SECTION IV

CONSTRUCTION SPECIFICATIONS

TECHNICAL SPECIFICATIONS

New Creamery Road Sewage Pump Station
Town of Emmitsburg, Maryland

Bid Submission

STATE OF MARYLAND
JEFFREY SCOTT GROW
22765
PROFESSIONAL ENGINEER

Divisions 1-15

Professional Certification. I hereby certify that these documents were prepared or approved by me, and that I am a duly licensed professional engineer under the laws of the State of Maryland.
License No. 22765 Expiration Date: 07/09/2024

STATE OF MARYLAND
D. TIMOTHY BOLLINGER
50811
PROFESSIONAL ENGINEER

Divisions 16 & 17

Professional Certification. I hereby certify that these documents were prepared or approved by me, and that I am a duly licensed professional engineer under the laws of the State of Maryland.
License No. 50811 Expiration Date: 06/14/2023

JANUARY 2023

Prepared By:

RK&K

700 East Pratt Street, Suite 500
Baltimore, Maryland 21202

TECHNICAL SPECIFICATIONS

TABLE OF CONTENTS

SECTION 01000

GENERAL REQUIREMENTS

PART 1 - GENERAL

1.01 DESCRIPTION

A. These Technical Specifications are hereby made a part of the Contract. In case of any conflict with the Frederick County General Conditions and Standard Specifications for Water Mains, Sanitary Sewers and Related Structures, or other sections of the Contract, these Technical Specifications shall govern.

B. All work to be performed under this Contract shall be done in strict compliance with the Frederick County General Conditions and Standard Specifications for Water Mains, Sanitary Sewers and Related Structures as amended, insofar as the same may be applicable except as modified herein.

1.02 BACKGROUND

A. Contract Documents were prepared for the Project by RK&K, 700 East Pratt Street, Suite 500, Baltimore, MD 21202 out of the York, Pennsylvania branch office. Phone 717.600.2220 or 800.787.2755.

B. The Drawings and written Contract Documents are intended to indicate as clearly as practicable the work to be done. The Contractor must realize; however, that construction details cannot always be accurately anticipated and that in executing the work, field conditions may require reasonable modifications in the details of the Drawings and the work involved. Work under the Contract shall be carried out to meet these field conditions to the satisfaction of the Engineer and in strict conformance with his instructions, the Drawings, conditions and covenants of the Contract Documents in accordance with their true intent and full meaning.

1.03 WORK PERIODS AND HOLIDAYS

A. The normal time of work for this Contract is limited to 40 hours per week and shall generally be between the hours of 7:00 a.m. and 5:00 p.m., Monday through Friday. The Contractor may elect to work beyond these hours or on weekends provided that all costs incurred by the Owner for additional engineering and costs associated with additional resident project representative (RPR) and Town employee inspection time shall be borne by the Contractor. The Contractor must submit a written request to work outside the normal hours to the inspector for the project and it must be approved by the Town. This request shall be completed five (5) business days in advance of the occurrence for working outside normal hours.

B. The Owner shall deduct the cost of additional inspection and engineering costs from monies due the Contractor.

C. If it shall become imperative to perform work at night, the Owner and Engineer shall be informed according to Paragraph 1.03.A a reasonable time in advance of the beginning of such work. Only such work shall be done at night as can be done satisfactorily and in a first class manner. Sufficient temporary lighting and all other necessary facilities for carrying out and inspecting the work and for the safety of personnel shall be provided and maintained at all points where such work is being done.

D. Unless otherwise specifically permitted, all work that would be subject to damage shall be stopped during inclement, stormy or freezing weather. Only such work as will not suffer injury to workmanship or materials will be permitted. Contractor shall carefully protect his work against damage or injury from the weather, and when work is permitted during freezing weather, he shall provide and maintain approved facilities for heating the materials and for protecting the finished work.

E. The Town observes the following holidays: New Year's Eve; New Year's Day; Martin Luther King Jr. Day; Good Friday; Memorial Day; Juneteenth Day; Independence Day; Labor Day; Columbus Day; Veteran's Day; Thanksgiving Day; Thanksgiving Friday; Christmas Eve; and Christmas Day.

F. Permission to Work

1. Except as noted below, the Contractor will not be permitted to do any work which requires the services of the Town's inspection or RPR more than nine hours a day nor on the days on which the abovementioned holidays are observed by the Town or on Saturdays or Sundays, unless otherwise authorized by the Engineer in writing. However, the Contractor with verbal permission of the Engineer, may be permitted to perform clean-up and such other items for which no specific payment is involved on Saturdays.

2. In case of extreme emergency, which may require that the work be done on Saturdays, Sundays, holidays or longer than nine hours per day, the Contractor shall request permission of the Engineer to perform work. If, in the opinion of the Engineer, the work is bona fide, he may grant permission of the Contractor to work such hours as may be necessary. Also, if in the opinion of the Engineer a bona fide emergency exists, he may direct the Contractor to work such hours as may be necessary whether the Contractor requests permission to do so or not.

1.04 DEMOLITION

A. Exterior Dust Control: To prevent unnecessary spread of dust during performance of exterior demolition work, thoroughly moisten surfaces and debris as required to prevent dust from being a nuisance to the public, neighbors and concurrent performance of other work on the site. Water for use in dust control shall be obtained from the Contractor's own source.

B. Protection: Exercise care during demolition work to confine demolition operations to those as indicated on the Drawings. The physical means and methods used for protection are at the Contractor's option.

1. Additionally, if public safety is endangered during the progress of the demolition work, provide adequate protective measures to protect public pedestrian and vehicular traffic on streets and walkways.

2. Signs, signals and barricades used shall conform to requirements of Federal, State and local laws, rules, regulations, precautions, orders and decrees.

C. Materials needed or required for temporary protection in the form of barricades, fences, enclosures, etc., may be pre-used construction materials of sound condition and reasonably clean. However, the condition of same materials shall meet or exceed the requirements of governing agencies or approving bodies as may be involved with the work.

D. The means and methods of performing demolition (and removal) operations are the sole responsibility of the Contractor. However, equipment used and methods of demolition (and removal) will be subject to approval of the Engineer.

1.05 TRAILERS, STAGING AND MATERIAL/EQUIPMENT STORAGE

A. Obtaining area(s) for placement of job trailer(s), staging and materials/equipment storage, if needed, is the responsibility of the Contractor. Written permission is required for use of any private properties and Owner approval is required for any proposed use of public street rights-of-ways for location of trailers, parking of equipment, or staging of materials. No special permission is required for temporary storage of materials on streets and/or sewer easements where such materials are being installed.

1.06 CONTRACTOR USE OF PREMISES

A. General: Limit use of the premises to construction activities in areas indicated; allow for use by the public.

B. Confine operations to area within property limits. Portions of the site beyond the property limits are not to be disturbed.

C. Keep driveways and entrances servicing the premises clear and available to the public at all times. Do not use these areas for parking or storage of materials. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on site.

1.07 PROGRESS SCHEDULE

A. General:

1. Scheduling of construction is the responsibility of the Contractor. The Contractor must take all reasonable action to avoid or to mitigate the effects of delays including, but not limited to, rescheduling or resequencing the work, accepting other work, and reassigning personnel. When the Contractor is responsible for any delays, the Owner may order the Contractor to accelerate construction, work overtime, add additional shifts or manpower, work on weekends, or to do anything else reasonably necessary to complete the work on time, at no additional cost to the Owner.

2. The Contractor shall submit to the Owner for review and approval a Baseline Schedule, Monthly Progress Schedules, and any required Recovery Schedules, as outlined in Paragraphs B through F of this section.

3. Failure of the Contractor to comply with the requirements of this section shall be grounds for determination by the Owner that the Contractor is not prosecuting the work with due diligence as to ensure completion of the work within the time specified in the Contract Documents or as agreed upon with the Owner after execution of the Contract. The Owner may terminate the Contractor's right to proceed with the work, or any separable part thereof.

4. The Contractor does not have the unilateral right to complete the work late and pay liquidated or other damages.

B. Baseline Schedule:

1. Within 30 days after the award of the Contract, the Contractor shall submit to the Owner a detailed Baseline Schedule indicating the time allocated by the Contractor for performance of each portion of the work. The schedule shall show commencement of work from the date the Notice to Proceed is issued. The schedule shall show completion of the work within the Contract time as specified in the Contract Documents or as agreed upon with the Owner after execution of the Contract.

2. The submitted Baseline Schedule shall be properly and reasonably sequenced to show the order of performing the various tasks of work. The schedule shall clearly identify the sequencing restraints and the critical activities necessary to complete the work on time and shall list proposed workdays, holidays and any special non-work days.

3. The submitted Baseline Schedule shall list the dollar value for each work item and shall show the Contractor's labor requirements for achieving each work item. The schedule shall also include a list of submittals related to material and equipment fabrication orders, permits, easements and any other work tasks requiring submittals. Each necessary submittal shall be

shown on the schedule as a separate work activity with necessary dates of submittal, anticipated review and response time, anticipated dates of re-submittal if necessary, and anticipated dates for final review and approval. Submittal review and response time shall be a minimum of 21 working days. A longer review and response time may be required for large or complex submittals, at the Engineer's discretion.

4. Within 14 calendar days after the Owner reviews and rejects or conditionally approves the submitted Baseline Schedule, the Contractor shall make all necessary corrections and resubmit the corrected schedule. The Owner may decline to issue Notice to Proceed until the Contractor submits the required schedule and the Owner approves it.

C. Monthly Progress Schedules:

1. Within 30 days after the Owner issues Notice to Proceed, and on monthly basis thereafter, the Contractor shall submit a revised Monthly Progress Schedule accurately updated to reflect all revisions to the previously submitted schedule including actual commencement dates of listed work activities, actual work activities completed to date, and any sequence changes made or planned for the order of work activities and their effect on the critical path for completion of the whole project. The sequencing changes shall show extension of times granted by the Owner and any delays or early completion of work activities.

2. The Contractor shall meet with the Owner, or its designated attendee, at least once a month to discuss in detail the Contractor's updating of the Monthly Progress Schedule and the necessity for revision or correction in the schedule.

3. Within 10 calendar days after the Owner reviews and rejects or conditionally approves the submitted Monthly Progress Schedule, the Contractor shall make all necessary corrections and resubmit the corrected schedule.

4. The Contractor shall submit the required Monthly Progress Schedule whether or not the Contractor submits an application for payment each month. The Owner may decline to process any pending payment requests for this project until the Contractor submits the required schedule and the Owner approves it.

D. Recovery Schedules:

1. Within 10 calendar days after the project falls behind schedule or is alleged by either party to be behind schedule, the Contractor shall furnish to the Owner, at no additional cost, a revised schedule hereinafter called a "Recovery Schedule". The Recovery Schedule shall show how the Contractor will finish the project by the Contract completion date.

2. The Recovery Schedule shall include all of the information required under Paragraphs B, C and E of this section.

E. Logical Sequencing and Layout of the Submitted Schedules (CPM Schedules):

1. Unless the Contract Documents expressly permit the Contractor to use a schedule other than a Critical Path Method (CPM) schedule, the submitted Baseline Schedule, the subsequent Monthly Progress Schedules, and any required Recovery Schedules shall all be CPM schedules.

2. CPM schedules are required to assure adequate planning and execution of the work and in evaluating the progress of the work and the impact on the schedule events, which could affect the completion date.

3. The submitted CPM schedules shall clearly designate the Substantial Completion Date of the project. This is the date when the construction project or specified part thereof is sufficiently completed, in accordance with the Contract Documents, such that the project or specified part thereof can be used to accomplish the purposes for which it was intended.

4. Logic or network diagrams shall show the order and interdependence of activities and the sequence in which work is to be accomplished as planned by the Contractor. These diagrams must show how the start of a given activity is dependent on preceding activities and how its completion restricts the start of the following activities.

5. At a minimum, the following information shall be furnished for each work activity:

   a. Activity number
   b. Description of activity
   c. Activity numbers for any predecessor and successor activities
   d. Relationships with preceding activities
   e. Activity duration in calendar days
   f. Percent of activity completed
   g. Early start date (by calendar date)
   h. Early finish date (by calendar date)
   i. Actual start date (by calendar date)
   j. Actual finish date (by calendar date)
   k. Float or slack

6. The Monthly Progress Schedules and any required Recovery Schedules shall show the activities or portion of the activities completed during the reporting period and their total dollar value as basis for the Contractor’s periodic request for payment. For each activity, the update shall state the percentage of work actually completed and the progress along the critical path in terms of days ahead or behind the allowable dates.

7. The Monthly Progress Schedules and any required Recovery Schedules shall include a comments section summarizing the updated analysis for the project as a whole, describing problems with work activities, and explaining proposed corrective actions.

8. Approved change orders shall be reflected as new activities or as change in logic and/or time framing of existing activities. They shall be shown on the updated schedule that immediately follows a receipt of a Change Order Approval from the Owner.

F. Form of Schedule Submittal:

1. All schedules, including the Baseline Schedule, the Monthly Progress Schedules, and any required Recovery Schedules shall be submitted electronically.

