. Gaskets to be of an approved type designed for the purpose. Improvised gaskets not acceptable.

c. Stainless steel cover screws.

d. External mounting lugs.

e. Drilled and tapped conduit holes.

f. Boxes where conduits enter a building below grade shall have 1/4-inch drain hole.

2. Boxes for damp, wet or corrosive locations shall meet NEMA 4X requirements.

3. Large boxes not available in cast construction shall be fabricated from type 304 stainless steel. Boxes shall have continuously welded seams. Welds shall be ground smooth. Box bodies shall be flanged and shall have no holes or knockouts. Box bodies shall not be less than 14 gauge metal and covers shall not be less than 12 gauge metal. Covers shall be fastened with stainless steel screws. Covers on pull boxes larger than 24-inch x 24-inch shall have handles and shall be reinforced and rigid.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Mount boxes so that sufficient access and working space is provided.

B. Securely fasten boxes to walls or other structural surfaces on which they are mounted. Provide independent galvanized steel supports where no walls or other structural surface exists.

C. Install pull boxes in runs containing more than three 90 degree bends, runs exceeding 200 feet, where indicated on the Drawings and where reuqired to conform with the National Electrical Code.

D. Size junction and pull boxes in accordance with the requirements of the National Electrical Code.

E. Provide terminal blocks in junction boxes where junction or splices are required in cables. Terminal blocks shall be so located as to be readily accessible without interference from wire and cables within the box.

END OF SECTION

SECTION 16C1

600 VOLT CABLE

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish and install 600 volt cable.

B. Related Work Specified Elsewhere:

1. Section 16E, Grounding System for ground cable.

1.2 QUALITY ASSURANCE

A. Requirements of Regulatory Agencies:

1. Codes: Cable shall be installed in accordance with the standards and recommendations of the National Electrical Code and with local codes which apply. Where discrepancies arise between codes, the most restrictive regulation shall apply.
2. Tests by Independent Regulatory Agencies: Cable shall bear the label of the Underwriters' Laboratories, Inc.

B. Reference Standards: Comply with applicable provisions and recommendations of the following except where otherwise shown or specified:

1. ASTM B 3, Soft or Annealed Copper Wire.
2. ASTM B 8, Concentric-Lay-Stranded Copper Conductors, Hard, Medium-hard or Soft.
3. IPCEA S-66-524, NEMA WC7-1971, Cross-linked-thermosetting-polyethylene-insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.
4. National Electrical Code.

5. UL Standard No. 44, Wires and Cables, Rubber-Insulated.

1.3 SUBMITTALS

A. Shop Drawings: Submit for approval the following:

1. Manufacturer's literature, specifications, and engineering data for 600 volt insulated cable.

B. Test Records: Submit for review copies of written records of field insulation resistance test results.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Insulated Cable In Raceways:

1. Material: Single conductor copper cable conforming to ASTM B 3 and B 8 with flame-retardant, moisture and heat resistant cross-linked polyethylene or thermoplastic insulation rated 90C in dry locations and 75C in wet locations and listed by UL as Type XHHW or THHN/THWN.
2. Application: Use XHHW for #4 and larger and THHN/THWN or XHHW for #6 and smaller.
3. Wire Sizes: Not smaller than No. 12 AWG for power and lighting and No. 14 AWG for control.
4. Stranding: All 600 volt cable shall be stranded except that solid cable, size 12 and smaller may be used for lighting circuits.
5. Product and Manufacturer: Provide material manufactured by one of the following:
   a. The Okonite Company.
   b. Pirelli Cable Corporation.

B. Multi-Conductor Aerial Cable:

1. Provide assembly of 3-1/C-X HHW-500MCM and 1-1/c #4/OX HHW cabled together with stranded copper-clad steel messenger and copper banding strip.
2. Messenger shall be 9/16" diameter formax span of 150' feet with sag of 2.5' @ 60°F.

C. Cable Connectors, Solderless Type:

1. For stranded wire sizes up to #6 AWG, use compression type.
2. Product and Manufacturer: Provide one of the following:
   a. T&B Sta-Kon.
   b. Burndy Hylug.
3. For sizes #4 AWG and above, use either compression type or bolted type with silver-plated contact faces.
4. For sizes #250 MCM and larger, use connectors with at least 2 cable clamping elements or compression indents and provision for at least 2 bolts for joining to apparatus terminal.

D. Cable Markers:

1. Product and Manufacturer: Provide one of the following:
   a. Omni-Grip by W.H. Brady Company.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install all cables complete with proper terminations at both ends. Check and correct for proper phase sequence and proper motor rotation.