1.08 CODES-RULES-PERMITS-FEES

A. General: The Contractor shall give all necessary notices, obtain all permits, and pay all governmental taxes, charges, fees and other costs necessary and incidental to the due and lawful prosecution of the work; file all necessary plans, prepare all documents and obtain all necessary approvals of all governmental departments having jurisdiction; obtain all required Certificates of Inspection and Approval for the work, deliver same to the Engineer, and pay all expenses associated with them.

B. Compliance: All materials furnished, and all work installed shall comply with the rules and regulations of the National Fire Protection Association, with all requirements of local utility companies, with the recommendations of the fire insurance rating organization having jurisdiction and with the requirements of all governmental departments having jurisdiction. Any items or requirements specified or indicated on the drawings in excess of minimum code requirements and permitted under the code shall be provided, unless special permission is obtained from the Engineer to the contrary.

C. Nonresidential building permit number 436345 was issued by the Frederick County Division of Planning and Permitting, Department of Permits and Inspections on 12/08/2022, expires 12/08/2023. Certification of occupancy is required before building may be occupied. Contractor shall be responsible to obtain any separate electrical, plumbing, fire, and grading permits required. Contractor shall coordinate with the County for finalization of the grading permit based upon the signed ESC Plans. Plans must be maintained and available to County Inspectors on the jobsite. All building permits expire 1 year from the date of issuance except when an extension has been granted. Contractor shall be responsible to login to the citizen portal (https://planningandpermitting.frederickcountymd.gov/,) prior to expiration of the permit, to submit an extension request. See Appendix B for the Building Permit and Placard.

1.09 PHOTOGRAPHIC REPORTS

A. The Contractor shall submit each month during construction not less than ten (10) digital photographs (electronic files) to the Owner, as outlined and stipulated hereinafter.

B. The Owner, or its representative, will designate the origin points of the photographs and the desired scope or perception of the photographs which are intended to give a complete picture of the status of the project. The photographs shall be taken by a person or firm experienced in such work and approved by the Engineer.

C. The cost of the aforementioned will not be a pay item, but shall be included in the lump sum price bid and no additional compensation to the Contractor will be considered.

1.10 BORINGS AND TEST PITS

A. Neither the Town of Emmitsburg nor the Engineer warrants or guarantees the conditions and/or materials that will be encountered in the prosecution of the work and/or any part thereof.

B. Bidders are urged to make their own subsurface exploration upon approval of written application. The cost of this exploration shall be included in the lump sum price bid; no additional compensation to the Contractor will be considered.

C. Soil borings or test pits for soil determination in improved roads are not to be excavated by the Contractor unless permission is granted by the Town of Emmitsburg.

D. All known subsurface lines, pipes, conduits and structures are shown on the plans and profiles. These lines are shown based upon the best available plans and maps. The locations have not been verified by test pits and the Town of Emmitsburg assumes no responsibility for the accuracy of the Drawings. In any area where the Contractor must make connections to or cross existing lines, it shall be his responsibility to test pit the lines and verify the locations to his satisfaction. In the event that lines are not found located as shown on the plans, the Contractor shall notify the Engineer so that an evaluation can be made as to the magnitude and methods of any adjustments in the plans.

E. The Contractor shall be solely responsible for all damage to underground or aboveground lines encountered in any manner during construction. When crossing and working in the vicinity of existing lines, it shall be the Contractor's responsibility to properly support and maintain the operation of the lines. Extreme care must be exercised in excavation and backfill operations. The Contractor shall correct at his own expense all damage caused to existing lines.

1.11 STORAGE AND PROTECTION OF EQUIPMENT AND MATERIALS

A. The Contractor shall maintain a neat and orderly construction site at all times.

B. The Contractor shall define the limits of a storage area(s) within the property limits. The Contractor shall be fully responsible for the security of this area(s), including fencing, watchman, and other means of security. Under no circumstances will the Owner be responsible for the security of any property belonging to the Contractor, his subcontractors, or any of his work forces.

C. All equipment and materials provided and work performed under this Contract shall be protected from the elements and physical damage before and after installation. The Contractor shall be responsible for work, equipment, and materials until inspected, tested and finally accepted.

D. The Contractor shall adhere to the Manufacturer's recommended storage procedures for all equipment furnished under this Contract. At no time shall the Contractor store material in a manner that contradicts these procedures. Specific types of equipment require storage procedures in addition to the minimum procedures defined by the Manufacturer. The Contractor shall refer to the various sections of these Specifications for these requirements.

E. During construction, the open ends of work shall be effectively closed with temporary covers or plugs to prevent the entry of foreign material.

F. Where permanent equipment called for under this Contract is installed before the erection of adequate protective structures, the Contractor, without additional compensation therefore, shall provide approved effective and durable covers for fully protecting such equipment against damage from the elements or from any other cause.

G. All electrical equipment shall be carefully and effectively covered with waterproofing material such as plastic wrap (6 mil minimum) and rigid barriers for protection at all times from the elements, and/or dust, moisture and impacts resulting from construction activities. All existing electrical equipment to remain shall be provided with a temporary heat source to prevent condensation for the duration of construction.

H. All structures, machinery, equipment, piping, electric conduit, wiring and accessories and appurtenances shall be adequately supported and safeguarded against all damage or injury during performance of work under this Contract. The Contractor shall be responsible for all damage or injury resulting from his operations and shall repair such damage immediately and to the satisfaction of the Engineer.

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

J. No delivery of materials and equipment will be accepted by the Owner, and all expenses incurred by the Owner in handling materials or equipment which have been consigned or directed to the Owner will be charged to the Contractor.

K. Following completion of the work, but before final payment, the Contractor shall remove all trailers, paving, stockpiled soil, stone, fencing, and other items used by him/her during the construction of the project and/or contained in his storage areas(s). The Contractor shall be responsible for placing topsoil, seeding and mulching in accordance with the Contract Drawings.

1.12 INTENT

A. It is the intent of the Drawings and Specifications to provide the Contractor with such information and instructions as may be necessary to complete this contract and to provide a complete and workable installation. The Contractor shall perform all work in accordance with the lines, grades, cross sections and dimensions shown on the plans. The Contractor shall furnish, unless otherwise provided in these plans and specifications, all materials, implements, machinery, equipment, tools, supplies, transportation and labor necessary for the prosecution and completion of the work. All materials and equipment installed as part of the permanent installation shall be new. It is intended that the Drawings and Specifications shall supplement each other. However, where variances occur between the Drawings and the Specifications or within the Document itself, the item or arrangement of better quality, greater quantity or higher cost shall be included in the Contract price. The Engineer will decide on the item and manner in which the work shall be installed.

B. Completeness: Any apparatus, appliance, material or work not shown on the Drawings but mentioned in the Specifications, or vice-versa, or any incidental accessories necessary to make the work complete and perfect in all respects and ready for operation, even if not particularly specified, shall be provided by the Contractor without additional expense to the Town of Emmitburg.

C. Schematics may not be shown to scale on Drawings, but the work shown on the schematic shall be provided by the Contractor without additional cost to the Town of Emmitsburg.

D. Adequacy: With submission of bid, the Contractor shall give written notice to the Engineer of any materials or apparatus believed inadequate or unsuitable; in violation of laws, ordinances, rules or regulations of Authorities having jurisdiction; and any necessary items of work omitted. In the absence of such written notice, it shall be understood that the Contractor has included the cost of all required items in his/her proposal and that he/she will be responsible for the approved satisfactory functioning of the entire system without extra compensation.

1.13 VIBRATION

A. It shall be the responsibility of the Contractor to protect and isolate from the existing structures all vibrations resulting from equipment operation. Insofar as practical, all mechanical and electrical equipment and its installation shall be vibration free. Under no circumstances shall any vibration be transmitted to the structures. Vibration isolators used in the installation shall be subject to the Engineer's approval.

1.14 GUARANTEE

A. The Contractor hereby guarantees all of the work including all components, for a period of at least two (2) years after the date of Substantial Completion thereof by the Owner, as follows:

1. Against all faulty or imperfect materials and against all imperfect, careless and/or unskilled workmanship.

2. That the equipment and each and every part thereof shall operate with proper care and attention in a satisfactory and efficient manner, and in accordance with the requirements of these Contract Documents.

3. That the structure, above and below grade, shall be entirely watertight and leak-proof at every joint and point of penetration for pipes, hatches, doors, etc.

4. The Contractor agrees to replace with proper workmanship and materials, and to re-execute, correct, or repair, without cost to the Owner, any work which may be found to be improper and/or which does not operate in a satisfactory manner or fails to perform as specified.

5. The guarantee obligations assumed by the Contractor under these Contract Documents shall not be held or taken to be in any way impaired because of the specifications, indication or approval by or on behalf of the Owner of any articles, materials, means, combinations or things used or to be used in the construction, performance and completion of the work or any part thereof.

6. No use or acceptance by the Owner of the work or any part thereof, nor any failure to use the same, nor any repairs, adjustments, replacements or corrections made by the Owner due to the Contractor's failure to comply with any of his obligations under the Contract Documents, shall impair in any way the guarantee obligations assumed by the Contractor under these Contract Documents.

7. The Contractor shall also, during this two-year guarantee period, be responsible for the proper operation and adjustment of all systems, equipment, apparatus or devices installed by him.

8. During the guarantee period, the Contractor shall respond to the site for required repair or replacement work within 48 hours of notification.

1.15 NAMEPLATES

A. The Contractor shall provide and install corrosion-resistant metal nameplates, with data engraved or stamped, for permanent attachment on all equipment. The data shall include the manufacturer, product name, model number, serial number, capacity, size, operating and power characteristics, and other essential data, as applicable for the particular equipment. The nameplates shall be permanently fastened to the equipment in a location that is accessible and visible, in a manner suitable for the particular equipment.

B. In addition to the manufacturer's nameplates, pumps shall be permanently identified by name and number corresponding to the as-built drawings with nameplates which shall be engraved and laminated black-on-white finish phenolic nameplates. Data and installation shall be approved by the Engineer. Nameplate letters shall be minimum 2-inch high etched white letters and beveled white trim. Nameplates for instrument panels shall be provided with 3/8-inch high letters. Identifying characters shall be not less than 2-inches high and shall be painted. Decals, Rotex, or Dymo field applied labels will not be acceptable. All nameplate data shall be reproduced in the Operating and Maintenance Manuals.

PART 2 - PRODUCTS

(NOT USED)

PART 3 - EXECUTION

(NOT USED)

END OF SECTION

SECTION 01200

PROJECT MEETINGS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section specifies administrative and procedural requirements for project meetings including but not limited to:

1. Preconstruction Conference.

2. Progress Meetings.

B. Construction schedules are specified in another Division 1 Section.

1.03 PRECONSTRUCTION CONFERENCE

A. At the Owner's discretion, Owner may schedule a preconstruction conference and organizational meeting no later than fifteen (15) days after execution of the Agreement and prior to commencement of construction activities.

B. Attendees: The Owner, Contractor, and Engineer.

C. Agenda: Discuss items of significance that could affect progress including such topics as:

1. Tentative construction schedule
2. Critical Work sequencing
3. Designation of responsible personnel
4. Procedures for processing field decisions and Change Orders
5. Procedures for processing Applications for Payment
6. Distribution of Contract Documents
7. Submittal of Shop Drawings, Product Data and Samples
8. Preparation of record documents
9. Use of the premises
10. Office, Work and storage areas
11. Equipment deliveries and priorities
12. Safety procedures
13. First aid

14. Security
15. Housekeeping
16. Working hours
17. Public Works Employment Verification Act requirements

D. Engineer will moderate meeting, record minutes and distribute copies of same to meeting attendees.

1.04 PROGRESS MEETINGS

A. Engineer will conduct progress meetings at the Project site as necessary. Any progress meetings will be scheduled as required.

B. Attendees: In addition to representatives of the Owner and Engineer, each subcontractor, supplier or other entity concerned with current progress or involved in planning, coordination or performance of future activities shall be represented at these meetings by persons familiar with the Project and authorized to conclude matters relating to progress.

C. Agenda: Review and correct or approve minutes of the previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to the current status of the Project.

1. Contractor's Construction Schedule: Review progress since the last meeting. Determine where each activity is in relation to the Contractor's Construction Schedule, whether on time or ahead or behind schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.

2. Review the present and future needs of each entity present, including such items as:

a. Interface requirements
b. Time
c. Sequences
d. Deliveries
e. Off-site fabrication problems
f. Access
g. Site utilization
h. Temporary facilities and services
i. Hours of Work
j. Hazards and risks
k. Housekeeping
l. Quality and Work standards
m. Change Orders
n. Documentation of information for payment requests

o. Documentation relative to Public Works Employment Verification Act

D. Reporting: After each progress meeting date, Engineer will distribute copies of minutes of the meeting to each party present and to other parties who should have been present.

1. Schedule Updating: Revise the construction schedule after each progress meeting where revisions to the schedule have been made or recognized.

PART 2 - PRODUCTS

(NOT USED)

PART 3 – EXECUTION

(NOT USED)

END OF SECTION

SECTION 01300

SUBMITTALS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section specifies administrative and procedural requirements for submittals required for performance of Work, including:

1. Contractor's construction schedule

2. Submittal schedule

3. Shop drawings

4. Product data

B. Administrative Submittals: Refer to other Division 1 Sections and other Contract Documents for requirements for administrative submittals.

1.03 SUBMITTAL PROCEDURES

A. Ten days after notice to proceed, the Contractor shall submit a submittal schedule listing as near as practicable by specification section number, all submittals required and approximate date submittal will be forwarded. No submittals will be reviewed by the Engineer until the submittal schedule has been submitted and approved.

B. Submittals are generally defined as all drawings, diagrams, illustrations, catalog cut sheets, product data sheets, brochures, schedules, bills of material, and other data, certified correct for construction, which are prepared by the Contractor, his subcontractors, suppliers or distributors, or equipment fabricators or manufacturers, and which illustrate the manufacture, fabrication, construction, installation of the work, or a portion thereof.

C. The Contractor's attention is specifically directed to the fact that working drawings are required, and shall be submitted, for each and every element of the work including, but not limited to, excavation support systems, reinforced concrete formwork systems, reinforcing steel details, concrete pours, construction joints, waterstops, structural steel and miscellaneous metals, masonry work, roofing

systems, each and every item of mechanical and electrical equipment, electrical conduit systems showing proposed field assembly, piping regardless of size or whether fabricated on or off the project site, and all other shop drawings which may be necessary, in the opinion of the Engineer, to comply with the all-inclusive intent of this requirement. Each submittal shall be assigned a sequential number; Submittal No. 1, 2, 3, 4, etc. for purposes of easy identification, and shall retain its assigned number, with appropriate subscript, on all required resubmissions. Changing manufacturers or models during the course of the submittal process shall not be cause for assigning a new submittal number. Once an item of work has been assigned a submittal number, that item of work shall retain the same number, for the duration of the project.

The following stamp shall be affixed to each submittal and appropriately completed.

CHECKED AND APPROVED FOR SUBMISSION

(CONTRACTOR'S NAME)

JOB _____
CONTRACT NO. _____
DATE _____ **BY** _____
SUBMITTAL NUMBER _____
ITEM _____
CONTRACT REFERENCES:
SPECIFICATION _____
DRAWING _____

Resubmittals shall be labeled with the letter "R" followed by the number of the resubmission. Example: The Contractor's tenth submittal, being resubmitted for the first time shall be numbered Submittal No. 10R1, resubmitted for the second time shall be numbered Submittal No. 10R2, etc. If a submittal is “approved as noted” and/or additional or supplemental information is requested, the additional information should be labeled with the original submittal number followed by the letter “A” and then sequential lettering for subsequent supplemental information submittals. Example: A resubmittal of Submittal 12 is submitted as Submittal No. 12R1, which is “approved as noted” with a comment to provide a color chart. The color chart shall be submitted as Submittal No. 12R1A.

D. All shop drawings shall be in conformity with the Contract Drawings and Special Provisions. All shop drawings except diagrams, illustrations, brochures and schedules shall be to appropriate scale, but in no case smaller than 1/4" = 1'-0", and shall give all dimensions required for manufacture, fabrication, assembly, installation and incorporation in the work. All shop drawings shall be complete, accurate and distinct, and shall show outline and section views, details, kinds of materials to be used, the kind of machine work and finish to be applied, and the installed locations of the said materials, equipment, accessories, appurtenances and related items.

Shop drawings showing field assembly of piping and/or conduit systems shall incorporate sufficient views, sections, plans and elevations to show each and every fitting, specialty, and item of equipment, including locations and spacing of hangers and supports. Piping and/or conduit systems 2-inches in diameter and smaller may be shown as a single line. Equipment and specialties installed within and/or connected to piping and conduit systems shall be cross referenced to equipment and specialty shop drawings by submittal identification number, manufacturer name, and catalog or model number. Such cross reference data may be shown at each individual equipment or specialty item on the system assembly drawing or, at the Contractor's option, may be incorporated in a coded bill of materials prepared integral with, and as a part of, the applicable shop drawing.

E. Electrical shop drawings include, but are not necessarily limited to, complete terminal identification diagrams and schedules, complete point-to-point interconnection diagrams, and complete single line and elementary wiring diagrams for all power, signal and control systems, together with panel layout drawings. Diagrams shall be oriented to display the general arrangement and location of wiring and equipment which is seen when facing the appropriate panels for maintenance and adjustment purposes, i.e.; for panels wired and serviced from the front, diagrams shall depict a front view, and for panels wired and serviced from the rear, diagrams shall depict a rear view. Mirror image diagrams are prohibited. Terminal point and wire identification on all shop drawings shall be identical to related terminal point and wire identification on equipment and panels, and absolutely no deviation from this requirement will be permitted.

F. After checking and verifying all field measurements, the Contractor shall submit to the Engineer, for approval, electronic copies of all submittals, which shall have been checked by and stamped with the approval of the Contractor and identified as shown herein. The information shown on the submittals shall be complete with respect to dimensions, design criteria, materials of construction and other requirements as specified or shown in the Contract Documents to enable the Engineer to review the information as required. Machinery outline drawings alone are not acceptable. All submittals covering related items of equipment or integrated systems of equipment shall be submitted at the same time in order that their complete operation can be adequately reviewed. Partial submissions will not be reviewed, but will be retained for subsequent review after related submittals have been submitted. At the time of each submission, the Contractor shall call to the Engineer's attention, in writing, any deviations that the submittals may have from the requirements of the Contract Documents.

G. The Engineer will be allowed three weeks for the initial review. Allow additional time if processing must be delayed to permit coordination with subsequent submittals. The Engineer will promptly advise the contractor when a submittal being processed must be delayed for coordination. The Engineers review and approval shall be only for conformance with the design concept of the project and for compliance with the information given in the Contract Documents. The approval of a separate item as such shall not indicate approval of the assembly in which the item functions. The Contractor shall make any corrections required by the Engineer and shall resubmit

the required number of corrected copies of each submittal until approved. The Contractor shall direct specific attention to revisions called for by the Engineer on previous submissions.

H. A maximum of two submissions of each submittal will be reviewed, checked, and approved or commented upon without charge to the Contractor. Any additional submissions which are ordered by the Engineer to fulfill the stipulations of the Contract Documents, and which are required by virtue of the Contractor's neglect or failure to comply with the requirements of the Contract Documents or to make those modifications and/or corrections ordered by the Engineer in the review of the first two submissions of each submittal, will be reviewed and checked as deemed necessary by the Engineer, and the cost of such review and checking, as determined by the Owner, and based upon a maximum rate of $275.00 per hour will be deducted from the Contractor's monthly invoices or from monies retained under the provisions of the Contract Documents. It is therefore incumbent upon the Contractor to make all modifications and/or corrections, and/or to cause such modifications and/or corrections to be made by his subcontractors, suppliers, distributors, equipment fabricators and/or manufacturers, as may be required by the Engineer in an accurate, complete, and timely fashion.

I. The Engineer's approval of submittals shall not relieve the Contractor from his responsibility for any deviations from the requirements of the Contract Documents unless the Contractor has in writing called the Engineer's attention to such deviations at the time of submission and the Engineer has given written approval to the specific deviation, nor shall any approval by the Engineer relieve the Contractor from responsibility for errors or omissions in the submittals. Submittals shall be submitted with sufficient time provided for checking, return to the Contractor, and/or resubmission as required. The words "APPROVED" or "APPROVED AS NOTED" or words of similar import placed by the Engineer on a submittal means that all items and details of the submittal are fully approved with the exception of those items or details that are specifically marked for further action. When the submission is marked "EXCEPTIONS NOTED" it means that the material or product can probably fulfill the intent of the plans and specifications but that enough questions or comments have arisen to require a corrected or updated submission. If the material submitted represents a product that is totally unsatisfactory and probably will not under any circumstances meet contract requirements, it will be marked "REJECTED" and will not be reconsidered by the Engineer. The withholding of an approval by the Engineer of any submittal in its entirety, including required certifications, shall under no circumstances constitute a basis for delay in arranging for and proceeding with the manufacturing, fabricating, delivering and installing, in accordance with the Contract, of those items or details in such submittals which may have been approved.

J. Upon receipt of submittal approval, the Contractor shall provide an electronic copy of all approved submittals to the Owner and Engineer in Portable Document Format (PDF). PDFs shall be submitted within 20 calendar days of Contractor receiving approval.

K. The Contractor's attention is specifically directed to the fact that no work shall be fabricated, nor equipment or materials ordered, nor any construction performed, prior to approval by the Engineer of submittals applicable thereto.

Construction performed in violation of this requirement will be neither approved nor certified for payment until applicable submittals have been approved. If the Engineer so directs, the Contractor shall disassemble, raze, and remove any such construction performed prior to approval by the Engineer of submittals applicable thereto, and the Contractor will be allowed neither additional compensation nor extension of Contract time thereto.

If the Contractor orders or causes to be ordered or delivered any equipment, machinery or materials in violations of this requirement, he/she does so at his/her own risk, and such equipment, machinery or materials shall neither be installed in the work nor stored on the site of the work. If, after submission and review of applicable submittals, the Engineer determines that any such equipment, machinery or materials do not meet the requirements of the Contract Documents, such equipment, machinery or materials will be rejected, and the Contractor will be allowed neither additional compensation nor extension of time therefore.

The Contractor's attention is specifically and especially directed to the fact that because manufacturer's standards and procedures are subject to unilateral changes over which the Owner has no control, the stipulations herein are applicable, and will be enforced, even for those elements of equipment, machinery, and/or materials which may be specified by manufacturer and model or catalog number in these Contract Documents.

1.04 CERTIFICATION OF MATERIALS AND INSTALLATIONS

A. The Contractor shall furnish certification from each manufacturer, or from an approved testing laboratory, that all material used in the work is in accordance with these and all referenced specifications. Upon completion of the work, and before acceptance by the Owner, the Contractor shall furnish the Owner with a certificate from each of the manufacturers that the equipment and material furnished by him has been erected and installed in a satisfactory manner and is ready for continuous service and operation.

B. Machinery and equipment for which manufacturer certification is specified will not be accepted, nor payment made therefore, without such certification. The Engineer reserves the right, however, to reject such certification when in his judgment, equipment and materials have been improperly installed or show evidence of unsatisfactory operation.

C. Certification shall be prepared as follows:

"Having inspected the following items of equipment (Insert here serial number and complete description of equipment) at rest and in operation, and having made all requisite service adjustments and calibrations, I hereby certify that the above listed items have been properly installed, serviced, adjusted and calibrated and are ready for continuous operation under specified conditions of service when maintained in accordance with the manufacturer's published instructions attached hereto.

_____ _____"

Date Name

1.05 AS-BUILT DRAWINGS

A. The Contractor shall keep one copy of all Contract Documents, including shop drawings, at the site, in good order, and annotated to show all changes made during the construction process. These as-built drawings shall be available to the Engineer and shall be delivered to the Engineer upon completion of the project. If the Contractor fails to maintain and submit the as-built drawings as required herein, final payment with respect to the Contract as a whole will be withheld until proper as-built drawings have been furnished to the Engineer, or the Town of Emmitsburg may, at its option, Contract for independent correction of shop drawings to as-built conditions, and the cost of such contracted services will be deducted from monies retained under the provisions of the Contract Documents.

B. The Contractor shall furnish, in quadruplicate, ¼-inch per foot minimum scale charts of all piping arrangements, as approved, giving the number and location of all control valves, their functions, and section of piping they control. These schematics shall be bound for filing and shall also be neatly folded and bound as a part of the "Operating and Maintenance Manuals".

C. The Contractor shall also furnish one copy of all final as-built shop drawings, conduit routing plans, and wiring diagrams and electrical schematics for the Motor Control Center, Pump Control Panel, and Generator. All shop drawings, diagrams, and schematics shall be 22-inches by 34-inches in size.

PART 2 - PRODUCTS

(NOT USED)

PART 3 – EXECUTION

(NOT USED)

END OF SECTION

SECTION 01516

TEMPORARY SANITARY FACILITIES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 REQUIREMENTS INCLUDED

A. Furnish, install and maintain temporary sanitary facilities for use through construction period; remove on completion of Work.

1.03 COSTS OF INSTALLATION AND OPERATION

A. Obtain and pay for permits as required by governing authorities.

B. Pay costs of temporary sanitary facilities, including costs of installation, maintenance and removal.

C. Pay service charges for use of portable units.

PART 2 - PRODUCTS

2.01 GENERAL

A. Materials may be new or used, but must be adequate for purpose intended, and must not create unsanitary conditions nor violate code requirements.

2.02 TOILET FACILITIES

A. Portable toilets. Locate a minimum of one toilet at each work site.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Place portable toilets in conformance with applicable laws, codes and regulations.