B. Pulling:

1. Use insulating types of pulling compounds containing no mineral oil.
2. Pulling tension shall be within the limits recommended by the wire and cable manufacturer.
3. Use a dynamometer where mechanical means are used.
4. Cut off section subject to mechanical damage.

C. Bending Radius: Limit to 6 times cable overall diameter.

D. Slack: Provide maximum slack at all terminal points.

E. Splices:

1. Where possible, install cable continuous, without splice, from termination to termination.
2. Where required, splice in junction box using terminal boards.
3. Splices in conduits not allowed.

F. Identification: Identify all conductors by circuit number and phase at each terminal or splice location.

G. Color code power cables in accordance with OWNER standard.

3.2 TESTING

A. Test each electrical circuit after permanent cables are in place to demonstrate that the circuit and connected equipment perform satisfactorily and that they are free from improper grounds and short circuits.

B. Individually test 600 volt cables for insulation resistance between phases and from each phase to ground. Test after cables are installed and before they are put in service with a 1000 volt Megger whose rating is suitable for the tested circuit. Tests shall meet with the applicable specifications of IPCEA S-66-524 and NEMA WC7-1971.

C. The insulation resistance for any given conductor shall not be less than the value recommended by the IPCEA or a minimum of 1 megohm for 600 volt and less service, if not IPCEA listed. Any cable not meeting the recommended value or which fails when tested under full load conditions shall be replaced with a new cable for the full length.

END OF SECTION

SECTION 16C4

INSTRUMENTATION CABLE

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope: CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish and install instrumentation cable.

1.2 SUBMITTALS

A. Shop Drawings: Submit for approval the following:

1. Manufacturer's literature, specifications and technical data for instrumentation cable proposed for use.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Single Shielded Pairs:

1. Tinned copper, stranded conductors, No. 18 AWG minimum, twisted with aluminum-polyester shield, stranded tinned 20 AWG copper drain wire and overall chrome vinyl jacket. Rated for 300 volts minimum.
2. Products and Manufacturers: Provide one of the following:
   a. Okonite Type P-OS.
   b. Belden #8760.

B. Multipaired Shielded:

1. Tinned copper, 7 strand XLPE insulated conductors, No. 18 AWG minimum, twisted in pairs with aluminum-mylar shield over each pair, silicone rubber fiberglass fire barrier tape, tinned copper drain wire, aluminum mylar overall shield, Hypalon outer jacket.

2. Products and Manufacturers: Provide one of the following:
   a. Okonite Type SP-OS.
   b. Dekoron Poly-set.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install instrumentation cables in conduit separate from power cables unless otherwise noted.

B. Ground shield at one end only and as recommended by instrument manufacturer.

C. Terminate stranded conductors with pre-insulated crimp type spade or ring torque terminals.

D. Install and terminate vendor furnished cable in accordance with vendor equipment requirements.

E. Install in conformance with National Electrical Code.

3.2 TESTING

A. Test all 600 volt wiring in conformance with the requirements of Section 16C1, 600 Volt Cable.

B. Test shielded instrumentation cable shields with an ohmeter for continuity along the full length of the cable and for shield continuity to ground.

C. Connect shielded instrumentation cables to a calibrated 3-20milliamp DC signal transmitted and receiver. Test at 4, 12, and 20 milliamp transmitter settings.

END OF SECTION

SECTION 16C5

HEAT TRACING CABLE

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope: CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified to furnish and install freeze protection heat tracing cable.

1.2 SUBMITTALS

A. Detail Drawings: Submit for approval the following:

1. Manufacturer's catalog literature, specifications and technical data for self-limiting heat-tracing cable proposed for use.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Tinned copper conductors encased in a conductive/resistive core material, with an insulating inner jacket and outer protective jacket.

B. Product and Manufacture: Provide one of the following:

1. Raychem - Chemelex Auto Trace®
2. Chromalox-Self-Regulating Rapid-Trace®
3. AC Industries - Power Trace®

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install on piping, and valves (process and domestic H_2O) subject to freezing. Provide all necessary materials, including power connection kit, splice kits, grommets and end seals.

B. Install in conformance with design specifications, vendor instructions and the NEC.

END OF SECTION

SECTION 16D4

DISCONNECT SWITCHES

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope: CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish and install disconnect switches as shown and specified and as required by the National Electrical Code.