3.02 MAINTENANCE

A. Maintain facilities in a clean, operable, sanitary condition.

3.03 REMOVAL

A. Remove portable units following Substantial Completion.

END OF SECTION

SECTION 01700

PROJECT CLOSEOUT

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section specifies administrative and procedural requirements for project closeout including but not limited to:

1. Inspection procedures.

2. Project record document submittal.

3. Operating and maintenance manual submittal.

4. Facility start-up, demonstration period and operator training.

5. Final cleaning.

B. Closeout requirements for specific construction activities are included in the appropriate Specification Sections.

1.03 SUBSTANTIAL COMPLETION

A. Preliminary Procedures: Before requesting inspection for certificate of Substantial Completion, complete the following:

1. Complete all work required by the Contract Documents including:

a. Installation of new influent sewer.

b. Installation and testing of replacement force main piping.

c. Installation of new force main air release valve and vault.

d. Installation of new force main combination air valve.

e. Installation and testing of new pump station, including pumps, piping and valves.

f. Installation of new precast concrete building including HVAC equipment.

g. Installation of all hoisting equipment.

h. Installation of all doors and access hatches.

i. Installation of new influent sewage grinder.

j. Installation of all electrical equipment including generator, conduit, wiring, control panels, lighting, etc.

k. Installation of new wetwell and new wetwell corrosion liner.

l. Completion of all painting.

m. Facility startup activities.

n. All other work required to provide the new pump station construction in its entirety to be fully operational.

2. In the Application for Payment that coincides with, or first follows, the date Substantial Completion is claimed, show 100 percent completion for the portion of the Work claimed as substantially complete. Include supporting documentation for completion as indicated in these Contract Documents and a statement showing an accounting of changes to the Contract Sum.

   a. If 100 percent completion cannot be shown, include a list of incomplete items, the value of incomplete construction, and reasons the Work is not complete.

3. Advise Owner of pending insurance change-over requirements.

4. Submit specific warranties, workmanship bonds, maintenance agreements, final certifications and similar documents.

5. Obtain and submit releases enabling the Owner unrestricted use of the Work and access to services and utilities; include occupancy permits, operating certificates and similar releases.

6. Deliver tools, spare parts, extra stock, and similar items. whether fabricated on or off the project site, and all other shop drawings which may be necessary, in the opinion of the Engineer, to comply with the all-inclusive intent of this requirement.

7. Make final change-over of permanent locks and transmit keys to the Owner. Advise the Owner's personnel of change-over in security provisions.

8. Submit Operations and Maintenance Data for approval. Issuance of substantial completion certificate is conditioned on approval.

9. Complete start-up testing of systems, and instruction of the Owner's operating and maintenance personnel. Discontinue or change over and remove temporary facilities from the site, along with construction tools, mock-ups, and similar elements.

10. Complete final clean up requirements, including touch-up painting. Touch-up and otherwise repair and restore marred exposed finishes.

B. Inspection Procedures: On receipt of a request for inspection, the Engineer will either proceed with inspection or advise the Contractor of unfilled requirements. The Engineer will prepare the Certificate of Substantial Completion following inspection, or advise the Contractor of construction that must be completed or corrected before the certificate will be issued.

1. The Engineer will repeat inspection when requested and assured that the Work has been substantially completed.

2. Results of the completed inspection will form the basis of requirements for final acceptance.

1.04 FINAL PAYMENT

A. Preliminary Procedures: Before requesting final inspection for final payment, complete the following. List exceptions in the request.

1. Complete all remaining work required by the Contract Documents including:

a. 30-day demonstration period.

b. Operator training.

c. Final as-built drawings.

d. O&M Manuals.

e. Installation certifications for all required equipment.

2. Submit the final payment request with releases and supporting documentation not previously submitted and accepted. Include certificates of insurance for products and completed operations where required.

3. Submit an updated final statement, accounting for final additional changes to the Contract Sum.

4. Submit a certified copy of the Engineer's final inspection list of items to be completed or corrected, stating that each item has been completed or otherwise resolved for acceptance, and the list has been endorsed and dated by the Engineer.

5. Submit final meter readings for utilities, a measured record of stored fuel, and similar data as of the date of Substantial Completion, or when the Owner took possession of and responsibility for corresponding elements of the Work.

6. Submit consent of surety to final payment.

7. Submit a final liquidated damages settlement statement.

8. Submit evidence of final, continuing insurance coverage complying with insurance requirements.

B. Reinspection Procedure: The Engineer will reinspect the Work upon receipt of notice that the Work, including inspection list items from earlier inspections, has been completed, except items whose completion has been delayed because of circumstances acceptable to the Engineer.

1. Upon completion of reinspection, the Engineer will prepare a certificate of final acceptance or advise the Contractor of Work that is incomplete or of obligations that have not been fulfilled but are required for final acceptance.

2. If necessary, reinspection will be repeated.

1.05 RECORD DOCUMENT SUBMITTALS

A. General: Do not use record documents for construction purposes; protect from deterioration and loss in a secure, fire-resistive location; provide access to record documents for the Engineer's reference during normal working hours.

B. As-Built Drawings:

1. The Contractor shall keep one copy of all Contract Documents, including shop drawings, at the site, in good order, and annotated to show all changes made during the construction process. These as-built drawings shall be available to the Engineer, and shall be delivered to the Engineer upon completion of the project. If the Contractor fails to maintain and submit the as-built drawings as required herein, final payment with respect to the Contract as a whole will be withheld until proper as-built drawings have been furnished to the Engineer, or the Owner may, at its option, Contract for independent correction of shop drawings to as-built conditions, and the cost of such contracted services will be deducted from monies retained under the provisions of the Contract Documents.

2. The Contractor shall furnish, in quadruplicate, 1/4-inch per foot minimum scale charts of all piping arrangements, as approved, giving the number and location of all control valves, their functions, and section of piping they control. These schematics shall be bound for filing, and shall also be neatly folded and bound as a part of the "Operating and Maintenance Manuals".

3. The Contractor shall also furnish one copy of all final as-built shop drawings, conduit routing plans, and wiring diagrams and electrical schematics for the Pump Control Panel, and Generator. All shop drawings, diagrams, and schematics shall be 22-inches by 34-inches in size.

4. The Contractor shall provide two full size (24” x 36”) paper copies of the final as-built drawings. In addition, the Contractor shall submit one CD containing an electronic copy of the as-built drawings as a Portable Document Format (PDF) file.

C. Record Specifications: Maintain one complete copy of the Project Manual, including addenda, and one copy of other written construction documents such as Change Orders and modifications issued in printed form during construction. Mark these documents to show substantial variations in actual Work performed in comparison with the text of the Specifications and modifications. Give particular attention to substitutions, selection of options and similar information on elements that are concealed or cannot otherwise be readily discerned later by direct observation. Note related record drawing information and Product Data.

1. Upon completion of the Work, submit record Specifications to the Engineer for the Owner's records.

D. Miscellaneous Record Submittals: Refer to other Specification Sections for requirements of miscellaneous record-keeping and submittals in connection with actual performance of the Work. Immediately prior to the date or dates of Substantial Completion, complete miscellaneous records and place in good order, properly identified and bound or filed, ready for continued use and reference. Submit to the Engineer for the Owner's records.

1.06 OPERATION AND MAINTENANCE MANUALS

A. Upon completion of the work, the Contractor shall furnish for the Engineer's review, one set of Operation and Maintenance Manuals for the pumping station. Manuals shall include operating and maintenance information on all systems and items of equipment per the following table:

SECTION	DESCRIPTION
08220	FRP Doors
08310	Access Hatches
11310	Base-Mounted Pumping System
11330	Influent Sewage Grinder
14100	Monorail Crane System
14110	Davit Arm Personnel Mast
14600	Portable Equipment Hoist
15110	Valves
15130	Sluice Gate
15400	Plumbing
15500	Heating and Ventilation Equipment
15700	Minisplit Heat Pump Air Conditioning System
16500	Lighting
16530	Emergency Lighting
16230	Emergency Generator System
17100	Motor Control Center
17110	Variable Frequency Drives
17300	Instrumentation
17400	Programmable Controller System

B. The data shall consist of catalogs, brochures, bulletins, charts, schedules, shop drawings corrected to as-built conditions and assembly drawings and wiring diagrams describing location, operation, maintenance, lubrication, operating weight, and other information necessary for the Engineer to establish an effective operating and maintenance program. All information provided shall be of the most current publications and literature supplied by the Manufacturers. Outdated or irrelevant information will not be accepted. Multiple items listed on a single page, which are not relevant, will be clearly crossed out. The following data shall also be included:

1. Title page and table of contents shall be printed on the Contractor's company letterhead and shall state the name and address of the station with the project number. These pages shall be inserted inside clear plastic sleeves.

2. Four 8-inch by 10-inch color photographs of the facility, views as directed by the County. Each Photograph shall be provided on photo quality paper and inserted into clear plastic sleeve. Photos shall be taken near the completion of the project, when all temporary measures and Contractor Equipment are removed, and final site improvements, including landscaping, are completed.

3. Two unique 8-inch by 10-inch color photographs of each piece of equipment in place. Each photograph shall be provided on photo quality paper and inserted into a clear plastic sleeve. Photos of equipment shall be taken at an orientation such that the permanent equipment marker is visible. When this is not practical, a temporary identification marker shall be provided and

included in the photo for each piece of equipment. Equipment photos shall be taken after equipment is permanently installed, with associated piping and appurtenances.

4. "Equipment Warranty" section, to be inserted in the first volume (following station photos), shall include a master log sheet stating equipment type, manufacturer's name, supplier's name, warranty length, and start and end dates. Copies of all warranties shall be included in this section for quick reference. This section shall also include materials not required for inclusion for the O&M Manuals that provide extended warranties, e.g., FRP doors, wetwell liner system, etc.

5. Literature and cutsheets for inclusion shall be printed double sided. Only prints, schematics or diagrams shall be single sided.

6. "Name Plate" data of all equipment.

7. Performance curves and performance data for the pumps and equipment installed.

8. Initial parameter settings for all equipment, as well as corresponding factory default settings. Initial parameter settings for equipment that differ from factory default settings shall be emphasized.

9. Approved shop drawings, including required certifications.

10. Manufacturers' cut sheets and dimension drawings of each piece of equipment, and details of all replacement parts.

11. Manufacturers' erection, operation and lubrication instructions for all equipment and apparatus.

12. Complete as-built wiring diagrams of all individual pieces of equipment and systems including one-line diagram; schematic or elementary diagrams; complete point-to-point interconnection diagrams; and interconnection and terminal board identification diagrams.

13. Complete underground piping and conduit layout and interconnecting drawings.

14. Manufacturer's certifications for specified equipment.

15. A list of all local manufacturers' representatives.

16. Complete parts list with parts assembly drawing (by exploded view), names and addresses of spare parts suppliers, recommended list of spare parts to be kept "in stock" and sample order forms for ordering spare parts. Lead time required for ordering parts shall be estimated and provided.

17. Instructions with easily understood schematics or diagrams for disassembling and assembling the equipment for overhaul or repair.

18. The manual shall also include detailed written procedures to be used for all modes of operation including any precautions for personal safety or for prevention of damage to the equipment (mechanical or electrical). This includes initial start-up, interim operation when necessary, normal operation, emergency operation, shutdown and restarting. Required operating checks, calibration and field performance measurements shall be described.

19. Preventive maintenance measures and their frequency shall be listed in tabular form. A troubleshooting chart containing symptoms, probable cause, and remedies shall be included. A lubricating schedule listing equipment (parts), frequency and lubricant (including equivalent major brand lubricants) shall be provided. In addition, a lubrication schedule shall be included for periods when the equipment is in standby or in storage.

20. Section dividers shall be provided, with labels that are non-removable.

C. Operation and Maintenance information shall be bound in loose leaf 3-ring binders with black plastic-coated covers. Binders shall be 4-inch thick maximum, high quality, turned edge construction with piano metal hinges and rings that stay closed and not allow pages to fall out. Binders shall be Binder Tek Model ARCH3 for 3-inch binders, ARCH4 for 4-inch binders, or approved equal. Binders shall be organized sequentially with section dividers for each applicable specification section as listed in the Special Provisions table of contents.

D. Shop drawings 11-inches by 17-inches in size shall be folded to approximately 11-inches by 8-½ inches with drawing title box exposed along either edge. Drawings descriptive of a single item of equipment shall be grouped together.

E. All shop drawings included in the binders shall be those copies previously submitted for review and approval and shall bear the Engineer's stamp of approval and comments as originally noted thereon.

F. Subsequent to the Engineer's approval of the Operation and Maintenance Manuals, the Contractor shall submit four complete sets of manuals for distribution by the Engineer. In addition, the Contractor shall submit either two (2) CD's or thumb drives as preferred by the Owner, each containing an electronic copy of the entire Operation and Maintenance Manuals as a Portable Document Format (PDF) file. CD's (or thumb drives) shall contain individual files for each specification section, matching the section dividers of the Operation and Maintenance Manuals. Operation and Maintenance Manuals shall be delivered to the Engineer in white binder boxes suitable for storing the specified binders. Each binder storage box shall have an interior measurement of 12-inches by 12¼-inches by 18½-inches and shall include a lift off lid. Binder storage boxes shall be Model No. 0073301 as manufactured by Bankers Box® or approved equal.

G. Final inspection and/or beneficial occupancy will positively not be undertaken until approved Operation and Maintenance Manuals have been submitted and approved. Partial approvals will not be made.