1.2 QUALITY ASSURANCE

A. Reference Standards: Comply with applicable provisions and recommendations of the following except where otherwise shown or specified:

1. National Electrical Code.
2. UL #98, Enclosed Switches.
3. NEMA KS-1, Enclosed Switches.

1.3 SUBMITTALS

A. Shop Drawings: Submit for approval the following:

1. Manufacturer's technical information for disconnect switches proposed for use.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Disconnect Switches:

1. Type: Unfused, horsepower rated, heavy-duty, single throw, two pole and three pole with visible blade and safety handle.

2. Enclosure: NEMA 12 for dry, indoor locations, and NEMA 4X for indoor damp, wet or corrosive locations and all outdoor locations.
3. Provide nameplate identifying equipment being disconnected.
4. Manufacturers: Provide products of one of the following:
   a. Square D Company.
   b. General Electric Company.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Mount equipment so that sufficient access and working space is provided for ready and safe operation and maintenance. Mount all disconnect switches four feet above floor level.

B. Securely fasten equipment to walls or other structural surfaces on which they are mounted. Provide independent galvanized steel supports where no wall or other structural surface exists.

C. Install disconnect switches where shown on the Drawings. In addition, install disconnect switches at each field mounted instrument, device or panel which receives 120, 208, 240 or 480 volt power.

D. Install in conformance with National Electrical Code.

END OF SECTION

SECTION 16E

GROUNDING SYSTEM

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope: CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish and install complete grounding for the electrical system.

1.2 QUALITY ASSURANCE

A. Reference Standards: Comply with applicable provisions and recommendations of the following except where otherwise shown or specified:

1. NEC Article 250, Grounding.
2. UL Standard #467, Electrical Grounding and Bonding Equipment.

1.3 SUBMITTALS

A. Shop Drawings: Submit for approval the following:

1. Manufacturer's technical information for grounding materials proposed for use.
2. Listing of grounding connector types identifying where they are to be used.
3. Layouts of each structure ground grid.
4. Test point construction details.
5. Results of ground resistance tests are each test point.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Bare Ground Cable:

1. Material: Annealed, bare, stranded copper, No. 4/0 AWG minimum size, for ground conductor installed in the earth, No. 6 minimum for equipment ground.
2. Manufacturers: Provide material manufactured by one of the following:
   a. Wire and Cable Division of Cablec Inc.
   b. General Cable Corporation.
   c. Rome Cable Corporation.

B. Ground Rods:
1. Material: Copper clad rigid steel rods, 3/4-inch diameter, 10 feet long.
2. Manufacturer: Provide ground rods by one of the following:
   a. Copperweld, Bimetallics Division.
   b. ITT Blackburn Company.

C. Grounding Connectors:
1. Material: Pressure connectors to be copper alloy castings, designed specifically for the items to be connected, and assembled with Durium or silicone bronze bolts, nuts and washers. Welded connections to be by exothermic process utilizing molds, cartridges and hardware designed specifically for the connection to be made.
2. Product and Manufacturer: Provide material manufactured by one of the following:
   a. Pressure Connectors:
      1) Burndy Corporation.
      2) O.Z./Gedney, Division of General Signal Corporation.
   b. Welded Connections:
      1) Cadweld by Erico Products, Incorporated.
      2) Therm-O-Weld by Burndy Corporation.

PART 3 - EXECUTION

3.1 STRUCTURE GROUND SYSTEM

A. Provide a #4/0 bare copper cable ground grid, minimum 2 feet-6 inches below grade, as shown on the Drawings.

B. Install ground rods to provide a resistance to ground of less than 5 ohms.

C. Install #4/0 ground cable from grid to columns as shown on the Drawings. Connect cable to steel using exothermic welds.

D. Connect grids to a continuous underground water pipe system when practical.

E. Provide accessible test point for measuring the ground resistance of each grid.

F. Weld all buried connections except for test point.

3.2 EQUIPMENT GROUNDING

A. Ground all electrical equipment in compliance with the National Electrical Code.

B. Equipment grounding conductors shall be bare stranded copper cable of adequate size installed in metal conduit where necessary for mechanical protection. Ground conductors pulled into conduits with ungrounded conductors shall be insulated, color coded green.

C. Connect ground conductors to conduit with copper clamps, straps or with grounding bushings.

D. Connect to piping by welding or brazing. Use copper bonding jumpers on all gasketed joints.

E. Connect to equipment by means of lug compressed on cable end. Bolt lug to equipment frame using holes or terminals provided on equipment specifically for grounding. Do not use holddown bolts. Where grounding provisions are not included, drill suitable holes in locations designated by the Engineer.

F. Connect to motors by bolting directly to motor frames, not to sole plates or supporting structures.

G. Connect to service water piping by means of copper clamps. Use copper bonding jumpers on all gasketed joints.

H. Scrape bolted surfaces clean and coat with a conductive oxideresistant compound.

3.3 INSTRUMENT GROUND SYSTEM

A. Install ground conductor from incinerator control panel to grid in one inch PVC conduit to isolate conductor from structural steel, or other grounded equipment grounding conductors.

3.4 TESTING

A. Test the complete ground systems for continuity and for resistance to ground using an electrical ground resistance tester.

END OF SECTION

SECTION 16F9

LIGHTING AND DISTRIBUTION PANELBOARDS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope: CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish and install lighting and distribution panelboards.

1.2 QUALITY ASSURANCE

A. Reference Standards: Comply with applicable provisions and recommendations of the following except where otherwise shown or specified:

1. NEC Article 384, Switchboards and Panelboards.
2. UL Standard #50, Electrical Cabinets and Boxes.
3. UL Standard #67, Electric Panelboards.
4. NEMA PBl, Panelboards.

1.3 SUBMITTALS

A. Shop Drawings: Submit for approval the following:

1. Manufacturer's literature, specifications and technical data for panelboards proposed for use.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Panel boards:

1. Rating: Voltage rating, current rating, number of phases, number of wires and number of poles shall be as indicated on the Drawings.
2. Circuit Breakers: Molded case, bolt-in thermal magnetic type with number of poles and trip ratings as shown on the Drawings. Provide ground fault interrupters with trip rating where shown on the Drawings.
3. Branch circuit interrupting capacity minimum 10,000 ampere rms symmetrical; for lighting panels, a minimum 55,000 ampere rms symmetrical for power panel boards.
4. Bus Bars: 98 percent conductivity copper. All 4-wire panelboards shall have a solid neutral bar. All panels shall have ground bus.
5. Main circuit breaker for all panelboards.
6. Branch circuit breakers connected for sequence phasing.
7. Directory: Typed card, with glass cover in frame on back of door giving the circuit numbers and the area or equipment served.
8. Construction Indoor noncorrosive area: Code grade steel, ample gutter space, flush door, flush snaplatch and lock. Surface or flush trim as required.
9. Products and Manufacturers: Provide one of the following:
   a. 120/208 volt Panels
      1) "Type NAB" by General Electric Company.
      2) Westinghouse Electric Corporation.
   b. 277/480 Volt Panels:
      1) "Type NHB" by General Electric Company.
      2) Westinghouse Electric Corporation.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Mounting: Install panelboards at locations shown on Drawings. Set cabinets so that top branch circuit breaker is not over 6 feet from the floor. Existing panelboards shall remain in place.

B. Directory: Complete typewritten directory indicating items controlled by each circuit breaker and the size of feeder serving the panel.

C. Balance the loads on the panelboards.

D. Modify existing lighting panel, provide new breakers where shown on Contract Drawings. Revise circuit directory to reflect changes.

END OF SECTION

SECTION 16G1

LIGHTING FIXTURES

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope: CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish and install lighting fixtures and to revise and reconnect existing lighting and receptacle systems.

B. Coordination: Coordinate location of fixtures with piping, ductwork, openings and other systems and equipment and locate clear of interferences.

C. Related Work Specified Elsewhere:
   1. Section 16D1, Outlet Boxes.
   2. Section 16D2, Snap Switches.

1.2 QUALITY ASSURANCE

A. Reference Standards: Comply with applicable provisions and recommendations of the following except where otherwise shown or specified:
   1. National Electrical Code.
   2. UL Standard #57, Electric Lighting Fixtures.
   3. UL Standard #1570, Fluorescent Lighting Fixtures.
   4. UL Standard #1571, Incandescent Lighting Fixtures.
   5. UL Standard #1572, High Intensity Discharge Lighting Fixtures.

1.3 SUBMITTALS

A. Shop Drawings: Submit for approval the following:

1. Manufacturer's catalog literature, specifications, photometric data and other technical information for lighting fixtures proposed for use.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Type: Lighting fixtures are noted in the Fixture Schedule at the end of this Section. Fixtures to be complete with supports, ballasts, lamps and incidentals as required.