1.07 FACILITY START-UP, DEMONSTRATION PERIOD AND OPERATOR TRAINING

A. When specified in individual sections of these Specifications, upon completion of all work for a particular section, the Contractor shall furnish at no extra cost to the Owner, the necessary manufacturer's engineers, representatives, technicians, skilled labor and helpers and shall perform all startup activities as required. During startup, the manufacturer's designated personnel shall fully inspect, test, calibrate, lubricate, operate and certify the equipment for which they are responsible.

B. When a manufacturer's representative is not required to perform startup activities for a particular piece of equipment, the Contractor shall perform any required startup activities in strict accordance with the manufacturer's instructions.

C. If the Operation and Maintenance Manuals specified hereinafter are not available at the time of the startup, the Contractor shall provide one copy of the manufacturer's operating literature for each system or item of equipment. Installation and operating sheets or booklets normally shipped with equipment may be used for this purpose.

D. Prior to starting up and operating any and all equipment installed in the pumping station, the Contractor shall notify the Owner. All lubrication and starting up of the equipment shall be done in the presence of and to the complete satisfaction of authorized representatives of the Bureau of Utilities, and in accordance with all manufacturer's recommendations. All temporary measures, utilities, resources, and equipment, including all associated permits and approvals, necessary for start-up and demonstration of equipment, including the use of fire hydrants, shall be the Contractor's responsibility and available prior to start-up activities.

E. The Contractor shall schedule the startup for a time mutually agreeable with the Engineer and the Owner, and shall provide a minimum of one week notice prior to the desired date. The Contractor shall submit a start-up and testing schedule for review and approval by the Engineer and the Owner. Start-up and testing activities shall not commence until the schedule is approved.

F. After all startup activities have been completed, the Contractor shall be responsible for the operation of the completed pumping station on a demonstrational basis for a period of thirty (30) days.

G. Prior to beginning the 30-day demonstration period, the Contractor shall complete the following:

1. All shop drawings shall be submitted and approved.

2. All Equipment Guarantee Certification Forms and manufacturer's certifications shall be completed and submitted, and all witness testing conducted and completed as required.

3. All startup activities shall be completed.

4. All test reports shall be submitted and approved.

5. All project photographs shall be submitted.

6. All Operation and Maintenance Manuals shall be submitted and approved.

7. A final walk-through of the facility shall be conducted by the Contractor with the Owner and Engineer in order to generate the punchlist for the project. Provide the Owner and Engineer two weeks' notice prior to the desired date.

8. Any items on the punchlist that are designated as requiring completion prior to the 30-day demonstration period shall be completed.

9. Any item on the punchlist not designated as requiring completion prior to the 30-day demonstration period shall be completed prior to the end of the 30-day demonstration period.

10. The facility shall be thoroughly cleaned, and any finishes requiring touchup shall be completed.

H. After all of the above items have been successfully completed, the Contractor shall receive notice from the Owner that he may begin the 30-day demonstration period.

I. During the 30-day demonstration period, the Contractor shall maintain the bypass pumping system in place and operational in the event that there is a problem with the permanent systems installed.

J. During the 30-day demonstration period, the Contractor shall respond to all bypass pumping system and/or station control system alarms and rectify the situation, as necessary.

K. During the 30-day demonstration period, the Contractor shall conduct all required training for the newly installed equipment. Training activities shall be performed separately from manufacturer's startup activities, and shall be held on separate days unless approved otherwise. Coordinate schedule of training with Owner and provide a minimum of two weeks' notice.

L. If problems occur during the 30-day demonstration period that are designated by the Owner and Engineer to be of significant magnitude, the problems shall be satisfactorily corrected, and the 30-day demonstration period shall restart from the beginning.

M. After successful completion of the 30-day demonstration period, all required training, all punchlist work, and all final cleanup, the Contractor shall schedule a follow up walk-through with the Owner and Engineer to verify compliance with all requirements.

N. After compliance has been demonstrated for all requirements, the Owner shall approve the removal of the bypass pumping system and associated Contractor demobilization.

PART 2 - PRODUCTS

(NOT USED)

PART 3 - EXECUTION

3.01 FINAL CLEANING

A. General: General cleaning during construction is required by the General Conditions.

B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to the condition expected in a normal, cleaning and maintenance program. Comply with manufacturer's instructions.

1. Complete the following cleaning operations before requesting inspection for final acceptance.

a. Remove labels that are not permanent labels.

b. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compound and other substances that are noticeable vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials.

c. Clean exposed exterior and interior hard-surfaced finishes to a dust-free condition, free of stains, films and similar foreign substances. Restore reflective surfaces to their original reflective condition. Leave concrete floors broom clean.

d. Wipe surfaces of mechanical and electrical equipment. Remove excess lubrication and other substances. Clean plumbing fixtures to a sanitary condition. Clean light fixtures and lamps.

e. Clean the site, including landscape development areas, of rubbish, litter and other foreign substances. Sweep paved areas broom clean; remove stains, spills and other foreign deposits. Rake grounds that are neither paved nor planted, to a smooth even-textured surface.

C. Removal of Protection: Remove temporary protection and facilities installed for protection of the Work during construction.

D. Compliance: Comply with regulations of authorities having jurisdiction and safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on the Owner's property. Do not discharge volatile, harmful or dangerous materials into drainage systems. Remove waste materials from the site and dispose of in a lawful manner. Where extra materials of value remaining after completion of associated Work have become the Owner's property, arrange for disposition of these materials as directed by the Owner.

END OF SECTION

SECTION 02221

BUILDING DEMOLITION

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes demolition and removal of a building and site improvements, removal of below-grade construction, disconnecting, capping or sealing, and removal of site utilities, and salvaging items for reuse by the Owner.

1.02 MATERIALS OWNERSHIP

A. Unless otherwise indicated or specifically requested, demolition waste becomes property of the Contractor.

B. The Owner reserves the right to salvage any equipment not specifically named and the Contractor shall verify same with authorized Town of Emmitsburg staff before removing. All equipment to be salvaged shall be delivered to the Town of Emmitsburg WWTP facility, located at 16683 Creamery Road.

C. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to the Owner that may be uncovered during demolition remain the property of the Owner. Carefully salvage in a manner to prevent damage and promptly return to the Owner.

1.03 SUBMITTALS

A. Proposed Protection Measures: Submit informational data, including drawings, that indicates the measures proposed for protecting individuals and property, for environmental protection, for dust control, and for noise control. Indicate proposed locations and construction of barriers.

B. Adjacent Buildings: Detail special measures proposed to protect adjacent buildings, if any, to remain.

C. Schedule of Building Demolition Activities: Detailed sequence of demolition work, with starting and ending dates for each activity.

D. Inventory: Submit a list of items to be removed and salvaged and delivered to the Owner prior to start of demolition.

E. Pre-demolition Photographs or Video: Show existing conditions of adjoining construction and site improvements, including finish surfaces, which might be misconstrued as damage caused by building demolition operations.

F. Permits for Disposal of Debris

1. Arrange for legal disposal of debris and obtain written agreements with the owners of the property where the debris will be deposited.

2. Submit two copies of each agreement releasing the Owner from all responsibility in connection with the disposal of the debris.

1.04 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

B. Standards: Comply with ANSI A10.6 and NFPA 241.

1.05 PROJECT CONDITIONS

A. Buildings to be demolished will be vacated and their use discontinued before start of the Work.

B. Do not close or obstruct walkways, exits, or other points of access used by occupants of adjacent facilities without written permission from authorities having jurisdiction.

C. Owner assumes no responsibility for buildings and structures to be demolished. Conditions existing at time of inspection for bidding purpose will be maintained by the Owner as far as practical.

D. Hazardous Materials: Other than as identified on the drawing notes, it is not expected that hazardous materials will be encountered in the Work. If materials suspected of containing hazardous materials are encountered other than as identified in the drawing notes, do not disturb; immediately notify the Owner.

1.06 COORDINATION

A. Arrange demolition schedule so as not to interfere with operations of Town of Emmitsburg facilities.

PART 2 - PRODUCTS

(NOT USED)

PART 3 - EXECUTION

3.01 EXAMINATION

A. Review project record documents of existing construction. Owner does not guarantee that existing conditions are same as those indicated in project record documents.

B. Inventory and record the condition of items to be removed and salvaged. Provide photographs or video of conditions that might be misconstrued as damage caused by salvage operations.

C. Perform an engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during building demolition operations.

3.02 PREPARATION

A. Existing Utilities: Locate, identify, disconnect, and seal or cap off indicated utilities serving buildings and structures to be demolished. Arrange to shut off indicated utilities with utility companies.

B. If removal, relocation, or abandonment of utility services will affect adjacent properties, then provide temporary utilities that bypass buildings and structures to be demolished and that maintain continuity of service to other buildings and structures.

C. Cut off pipe or conduit a minimum of 24 inches below grade. Cap, valve, or plug and seal remaining portion of pipe or conduit after bypassing according to requirements of authorities having jurisdiction.

D. Temporary Shoring: Provide and maintain interior and exterior shoring, bracing, or structural support to preserve stability and prevent unexpected movement or collapse of construction being demolished. Strengthen or add new supports when required during progress of demolition.

E. Salvaged Items: Clean salvaged items of dirt and demolition debris, pack or crate items after cleaning and identify contents of containers. Store items in a secure area until delivery to the Owner. Transport items to storage area designated by Owner. Protect all items from damage during transport and storage.

3.03 PROTECTION

A. Existing Facilities: Protect adjacent walkways, building entries, and other building facilities during demolition operations. Maintain exits from existing buildings.

B. Existing Utilities: Maintain utility services to remain and protect from damage during demolition operations.

C. Do not interrupt existing utilities serving adjacent occupied or operating facilities unless authorized in writing by Owner and authorities having jurisdiction.

D. Provide temporary services during interruptions to existing utilities, as acceptable to Owner and authorities having jurisdiction. Provide at least 72 hours' notice to occupants of affected buildings if shutdown of service is required during changeover.

E. Temporary Protection: Erect temporary protection, such as walks, fences, railings, canopies, and covered passageways, where required by authorities having jurisdiction and as indicated. Protect existing site improvements, appurtenances, and landscaping to remain. Erect a plainly visible fence around drip line of individual trees or around perimeter drip line of groups of trees to remain. Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain. Provide protection to ensure safe passage of people around building demolition area and to and from occupied portions of adjacent buildings and structures. Protect walls, windows, roofs, and other adjacent exterior construction that are to remain and that are exposed to building demolition operations. Erect and maintain dustproof partitions and temporary enclosures to limit dust, noise, and dirt migration to occupied portions of adjacent buildings.

F. Remove temporary barriers and protections where hazards no longer exist. Where open excavations or other hazardous conditions remain, leave temporary barriers and protections in place.

3.04 DEMOLITION, GENERAL

A. General: Demolish indicated existing building and site improvements completely. Use methods required to complete the work within limitations of governing regulations and as follows:

1. Do not use cutting torches until work area is cleared of flammable materials. Maintain portable fire-suppression devices during and after flame-cutting operations. Maintain fire watch and adequate ventilation during and for an extended period after flame cutting operations.

2. Locate building demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.

B. Site Access and Temporary Controls: Conduct building demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities. Do not close or obstruct streets, walks, walkways, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide

alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.

C. Use water mist and other suitable methods to limit spread of dust and dirt. Comply with governing environmental-protection regulations. Do not use water when it may damage adjacent construction or create hazardous or objectionable conditions, such as ice, flooding, and pollution.

D. Explosives: Use of explosives is not permitted.

3.05 DEMOLITION BY MECHANICAL MEANS

A. Proceed with demolition of structural framing members systematically, from higher to lower level. Complete building demolition operations above each floor or tier before disturbing supporting members on the next lower level.

B. Remove debris from elevated portions of the building by chute, hoist, or other device that will convey debris to grade level in a controlled descent. Remove structural framing members and lower to ground by method suitable to minimize ground impact and dust generation.

C. Below-Grade Construction: Demolish foundation walls and other below-grade construction.

D. Existing Utilities: Demolish existing utilities and below-grade utility structures that are within 10 feet outside footprint indicated for new construction. Abandon utilities outside this area. Fill abandoned utility structures with a minimum of 6 inches of concrete.

3.06 SITE RESTORATION

A. Below-Grade Areas: Rough grade below-grade areas ready for further excavation or new construction.

B. Site Grading: Uniformly rough grade area of demolished construction to a smooth surface, free from irregular surface changes. Provide a smooth transition between adjacent existing grades and new grades.

C. Promptly repair damage to adjacent buildings caused by demolition operations.

3.07 DISPOSAL OF DEMOLISHED MATERIALS

A. Remove demolition waste materials from Project site and legally dispose of them in an EPA-approved landfill acceptable to authorities having jurisdiction. Do not allow demolished materials to accumulate on-site, and remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

B. Do not burn demolished materials.

3.08 CLEANING

A. Clean adjacent structures and improvements of dust, dirt, and debris caused by building demolition operations. Return adjacent areas to condition existing before building demolition operations began.