B. Lamps:
   1. Fluorescent: Warm white, energy efficient type.
   2. High Pressure Sodium: Coated.

C. Ballasts:
   1. Fluorescent: High power factor, energy efficient type, equipped with thermal protectors (Type "P" Ballast), compatible with lamps installed.
   2. High Intensity Discharge: High power factor, constant wattage, stabilized autotransformer with line starting current the same or less than operating current. Low temperature (minus 20°C) where specified.
   3. Ballasts to have "C" sound rating (min.) and be ETL/CBM certified.
   4. Fixtures with 2-two lamp ballasts shall be wired with outboard lamps on one ballast and one circuit, and inner lamps on one ballast on second circuit. Ballasts shall be capable of operating on power supplies having up to 70 percent harmonic distortion.

D. Hardware: All necessary hangers, supports, conduit adapters, reducers, hooks, brackets and other hardware required for safe fixture mounting shall be furnished. Hardware shall have a protective, non-corrosive finish.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Fixture mounting heights and locations indicated on the Drawings are approximate and are subject to revision in the field where necessary to clear conflicts and obstructions.

B. Suspended Fixtures: Pendant mount using 1/2-inch conduit stems. Ground to outlet box. Attach mounting to building structure with expansion anchors. Fixtures shall not be dependent upon the outlet box cover screws for support, unless approved by the ENGINEER.

C. Surface Mounted Fixtures: Attach to appropriate outlet box.

D. Boxes and Fixtures:

1. For units mounted against masonry or concrete walls, provide suitable 1/2-inch spacers to prevent mounting back of box directly against wall.
2. Bolt units rigidly to building with expansion anchors, toggle bolts, hangers or Unistrut.
3. No boxes shall be installed with open conduit holes.
4. Cable each circuit and identify with tag.

E. Mounting Heights: Mounting heights or elevations are to bottom of the fixture or to centerline of device.

F. Install fixtures in conformance with the National Electrical Code.

G. Existing fixtures which are temporarily removed and reinstalled shall be cleaned, repaired and relamped with new lamps of the same wattage and type as existing.

LIGHTING FIXTURE SCHEDULE

Type	General Description	Mfgr. & Cat No.
B	Wall mounted, enclosed & gasketed, fixture with borosilicate prismatic glass refractor for 100 watt HPS lamp, HPF ballast with 120 volt fused primary.	Holophane #WL2K-100HP12GR-F1 HiTek-TW 100S-SF
E	Shall be on adjustable sealed beam floodlight for operation on a 24 Volt DC battery power supply. Batteries per Notes A&B below.	Dual-Lite Model NF-600-28 Watt Orthobeam 28 Watt Fixture Emergi-lite Double 18 Watt High Intensity Incandescent, EF-9D or equal.
F	Pendant mounted industrial open fluorescent fixture, 4' long with 2x40 W RS lamps, 120 volt, Imperial, white porcelain enameled reflector, with 20-30% uplight.	Miller Cat. No. IL-2101-04-120V
FC	Surface mounted, fluorescent fixture with clear acrylic prismatic wrap around diffuser for 2-40W T12 RS 40 watt lamps. Ballast 120 volts.	Lithonia WA-240A-120V Miller DB-2101-04-120V
FL	Same as Type "F" with attached louver.	
FP	Recessed 2'x4' fluorescent troffer for four (4) F40-T12 rapid start lamps with two 2-lamp type "P" 120V ballasts (one for outside lamps). Fixture shall have an aluminum covered parabolic shaped plastic lens 1-1/2"x1-1/2x1" louver in hinged door frame for installation in a grid ceiling with exposed T-bar supports.	Lightolier Ventilline Air Handling Cat. No. 64675 Lithonia 2GP440-PC-2-14QV Lightron AFG440-PC-II (2x4) Keystone #2SG440-PWS-120
H	Ceiling or pendant mounted open industrial type fixture with high bay reflector for 150 watt HPS 100 volt lamp, HPF ballast with 120 volt fused primary and hot instant restrike capability.	Appleton G-HB41AL-MT-HRS Holophane #PP5K150-HP12POM35-F1

H-1	Ceiling or pendant mounted open reflector industrial type fixture for low mounting with 150 watt HPS-IOOV lamp, HPF ballast with 120 volt fused primary.	Appleton G-1M452L-MT, Hitek-TG150SALW-120-SF
H-2	Same as Type "A2" with instant restrike feature to restore lamp output upon return of power supply to fixture.	Appleton G-LM452L-MT-HRE Hitek-TG150SALW-120-SF-Instant Restrike
I	Recessed quare fluorescent fixture with two (2) 13W PL lamps with prismatic glass, dicast aluminum trim. Matte white finish and suitable for damp locations, plaster frame and suitable for operation on 120 volts.	Prescolite Cat. No. CF10SQ2S-1-120V

Note:

(A) Provide 24 volt DC battery power supply for each stairway emergency lighting. Battery system shall be capable of supplying 328 watts for 1-1/2 hours, to not less than 87.5 percent of nominal system voltage (24 V) equal to Dual-LiteModel 120-24-C-L21XL-MON-XBFA, sealed extra long life lead batteries. Including options ACCB-LVD a set and GLS.

(B) Provide 24 volt DC battery power supply for equipment area, control rooms, MCC room etc. Battery system shall be capable of supplying 1700 watts for 1-1/2 hours, to not less than 87.5 percent of nominal. Equal to Dual-Lite Model 120-24-C-L26XL-MON-XBFA, sealed extra long life batteries, including options ACCB-LVD-ASET and GLS.

END OF SECTION

SECTION 16H1

MOTOR CONTROL CENTERS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope: CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish and install motor control centers.

B. Coordination:
1. Obtain motor nameplate data on equipment being furnished for properly sizing circuit breakers, starters and overloads.
2. Coordinate motor starter schematics with control requirements of local control panels.

C. Related Sections:
1. Section 3D, Cast-In-Place Concrete for concrete pad.
2. Section 13F3, Sludge Incineration System for motor control center furnished with the incineration system equipment.

1.2 QUALITY ASSURANCE

A. Reference Standards: Comply with applicable provisions and recommendations of the following except where otherwise shown or specified:
1. UL Standard #845, Electric Motor Control Centers.
2. NEMA ICS2-322, AC General Purpose Motor Control Centers.
3. National Electrical Code.

1.3 SUBMITTALS

A. Shop Drawings: Submit for approval the following:

1. Manufacturer's technical information for motor control centers proposed for use.
2. Outline and summary sheets with schedules of equipment in each unit.
3. Unit control schematic and elementary wiring diagrams showing numbered terminal points and interconnections to other units.
4. MCC terminal compartment wiring diagrams showing external connections to field devices, control panels and to MCC starter units.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Motor control center lineups shall be provided as shown on the Drawings.
   1. Service: Voltage rating and number of wires shall be as shown on the Drawings. MCC shall operate from a 3 phase, 60 hertz system.
   2. Wiring: NEMA Class II, Type B.
   3. Enclosure: NEMA 12.

B. Construction:
   1. Totally enclosed structure, dead front, consisting of nominal 20-inch deep, 20-inch wide, 90-inch high vertical sections bolted together to form a unit assembly.
   2. Removable lifting angles for each shipping section.
   3. Two removable floor sills for mounting.
   4. Horizontal wireways top and bottom, isolated from horizontal bus and readily accessible.
   5. Isolated vertical wireways with cable supports, accessible through hinged doors, for each controller section.
   6. All metal non-conducting parts electrically continuous.

C. Bus System:
   1. Rating: Bus bracing and bus current capacities as indicated on the Drawings.

E. Spare Parts:

1. Provide the following spare parts for each motor control center lineup:
   a. Two fuses of each size and type used.
   b. One auxiliary control relay with at least two normally open and two normally closed contacts.
   c. One control transformer of each size used.
   d. Twelve indicating lamps.
2. Package spare parts in suitable containers bearing labels clearly indicating the contents and equipment with which they are to be used. Deliver spare parts at the same time as the motor control centers.

F. Product and Manufacturer: Provide motor control centers of one of the following:

1. 8000 Line by General Electric Company.
2. Model 4 by Square D Company.
3. Centerline by Allen Bradley Company.
4. Unitrol by Cutler Hammer.
5. System 89 by Furnas Electric.
6. Series 2100 by Westinghouse Electric Corporation.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install on raised concrete base at locations shown on the Drawings. Install support channels in concrete per manufacturer's recommendations.

B. For installations against masonry walls, provide an insulation board, 1/4 inch minimum thickness, between motor control center and wall for corrosion protection. Trim board neatly within outline of unit.

C. Provide no openings in top or side of units not required for conduit.

D. Cable circuits together within enclosures and identify with durable tag secured to cabling twine.

E. Set motor circuit protectors at lowest setting which permits motor starting without nuisance tipping.

F. Field test all motor control center components.

G. Verify that wiring diagrams on inside of door of each compartment reflects the "as-built" circuitry and that the correct overload heater size and motor circuit protector setting are noted.

H. Install in conformance with the National Electrical Code.

3.2 MANUFACTURER TRAINING SERVICES

A. CONTRACTOR shall furnish the services of qualified factory trained specialists from the manufacturer to instruct OWNER'S operations and maintenance personnel in the recommended operation and maintenance of this equipment.