END OF SECTION

SECTION 02240

DEWATERING

PART 1 - GENERAL

1.01 SUMMARY

A. The work to be performed under this section includes, but is not limited to, the furnishing of all materials, labor, tools and equipment necessary to provide construction dewatering to keep all excavations and structures free from water during excavation and construction.

1.02 PERFORMANCE REQUIREMENTS

A. Design, furnish, install, test, operate, monitor, and maintain dewatering system of sufficient scope, size, and capacity to control surface water and groundwater flows into excavations and permit construction to proceed on dry, stable subgrades.

1. Dewatering plans, including detailed shop drawings, shall be prepared, sealed and signed by a qualified Professional Engineer registered in the State of Maryland.

2. Maintain dewatering operations to ensure erosion control, stability of excavations and constructed slopes, that excavation does not flood, and that damage to subgrades and permanent structures is prevented.

3. Prevent groundwater and surface water from entering excavations.

4. Accomplish dewatering without damaging existing buildings, pavements, utilities, and other improvements adjacent to excavations.

5. Remove dewatering system when no longer needed.

1.03 SUBMITTALS

A. Shop Drawings for Information Only: Show arrangement, locations, and details of wells and well points; locations of headers and discharge lines; and means of discharge and disposal of water. Shop drawings shall be prepared, sealed and signed by a qualified Professional Engineer for dewatering systems.

1. Include layouts of piezometers and flow-measuring devices for monitoring performance of dewatering system.

2. Include a written report outlining control procedures to be adopted if dewatering problems arise.

B. Qualification Data: For the Professional Engineer and the dewatering system installer.

C. Photographs or videotape, sufficiently detailed, of existing conditions of adjoining improvements that might be misconstrued as damage caused by dewatering operations.

D. Record drawings identifying and locating any capped utilities and other subsurface conditions performed during dewatering, including locations and capping depth of wells and well points.

E. Field Test Reports: Before starting excavation, submit test results and computations demonstrating that the dewatering system is capable of meeting performance requirements.

1.04 PROJECT CONDITIONS

A. Existing Utilities: Do not interrupt utilities serving the existing pumping station or other facilities unless permitted in writing by the Engineer and then only after arranging to provide temporary utility services according to requirements indicated.

B. Project Site Information: Geotechnical soil borings obtained in the project site area during design, if any, are available for information purposes only. The soil borings, and opinions expressed in any accompanying reports, are those of the geotechnical engineer and represent interpretations of subsoil conditions, tests and results of analyses conducted by the geotechnical engineer for design purposes only. The Owner and Engineer will not be responsible for interpretations or conclusions drawn from this data. The Contractor shall make his own test borings and conduct other exploratory operations as necessary for providing dewatering systems.

C. Survey adjacent structures and improvements, employing a qualified Professional Engineer or Land Surveyor, and establish exact elevations at fixed points to act as benchmarks. Clearly identify benchmarks and record existing elevations. During dewatering, regularly resurvey benchmarks, maintaining an accurate log of surveyed elevations for comparison with original elevations. Promptly notify the Engineer if changes in elevations or positions occur or if cracks, sags, or other damage is evident in adjacent improvements.

PART 2 - PRODUCTS

(NOT USED)

PART 3 - EXECUTION

3.01 PREPARATION

A. Protect structures, utilities, pavements, and other facilities and improvements from damage caused by settlement, lateral movement, undermining, washout, and other hazards that could develop during dewatering operations.

1. Prevent surface water and subsurface or groundwater from entering excavations, from ponding on prepared subgrades, and from flooding site and surrounding area.

2. Protect subgrades and foundation soils from softening and damage by rain or water accumulation.

B. Install dewatering systems to ensure minimum interference with roads, streets, alleys, walks, driveways, residences and other adjacent occupied or used facilities. Do not close or obstruct roads, streets, alleys, walks, driveways and other adjacent occupied or used facilities without permission of the Owner and authorities having jurisdiction.

C. Promptly repair damages to adjacent facilities or improvements caused by dewatering operations at no additional cost to the Owner.

3.02 INSTALLATION

A. Install dewatering system utilizing wells, well points, or similar methods complete with pump equipment, standby power and pumps, filter material gradation, valves, appurtenances, water disposal, and surface-water controls.

B. Before excavating below groundwater level, place system into operation to lower water to specified levels. Operate system continuously until drains, sewers and structures have been constructed and fill materials placed, or until dewatering is no longer required.

C. Provide an adequate system to lower and control groundwater to permit excavation, construction of structures, and placement of fill materials on dry subgrades. Install sufficient dewatering equipment to drain water-bearing strata above and below bottom of foundations, drains, sewers and other excavations. Do not permit open-sump pumping that leads to loss of fines, soil piping, subgrade softening, and slope instability.

D. Reduce hydrostatic head in water-bearing strata below subgrade elevations of foundations, drains, sewers, and other excavations. Maintain piezometric water level a minimum of 24-inches below surface of excavation.

E. Dispose of water removed by dewatering in a manner that avoids endangering public health, property, and portions of work under construction or completed.

Dispose of water in a manner that avoids inconvenience to others. Provide sumps, sedimentation tanks, and other flow-control devices as required by authorities having jurisdiction.

F. Provide standby equipment on-site, installed and available for immediate operation, to maintain dewatering on continuous basis if any part of the system becomes inadequate or fails. If dewatering requirements are not satisfied due to inadequacy or failure of dewatering system, restore damaged structures and foundation soils at no additional expense to the Owner.

G. Remove dewatering system upon completion of dewatering. Plug or fill well holes with sand or cut off and cap wells a minimum of 36-inches below overlying construction.

3.03 OBSERVATION WELLS

A. Provide, take measurements, and maintain at least the minimum number of observation wells or piezometers necessary and additional observation wells as may be required by authorities having jurisdiction.

B. Observe and record daily elevation of ground water and piezometric water levels in observation wells.

C. Repair or replace, within 24 hours, observation wells that become inactive, damaged, or destroyed. Suspend construction activities in areas where observation wells are not functioning properly until reliable observations can be made. Add or remove water from observation well risers to demonstrate that observation wells are functioning properly.

D. Fill observation wells, remove piezometers, and fill holes when dewatering is completed.

END OF SECTION

SECTION 02260

EXCAVATION SUPPORT AND PROTECTION

PART 1 - GENERAL

1.01 SUMMARY

A. The work to be performed under this section includes, but is not limited to, the furnishing of all materials, labor, tools and equipment necessary to provide temporary structure and excavation support and protection systems.

1.02 PERFORMANCE REQUIREMENTS

A. Design, furnish, install, monitor, and maintain excavation support and protection systems capable of supporting excavation sidewalls and of resisting soil and hydrostatic pressure and superimposed and construction loads.

1. Excavation support and protection plans, including detailed shop drawings, design calculations, and a comprehensive engineering analysis, shall be designed, sealed and signed by a qualified Professional Engineer registered in the State of Maryland.

2. Prevent groundwater and surface water from entering excavations.

3. Install excavation support and protection systems without damaging existing buildings, pavements, utilities, and other improvements within or adjacent to excavations.

B. Contractor to conduct, as needed, additional subsurface explorations and associated laboratory testing to verify conditions and assumptions used for the design of the excavation support and protection.

C. The Contractor shall make every effort to avoid damage to all structures and utilities in the area of the proposed construction. The Contractor is responsible for vibration damage to any structures or utilities.

1.03 SUBMITTALS

A. Shop Drawings, design calculations, and engineering analysis for Information Only: Prepared, sealed and signed by a qualified Professional Engineer for excavation support and protection systems.

B. Qualification Data: For the Professional Engineer and the excavation support and protection system installer.

C. Photographs or videotape, sufficiently detailed, of existing conditions of adjoining improvements that might be misconstrued as damage caused by the absence of, the installation of, or the performance of excavation support and protection systems.

D. All test borings and soil data obtained by the Contractor.

1.04 PROJECT CONDITIONS

A. Existing Utilities: Do not interrupt utilities serving the existing pumping station or other facilities unless permitted in writing by the Engineer and then only after arranging to provide temporary utility services according to requirements indicated.

B. Project Site Information: Geotechnical soil borings obtained in the project site area during design, if any, are available for information purposes only. The soil borings, and opinions expressed in any accompanying reports, are those of the geotechnical engineer and represent interpretations of subsurface conditions, tests and results of analyses conducted by the geotechnical engineer for design purposes only. The Owner and Engineer will not be responsible for interpretations or conclusions drawn from this data. The Contractor shall make his own test borings and conduct other exploratory operations as necessary for providing excavation support and protection.

C. Survey adjacent improvements, employing a qualified Professional Engineer or Land Surveyor, and establish exact elevations at fixed points to act as benchmarks. Clearly identify benchmarks and record existing elevations. During installation of excavation support and protection systems, regularly resurvey benchmarks, maintaining an accurate log of surveyed elevations and positions for comparison with original elevations and positions. Promptly notify the Engineer if changes in elevations or positions occur or if cracks, sags, or other damage is evident in adjacent improvements.

PART 2 - PRODUCTS

2.01 MATERIALS

A. General: Provide materials that are either new or in serviceable condition.

B. Structural Steel: ASTM A36, A690, or A992.

C. Steel Sheet Piling: ASTM A328, A572, or A690; with continuous interlocks.

D. Wood Lagging: Lumber, mixed hardwood, nominal rough thickness of 4 inches.

E. Cast-In-Place Concrete: ACI 301, of compressive strength required for the application, in accordance with the design.

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

PART 3 - EXECUTION

3.01 PREPARATION

A. Shore, support and protect structures, utilities, pavements, and other facilities and improvements from damage caused by settlement, lateral movement, undermining, washout, and other hazards that could develop during excavation support and protection system operations.

B. Install excavation support and protection systems to ensure minimum interference with roads, streets, alleys, walks, driveways, residences and other adjacent occupied or used facilities. Do not close roads, streets, alleys, walks, driveways, residences and other adjacent occupied or used facilities without permission of the Owner and authorities having jurisdiction.

C. Locate excavation support and protection systems clear of permanent construction, so that forming and finishing of concrete surfaces, or setting of precast concrete structures, is not impeded.

D. Monitor excavation support and protection systems daily during excavation progress and for as long as excavation remains open. Promptly correct bulges, breakage, or other evidence of movement to ensure that excavation support and protection systems remain stable.

E. Promptly repair damages to adjacent facilities or improvements caused by installing excavation support and protection systems at no additional cost to the Owner.

3.02 SOLDIER BEAMS AND LAGGING

A. Install steel soldier beams before starting excavation. Space soldier beams at regular intervals not to exceed allowable flexural strength of wood lagging. Accurately align exposed faces of flanges to vary not more than 2 inches from a horizontal line and not more than 1:120 out of vertical alignment.

B. Install wood lagging within flanges of soldier beams as excavation proceeds. Trim excavation as required to install lagging. Fill voids behind lagging with soil, and compact.

C. Install wales horizontally at centers as designed and secure to soldier beams.

3.03 SHEET PILING

A. Before starting excavation, install one-piece sheet piling lengths and tightly interlock to form a continuous barrier. Limit vertical offset of adjacent sheet piling to 60 inches. Accurately align exposed faces of sheet piling to vary not more than 2 inches from a horizontal line and not more than 1:120 out of vertical alignment. Cut tops of sheet piling to uniform elevation at top of excavation.

3.04 BRACING

A. Locate bracing to clear permanent construction work. If necessary to move brace, install new brace before moving original brace. Install internal bracing, if required, to prevent spreading or distortion of braced frames. Maintain bracing until structural elements are supported by other bracing or until permanent construction is able to withstand lateral earth and hydrostatic pressures.

3.05 METHODS

A. The Contractor may, at his option, furnish and install other supporting systems for the excavation of the pumping station provided the design of such systems is approved by the Owner and the design performed is signed and sealed by a Professional Engineer registered in the State of Maryland. The Contractor shall be responsible for the maintenance of the excavation support system for the full term of the contract. All costs shall be included in the lump sum bid and no separate payment will be made.

3.06 REMOVAL AND REPAIRS

A. Remove excavation support and protection systems when construction has progressed sufficiently to support excavation and bear soil and hydrostatic pressures. Remove in stages to avoid disturbing underlying soils or damaging structures, pavements, facilities and utilities.

B. Promptly repair or replace, as approved by the Engineer, adjacent work or improvements damaged or displaced by removing excavation support and protection systems at no additional cost to the Owner.

END OF SECTION

SECTION 02280

CONSTRUCTION VIBRATION MONITORING

PART 1 - GENERAL

1.01 SUMMARY

A. The work to be performed under this section includes, but is not limited to, monitoring the existing pumping station, valve vault, and generator pad structures for vibration during all construction operations to complete the new sewage pump station construction. Locations to be monitored include the existing Creamery Road Sewage Pump Station and associated structures.