END OF SECTION

2. All bus bars tin plated copper rated UL heat rise standards.
3. Bus bar connections easily accessible with simple tools.
4. Main Horizontal Bus: Continuous edge mounted, and isolated from wireways and working areas.
5. Vertical Bus: Continuous, and isolated by a glass polyester barrier.
6. Grounding Bus: Full length mounted across the bottom, drilled with lugs of appropriate capacity as required.
7. Neutral Bus: Insulated, continuous through control center for 4 wire services, drilled with lugs of appropriate capacity as required.

D. Unit Compartments:

1. Individual front door for each unit compartment with engraved nameplate identifying equipment. Nameplates to be 1 inch by 3 inches minimum, secured to unit door with two screws.
2. Starter and feeder-unit doors interlocked mechanically with the unit disconnect device to prevent unintentional opening of the door while energized and unintentional application of power while door is open, with provisions for releasing the interlock for intentional access and application of power.
3. Padlocking arrangement permitting locking the disconnect device in the OFF position with at least three padlocks with the door closed or open.
4. NEMA 1 minimum motor starter size. Starter units completely drawout type in Sizes 1 and 2 and drawout type after disconnecting power leads only in Sizes 3 and 4.
5. Motor starters shall include a magnetic contactor, NEMA rated with encapsulated magnet coils. Wound coils not acceptable.
6. Reversing Starters: Single speed full voltage with two contactors and extra interlocking contacts.
7. Reduced Voltage Starters: Autotransformer, closed-transition type with embedded type overtemperature protection. Set on 65 percent starting tap unless otherwise noted.
8. Overload Relays: Three melting alloy type, manually reset from outside the enclosure by means of an insulated button with normally open auxiliary contact for remote alarm purposes and

separate heater elements sized for the full load amperes and service factor of the actual motors furnished.

9. Individual control power transformers for all starters, capacity as required for all control circuit devices, 10OVA minimum, Class A insulation, two primary fuses, 120 volt secondary, one secondary fuse and the other secondary leg grounded.

10. Separate Control: Where control power to starter is provided by a separate power source, a control power fuse shall be provided in the unit and the main disconnect shall be equipped with a normally open contact to isolate the control circuit from the source when the controller disconnect is open.

11. Motor horsepowers shown are preliminary. Circuit breaker trips and starter overload heaters to be coordinated with the actual equipment installed.

12. Auxiliary contacts, relays, timers as required for specified control functions and those shown on the Drawings.

13. All starter devices, including spare contacts wired to numbered terminal blocks.

14. Control devices shall be 600 volt heavy duty, NEMAA600. Relays shall have convertible contacts. Pilot devices shall be oiltight. Pilot lights shall be transformer type with 6 volt secondary.

15. Feeder Circuit Breakers: Thermal magnetic type.

16. Motor Starter Circuit Breakers: Magnetic trip only motor circuit protectors.

17. Terminal Compartments: Provide separate compartments in each motor control center complete with terminal blocks for terminating external control wiring to the incinerator and automatic temperature control panels. Connections between the terminal compartments and MCC starter units shall be factory wired.

18. Provide the following diagrams and tables on the inside of the door for each compartment: a. Elementary wiring diagram.

    b. Table of overload heater sizes with the correct heater highlighted.

    c. Table of the motor circuit protector settings with the correct setting highlighted.

SECTION 16H2

MAGNETIC MOTOR STARTERS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope: CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish and install motor starters and circuit breakers in existing motor control centers and individually enclosed motor starters.

1.2 QUALITY ASSURANCE

A. Reference Standards: Comply with applicable, provisions, and recommendations of the following except where otherwise shown or specified.

1. NEMA Standard ICS2-110, General Standards for Manual and Magnetic Controllers.
2. NEMA Standard ICS2-321 AC General Purpose Class A Controller for Squirrel Cage Induction Motors, 600 volts and less.
3. UL Electrical Construction Materials Directory (NLDX).
4. National Electrical Code.

1.3 SUBMITTALS

A. Shop Drawings: Submit for approval the following:

1. Manufacturer's literature, specifications and technical data for all magnetic motor starters proposed for use, including control schematics and wiring diagrams shown on the drawings and for the reduced voltage auto transformer type.
2. Drawings showing proposed modifications to existing MCC structures and front panels, to accommodate added starters and circuit breakers, etc.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General:

1. Type: Magnetic coil operated, FVNR, horsepower rated at 480 volts, 3 pole, with three thermal phase overload protection, set per NEC for motor nameplate full load.
2. Functional Type:
   a. Circuit breaker combination starter with thermal magnetic circuit breaker, with integral current limiting fuse, as required for installation in existing motor control centers.
   b. Auto transformer reduced voltage magnetic starter with taps for 50, 65 and 80 percent with contactors for 2 step starting. Tap shall be set as shown on the drawings or as required to accelerate the motor controlled, along with equipment connected.
3. Enclosures: Existing motor control centers and NEMA-1 enclosure for 250 HP reduced voltage auto-transformer starter.
4. Control power transformer fused on primary with two fuses, fused and grounded on low voltage side for each starter.
5. Auxiliary contacts for motor space heaters, remote status signals and interlocks as shown on the Drawings.
6. Three overload relays of the temperature compensated type with overload heaters sized to coordinate with actual motor nameplate being controlled.
7. Nameplate identifying the equipment controlled.
8. Normally open overload contact for remote malfunction.

B. Products and Manufacturers: Provide one of the following:

1. Westinghouse Electric Corporation.
2. General Electric.
3. Allen Bradley.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Mount equipment so that sufficient access and working space is provided for safe operation and maintenance.

B. Securely fasten enclosure to wall or other mounting surfaces. Where local wall is not available, provide galvanized steel supports to rigidly support equipment reasonably close to motor.

C. Modify existing motor control centers as shown on contract drawings. All the circuit breakers to have interrupting capacity and withstand to meet requirements of existing available short circuit. Existing starters, breakers and motor control center were furnished by Westinghouse Electric Corporation. All components shall fit into existing equipment and meet all requirements.

D. Install in conformance with the National Electrical Code.

END OF SECTION

SECTION 16H3

DRY TYPE TRANSFORMERS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope: CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish and install dry type 480 volt - 120/280 volt transformers.

1.2 QUALITY ASSURANCE

A. Reference Standards: Comply with applicable provisions and recommendations of the following except where shown or specified:

1. National Electrical Code - Article 450
2. NEMA Standards

1.3 SUBMITTALS

A. Shop Drawings: Submit for approval copies of manufacturer's technical information for transformers proposed for use.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Dry type transformers shall be provided as shown on drawings:

1. Service: KVA, and voltage as shown on drawing
2. Use natural air draft as cooling medium
3. Average temperature rise of 55° C (Class A) to 150° C (Class H) and may be forced-air cooled with fans.

4. The insulation materials used do not support flame, (self-extinguishing).
5. Full capacity taps; 2 1/2 percent above and below normal.

B. Product and Manufacture: Provide one of the following:

1. Sylvania
2. Westinghouse
3. Square D

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install dry type transformer as indicated on power plan.
1. Terminate all incoming and outgoing wiring in compartment provided.
2. Identify all terminations.

END OF SECTION

SECTION 16H4

CONTROL STATIONS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope: CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish and install pushbuttons, selector switches and other control stations.

1.2 QUALITY ASSURANCE

A. Reference Standards: Comply with applicable provisions and recommendation of the following except where otherwise shown or specified.

1. NEMA Standard ICS2-216, Pushbutton, Selector Switches, Indicating Lights and Pushbutton Stations.
2. National Electrical Code.

1.3 SUBMITTALS

A. Shop Drawings: Submit for approval copies of manufacturer's technical information for control stations proposed for use.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Control Stations:

1. Type: Industrial, heavy duty, oiltight construction with clearly marked legend plates.
2. Lockout Stop: Two pushbutton maintained contact type.
3. Pushbutton: Momentary type.

4. Selector Switches: Rotary type with round or oval handles and positioning device to securely hold switch in selected position.
5. Indicating Lights: Transformer type with 6 volt lamp. Lens color red for running, green for stopped or ready and amber for failure.
6. Enclosure: NEMA 12 for dry indoor non-hazardous locations, and NEMA 4X for outdoor and damp, wet or corrosive indoor locations.
7. Nameplates identify equipment controlled if not readily apparent.
8. Products and Manufacturers: Provide one of the following:
   a. Westinghouse Electric Corporation.
   b. General Electric Company.
9. Components for MCC's shall match existing, insofar as same are available.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Mount equipment so that sufficient access and working space is provided for ready and safe operation and maintenance.

B. Securely fasten equipment to walls or other surfaces on which they are mounted. Provide independent galvanized steel supports where no wall or other surface exists.

C. Install in conformance with National Electrical Code.

END OF SECTION