1.02 SUBMITTALS

A. Description of the surveying equipment to be used.

B. Detail showing actual seismograph locations.

C. Description of the vibration monitoring equipment to be used.

D. Pre-Construction Survey Report.

E. Seismic Monitoring Data Report.

PART 2 - PRODUCTS

2.01 MATERIALS

A. The Contractor shall provide a minimum of one seismograph to measure and record ground motion caused by construction under the Contract. The seismograph shall be attached or located immediately adjacent to the nearest structure or as approved by the Engineer. The seismograph equipment shall be an Everlet seismograph, GeoSonic 3000 LC seismograph, or equivalent, capable of producing a permanent record of the three components of ground motion in terms of particle velocity. The instrument shall be capable of internal dynamic calibration. The Contractor shall submit the latest manufacturer's calibration for the specific machine to be used in the field to the Engineer at least 10-days prior to the field work beginning. The manufactures calibration should be within the last 6-months. The record of each construction activity shall consist of the seismograph records identified by instrument number, location of the instrument positively identified, date, time and location of the construction activities, and all other data necessary for the proposed construction. These records, as a formal report, shall be made available to the Engineer as required.

PART 3 - EXECUTION

3.01 PREPARATION

A. The Contractor shall make every effort to avoid damages to all structures in the area of the proposed construction. The Contractor is responsible for vibration damages to any structures.

3.02 PRE-CONSTRUCTION SURVEY

A. Data must be obtained by the Contractor during the pre-construction survey to establish a base for determining effects of construction, excavating, and other construction activities on nearby structures.

B. All structural and cosmetic defects shall be thoroughly documented in writing, with annotated photographs and videos.

C. At least 10 days prior to any excavation or construction activities, the general plan for the seismic monitoring shall be submitted to the Engineer for review and approval.

D. Prior to starting, the Contractor shall retain the services of a qualified Professional Engineer licensed in the State of Maryland with experience in pre-construction condition surveys to make a detailed inspection of all structures within the monitoring scope or as designated by the Engineer.

E. The inspection report shall include notes, sketch measurements, photographs, video and a DVD (with audio sound track) of all structures prior to the start of construction. The audio description of the inspection shall include the date, time, weather conditions, address/stationing/location, brief description of the facility and description of physical conditions encountered. The inspection should also include documentation of existing damage and other factors (both inside and outside) which could be affected by construction activity. Photographs shall be a minimum of 8" x 10" in size and in color. The report shall also recommend any adjustments to the Peak Particle Velocity (PPV) contained in this specification.

3.03 SEISMIC MONITORING

A. Seismic monitoring is required for all construction operations with a distance of 25-ft of existing structures or as directed by the Engineer. These operations include, but are not limited to, pile driving, jack hammering, excavation, compaction, and utility installation.

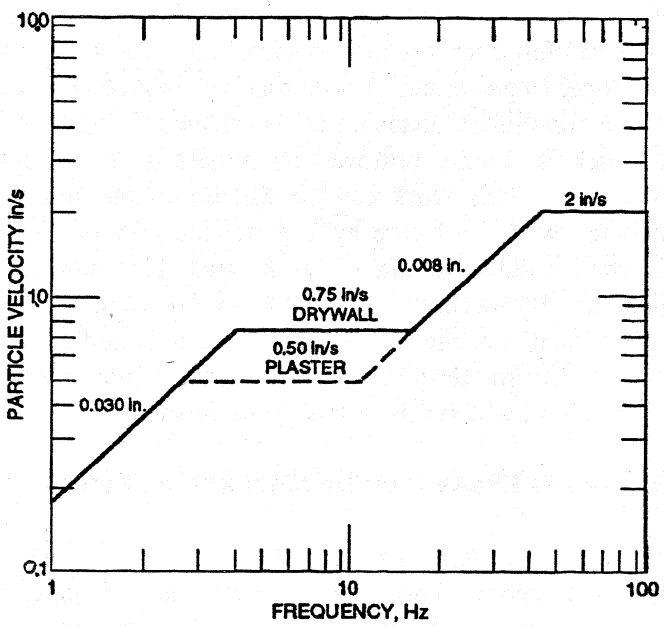
B. The Contractor shall submit the qualifications of the individual or subcontractor responsible for the seismic monitoring to the Engineer for approval. The individual or subcontractor responsible for the vibration monitoring shall also be present during the pre-construction survey of all structures within the influence area of the project.

C. Qualifications: The supervisor of the seismic monitoring work shall be either a professional geologist or professional engineer with a minimum of 5 years' experience of similar scope, size, and complexity. The supervisor of the seismic work shall submit a resume with a minimum of five projects of similar scope, size, and complexity for the Engineers review and approval at least 10 days prior to start of the work. The field technician for the seismic monitoring shall have experience with at least three projects of similar scope, size, and complexity in addition to having a BS in Engineering or Geology. The field technician's resume shall be submitted for review and approval of the Engineer.

D. Peak particle velocity (PPV) at existing adjacent structures shall not exceed that shown in the OSM Method 3 Figure below. Peak particle velocity is defined as the vector sum of the three velocity components in three mutually perpendicular directions, measured at any point by an instrument approved by the Engineer. The criteria for drywall shall be used for all structures except those that actually are constructed of plaster and otherwise noted above. These limits may be adjusted by the Engineer based on any evidence of damage to structure.

E. All data submitted by the Contractor shall be presented in tabular and graphical form. The record for each instrument shall consist of the seismograph records identified by instrument number, location of the instrument positively identified, date and time.

F. All construction operations should be monitored in accordance with the Office of Surface Mining (OSM) Method 3 and the following figure.



END OF SECTION

SECTION 02300

EARTHWORK

PART 1 - GENERAL

1.01 SUMMARY

A. The work to be performed under this section includes, but is not limited to, the furnishing of all materials, labor, tools and equipment necessary to complete:

1. Test Pits

2. Structure Excavation

3. Borrow Excavation

4. Select Backfill

5. Trench Excavation, Backfill, and Compaction

6. Subgrade Preparation

B. All excavation work performed under this contract is UNCLASSIFIED, and includes excavation and removal of all soil, shale, rock, boulders, wood, lumber, fill, sheeting & shoring, conduits, pipe and other materials encountered of whatever nature.

1.02 DESCRIPTION

A. Test pits shall include, but not necessarily be limited to, excavation to determine the exact location and/or elevation of underground structures, utilities, and other obstructions; the backfill and compaction of the excavation; and the stabilization of the surface.

B. Structure excavation shall include, but not necessarily be limited to, excavation for all concrete structures as shown on the Contract Drawings.

C. Borrow excavation shall include, but not necessarily be limited to, furnishing, excavating, hauling, and depositing of approved materials for backfills when sufficient quantities of suitable materials are not available from onsite excavations, and shall include all work for backfills and subgrade preparations. Borrow excavation shall be at no additional cost to the Owner.

D. Select backfill shall include, but not necessarily be limited to, furnishing and placing satisfactory foundation bedding and backfill materials for wetwells, valve vaults, pipes, manholes, and other structures.

E. Trench excavation, backfill, and compaction shall include, but not necessarily be limited to, the excavation, backfill and compaction of trenches for sanitary sewers, force mains, drains, water service lines, and other underground utility systems shown on the Contract Drawings.

F. Subgrade preparation shall include, but not necessarily be limited to, preparation, protection, and maintenance of the subgrade before construction of any succeeding courses or structure foundations.

G. All material excavated, regardless of its nature or composition, shall be classified as UNCLASSIFIED. Excavation shall include the removal of all loose or disturbed soil, rock, weathered rock, rocks of all types, boulders, lumber, fill, sheeting & shoring, conduits, pipe and all other obstacles encountered of whatever nature. The cost of excavation shall be considered as incidental and no additional payment will be made for the removal of obstacles encountered.

1.03 QUALITY ASSURANCE

A. Backfilled areas shall not suffer from ponding or settlement in excess of 0.10 feet for a period of one year from the date of final acceptance. Backfilled areas which settle in excess of this limitation shall be removed and replaced with suitable material at no additional cost to the Owner. Structures, paving, utilities, and other site improvements damaged by such settlement shall be removed and replaced at no additional cost to the Owner.

B. Backfill and fill material shall be subject to in-place moisture/density testing, which shall be performed by an independent soil testing laboratory, arranged and paid for by the Contractor and approved by the Engineer. Should testing determine that the required density is not being met, or the material is outside the specified moisture range, the Contractor shall re-excavate, rework, and/or re-compact the particular layer or section until the required density and/or moisture is attained.

1.04 SUBMITTALS

A. Submit material test results from a qualified testing agency in accordance with ASTM D2487 and certificates of suitability for each on-site and borrow soil material proposed for fill and backfill.

B. Submit for approval a list of compaction equipment that the Contractor intends to use on the project, the recommendations of the equipment manufacturer as to the maximum lift thickness, which can be placed with that equipment, and the method of compaction to be used with this equipment.

C. Submit for approval the sources of all material in Paragraph 2.01 to be used for this project.

D. Delivery Tickets

The Contractor shall submit delivery tickets with each load of material specified in Paragraph 2.01 brought to the site showing the following information:

1. Name and location of supplier or source.

2. Type and amount of material delivered.

3. Test information on the material as required by the specifications.

PART 2 - MATERIALS

2.01 SUITABLE MATERIAL

All excavated material from within the limits of the project, which is to be used for the construction of embankments or fill or used for backfilling, shall be approved by the Engineer.

A. Backfill adjacent to pipe and associated structures in area from subgrade of trench to two (2) feet above the crown of pipe or top of structure shall consist of 100 percent material passing the 1-inch sieve, or in accordance with pipe manufacturer's recommendations. Material above this point shall not contain stones or any other particles exceeding one half the lift thickness in any dimension and a maximum dry density no less than 105 pounds per cubic foot in accordance with AASHTO T-180.

B. Select Backfill

Material shall be AASHTO M145 Soil Classification Groups A-1-a, A-1-b, A-2-4, A-2-5, or A-3 and a maximum dry density no less than 110 pounds per cubic foot in accordance with AASHTO T-180.

C. Satisfactory Soils

AASHTO M145 Soil Classification Groups A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-3 or A-4; or a combination of these groups, and a maximum dry density of at least 100 pounds per cubic foot in accordance with AASHTO T-180.; free of rock or gravel larger than one half the lift thickness in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.

D. Stone Fill

Stone fill under cast-in-place or precast concrete structures or as noted on plans shall be gravel, crushed stone or crushed gravel meeting the gradation requirements for Crusher Run Aggregate CR-6 or AASHTO M43 Number 57 Aggregate as indicated on the plans.

2.02 UNSUITABLE MATERIAL

A. The following excavated materials will be unsuitable for reuse in fills and backfills.

1. Material having a maximum dry density of less than 100 pounds per cubic foot in accordance with AASHTO T-180.

2. Refuse and putrescent items.

3. Organic material, wood, lumber and other deleterious material.

4. Any material which, in the opinion of the Engineer, is unsatisfactory.

B. Unsatisfactory Soils: AASHTO M145 Soil Classification Groups A-5, A-6 and A-7; or a combination of these groups; and any soils not maintained within 2-percent of optimum moisture content at time of compaction.

2.03 USE OF EXCAVATED MATERIAL

A. All suitable material excavated from test pits shall be used, as far as practicable, for backfill. The Contractor shall properly store or stockpile and protect all materials that are to be reused in the work. Boulders, logs, wood, lumber or any other unforeseen obstacles encountered shall be removed. All unsuitable material shall be removed from the excavation and disposed of off-site by the Contractor at no additional cost to the Owner.

2.04 TESTS

A. The Contractor shall hire an independent inspection agency and testing laboratory for inspection and testing of soils and compaction. The agency's responsibilities shall include:

1. Inspection of exposed subgrade prior to preparation of site.

2. Testing and approving all materials used for fill and/or backfill and borrow.

3. Maintaining accurate records in regard to excavation and fill or backfill for ordered undercutting or over-excavation.

4. Approving all backfilling procedures and mechanical compaction equipment.

5. Verifying compaction by in-place density tests. Tests to be submitted to the Engineer for review. A minimum of one (1) density test per AASHTO T-310 shall be performed for each 5,000 square feet of lift or pavement area or more often if directed by the inspection agency. At least one density test per AASHTO T-310 shall be performed per lift in structural areas or more often if directed by the inspection agency.

6. Observe and inspect all proof rolling operations with a minimum of four passes of a fully loaded dump truck, or equivalent, to determine whether additional excavation and backfilling is required. Inspect and test excavation for structure footings to determine that the design bearing pressures are available and that no loose or soft pockets exist beneath the bearing surface. Approve the bearing surfaces or recommend undercutting and structural fills as necessary.

7. Submitting weekly written reports as to the status of the backfill or fill.

8. Submit a final report indicating that the backfill or fill meets the requirements of the Specifications.

9. Determine all earthwork quantities for which unit price payments apply.

B. It shall be the responsibility of the Contractor to notify the inspection agency three (3) days prior to the beginning of work so that the inspection agency can have a soils technician on the site during the work. The Contractor shall pay for all costs of this inspection service.

2.05 FILTER FABRIC

A. Undercut areas to be backfilled with stone only shall use a filter fabric that permits subsurface drainage. Filter fabric shall be Maryland SHA Class SE non-woven Geosynthetic, or approved equal, with the following minimum properties determined according to ASTM D4759 and referenced standard test methods:

1. Grab Tensile Strength: 200 lb; ASTM D4632

2. Puncture Strength: 80 lb; ASTM D6241

3. Permittivity: 0.20 sec-1; ASTM D4491

4. Apparent Opening Size: 0.30 mm; ASTM D4751

5. Trapezoid Tear Strength: 80 lb; ASTM D4533

B. Filter fabric for all other areas shall be Maryland SHA Class ST woven Geosynthetic, or approved equal, with the following minimum properties determined according to ASTM D4759 and referenced standard test methods:

1. Grab Tensile Strength: 300 lb; ASTM D4632

2. Grab Tensile Elongation: 15% (Machine Direction); ASTM D4632

3. Puncture Strength: 110 lb; ASTM D4833

4. Permittivity: 0.05 sec-1; ASTM D4491

5. Apparent Opening Size: 0.15 mm; ASTM D4751

6. Trapezoid Tear Strength: 110 lb; ASTM D4533

PART 3 - EXECUTION

3.01 TRENCH EXCAVATION AND BACKFILL

A. Trench Excavation

1. The Contractor shall excavate, protect, and refill all excavation that may be necessary for completing the work under the contract. Unless otherwise specified, excavation shall be open cut, except that short sections of a trench may be tunneled if, in the opinion of the Engineer, the pipe can be safely and properly installed and backfill can be properly consolidated in such tunnel sections. No extra compensation will be allowed for tunneling instead of open cut. Sheeting, shoring, interlocking sheet piling, hand excavation or other suitable methods shall be done as may be necessary for the protection of the work and for the safety of personnel.

2. Trenches shall be excavated to the necessary width and depth.

3. The sides of trenches shall be practically plumb and will be permitted to be sloped only with the written approval of the Engineer. Bell-holes shall be excavated in the bottom and side of trenches to permit the proper making of joints.

4. In paved areas, the Contractor shall remove the paving for such width only as is necessary for the excavation of the trench, as shown on standard trench details, and in case the Contractor removes the paving for a greater width than is deemed necessary, or in case the Contractor removes or disturbs any paving on account of settlement, slides or caves, or in making excavation outside the lines of the work without the written order of the Engineer, the Contractor shall replace at his/her own expense such paving, or the Owner may retain from any monies due or to become due to the Contractor, the cost of permanently replacing the paving so removed.

5. The Contractor shall support the sides and ends of all excavations or structures, whenever necessary.

6. All sheeting in excavations shall be withdrawn as the refilling is being done, except where the Engineer shall permit the sheeting and shoring be left in place at the Contractor's expense and upon his/her request. The Contractor shall cut off any sheeting left in place at least eighteen (18) inches below finished grade and shall remove the material cut off.

7. Wherever necessary, in quicksand or soft ground, or for the protection of any structure or property, sheeting shall be driven, to such depth below the bottom of the trench as may be required.

8. The Contractor is responsible for the stability, safety and integrity of the existing adjacent structures or underground pipes, and for any corrective measures or repairs required to restore the damaged structures to the condition, which existed prior to the start of work.

9. The Contractor shall be responsible for the condition of all excavations made by him/her. All slides and caves shall be removed without extra compensation, at whatever time and under whatever circumstance they may occur.

10. The excavation of all trenches shall be fully completed at least twenty (20) feet in advance of pipe laying unless otherwise authorized. The Engineer may at any time require the refilling of open trenches over completed pipe line, if in the Engineer's judgment such action is necessary, and the Contractor shall thereby have no claim for extra compensation, even though to accomplish said refilling the Contractor is compelled temporarily to stop excavation or other work at any place. If work is stopped on any trench, for any reason except by order of the Engineer, and the excavation is left open for an unreasonable length of time in advance of construction, the Contractor shall, if so directed, refill such trench at his/her own cost, and shall not again open said trench until the Contractor is ready to complete the pipe laying therein. If the Contractor shall refuse or fail to refill such trench completely within forty-eight (48) hours after said notice, the Owner shall be authorized to do the work and the expense thereof shall be charged to the Contractor.

11. All excavations shall be kept free of water below the subgrade of the work while work is in progress. Water removed from excavations shall be disposed of in accordance with approved erosion and sediment control practices.

12. The Contractor shall complete excavations in earth as nearly as practicable to the neat lines of the facilities to be built therein. All irregularities and cavities in the bottom of trenches or tunnels shall be filled up to the required level with clean earth or other approved material, firmly compacted, before pipelines are laid therein, and without extra compensation unless said cavities have been formed by the direction of the Engineer, and their excavation classed as excavation below sub-grade.

B. Trench Backfill

1. Material meeting the requirements of Paragraph 2.01 shall be carefully deposited in the trench by methods which will not damage or disturb the pipe or structures and shall be solidly tamped around the pipe or structure. The volume from the bottom of the trench to the spring line of the pipe shall be

placed in four (4) inch compacted layers. The volume from the spring line of the pipe to a point twelve (12) inches below road sub-base, or to grade, where the pipe is not laid in a road, shall be refilled in six (6) inch compacted layers. All tamping of material from the bottom of the trench to the spring line shall be done by pneumatic hand tampers; or if the material is composed largely of coarse aggregate, use hand tampers to insure protection of the pipe. Above this point, mechanical tampers capable of exerting a blow of 250-foot pounds per square foot of area of tamping face shall be employed.

2. The moisture content of the material being compacted shall be within plus or minus two (2) percentage points of optimum, as determined by AASHTO T-180 Method C and meet the following requirements:

Maximum Laboratory Dry Density (Lbs. per Cu. Ft.)	Minimum Field Compaction Requirements (% of Max. Lab. Dry Density)
105 minimum	Paved Areas 95, Unpaved Areas 92

Material containing an excess of moisture shall be processed and dried or permitted to dry until the moisture content is within the specified range.

3. The Engineer may make compaction tests of the backfilled trenches at any time during construction or upon completion of the backfill operations. If the results of any tests show that backfills do not meet the specified compaction requirements, the Contractor shall at his/her own expense, correct the condition in such portions of the trench represented by the unsatisfactory test results.

4. The top twelve (12) inches below the existing roadway subgrade for all trenches located in paved areas and shoulders shall be backfilled with well-compacted graded aggregate sub-base course. Trench backfill from the top of the compacted sub-base course to the existing roadway surface shall be maintained for a minimum of 30 days before permanent repairs are made.

5. All excavations not in paved areas shall be restored to the condition that existed prior to beginning work and maintained for a period of one year following the date of conditional acceptance.

6. The Contractor shall, at his/her own expense, maintain all backfilled excavations in proper condition. Just prior to the termination date for maintaining excavations, the trench surfaces shall be given a final reshaping where necessary. All depressions appearing in the backfilled excavations shall be properly refilled. If the Contractor fails to make repairs within forty-eight (48) hours after receipt of written notice from the Owner, the Owner may refill said depression or protect with signs and lanterns wherever necessary without giving additional notice to the Contractor and the cost of so doing will be retained from any monies due or to become due the

Contractor under the Contract. The Contractor shall be responsible for any injury or damage that may result from lack of maintenance of any refilled excavation at any time previous to the end of the mentioned termination dates.

7. All unauthorized excavations made by the Contractor shall be immediately backfilled in accordance with the requirements of the specifications at the Contractor's expense.

8. After completion of backfilling, all material not used therein, shall be removed and disposed of in such a manner, and at such point as shall be approved, and all roads, sidewalks, and other places on the line of the work shall be left free, clean and in good order. Said cleaning up shall be done by the Contractor without extra compensation, and, if he/she fails to do such work within a reasonable time after receipt of notice, it will be performed by the Owner, and the cost will be retained out of the monies due or to become due the Contractor under the contract.

C. Excavation Below Trench Subgrade and Refill

1. Unsuitable or other material encountered at or below the excavation limits which in the judgment of the Engineer should be removed, shall be removed to the extent directed; and all spaces created by the removal of any and all material shall be backfilled with thoroughly compacted stone fill.

2. In general, this item of work will be performed when the planned subgrade is in rock and a cushion is deemed necessary or where the planned subgrade is an unsuitable or unstable area. In any event, the work will be performed only upon the written direction of the Engineer.

3.02 STRUCTURE EXCAVATION AND BACKFILL

A. Structure Excavation

1. Structure excavation shall consist of the excavation of all earth, rock, boulders and all other materials encountered regardless of type, which the Contractor may encounter while excavating for structures. Support sides of excavation as necessary. All excavations contiguous to existing pavements and structures shall be sheeted, shored, braced and supported in a substantial manner to prevent settlement, movement or damage.

2. All suitable material shall be used for backfilling or reserved for the construction of embankments and fills. All unsuitable material shall be removed, at the Contractor's expense, from the limits of the work. No excavated material shall be deposited at any time so as to endanger partly finished structures either by direct pressure, or indirectly by overloading banks contiguous to the operation, or by any other means.

3. Trenches and foundation pits for structures or structure footings shall be excavated to the lines and grades, or elevations, indicated on the Plans, and shall be of sufficient size to permit the construction of the structures, or structure footings, as shown.

4. Where structures or structure footings are to be carried to rock, the rock shall be cut to a firm surface, either level or stepped, and serrated as indicated on the Plans. All thin strata and loose material shall be removed. All structure and structure footings, which are to be carried to rock shall be carried a minimum of six (6) inches into solid rock for the full area of the structure or structure footings.

5. Where structure or structure footings are to rest on material other than rock or piles, special care shall be taken so as not to disturb the bottom of the excavation. Should environmental conditions or construction traffic disturb the subgrade soils, the Contractor must restore the subgrade to a stable condition, as determined by the Engineer, prior to placing structure or footing.

6. Structure excavations shall be kept dewatered by such methods, as the Contractor deems necessary, subject to the approval of the Engineer. Where pumping is required a sufficient number of pumps of adequate size shall be employed to keep the excavation free of water until the foundation work is completed. The pumping and drainage operations shall be subject to the approval of the Engineer at all times. Water removed from the excavations shall be disposed of in such a manner as to not cause injury to public health, private property, street surfaces, or to any portion of the work completed or in progress, and in accordance with approved erosion and sediment control practices.

B. Structure Backfill

1. Where required, it shall be the Contractor's responsibility to obtain borrow excavation to complete backfilling to the elevations, lines and grades indicated on the Contract Drawings. If necessary, borrow excavation shall be obtained from an off-site location at no additional cost to the Owner.

2. All excavated material not required or suitable for backfill or other designated purposes shall be removed from within the limits of the work and disposed of by the Contractor.

3. To equalize external pressures against structures, backfill material shall be placed and compacted uniformly around the perimeter of the structure.

4. No backfill shall be placed against any new concrete or masonry structure until all of the provisions for curing, dampproofing, and waterproofing have been complied with, and until the compression test cylinders indicate that the concrete has obtained a minimum 2500 psi compressive strength.

5. Backfill material shall be placed in uniform layers not more than eight (8) inches thick and compacted to the specified density. Each layer shall be uniformly compacted to the specified density before the next layer is placed and processed.

6. The moisture content of the material being compacted shall be within plus or minus two (2) percentage points of optimum, as determined by AASHTO T-180 C and meet the following requirements.

Maximum Laboratory Dry Density (Lbs. per Cu. Ft.)	Minimum Field Compaction Requirements (% of Max. Lab. Dry Density)
105 minimum	95

Material containing an excess of moisture shall be processed and dried or permitted to dry until the moisture content is within the specified range. Material which is too dry shall be wetted until the moisture content is within the specified range.

3.03 TEST PIT EXCAVATION AND BACKFILL

A. The Contractor shall not proceed with a test pit until the Contractor has determined, based upon available information, the location of all underground utilities in the vicinity of the test pit, nor shall the Contractor proceed with excavation of the test pit without the Engineer's approval. The Contractor shall excavate the test pits in such a manner that existing underground utilities are not damaged by his/her operations. Should any damage to existing utilities or structures occur as a result of the Contractor's operations, he/she shall, at his/her own expense, restore such utilities or structures to a condition equal to or better than that, which existed before the damage was done.

B. The Contractor shall work on one test pit at a time. The Contractor shall conduct his/her work as to enable the Engineer to inspect and accurately locate the utilities within the test pits. All measurements of utility locations and elevations, and all probing will be made by the Contractor.

C. Excavation shall be performed by using both power equipment and hand tools. Power equipment shall be utilized to the maximum extent possible; however, to protect existing utilities and adjacent foundations, a part of the total excavation shall be excavated with hand tools.

D. Test pits shall be wide enough to allow the Engineer to stand in the excavation to investigate the exposed utilities. The length of each test pit will depend upon the location of the existing utilities.

E. The contract drawings show, in addition to the pipe work and structures to be built, certain information regarding the location of pipes and other structures, which exist along the lines of work, both at and below the surface of the ground. The Owner and Engineer assume no responsibility for the accuracy and completeness of the information given on the contract drawings with regard to existing pipes and structures, and if the Contractor relies upon the information thus given in prosecuting the work, the Contractor does so at his/her own risk. The Contractor must verify the information given to his/her own satisfaction.

F. Test pits shall be backfilled in accordance with the applicable provisions of Paragraph 3.01.B, "Trench Backfill".

3.04 EXCAVATION AND GRADING

A. Excavation and grading shall be carried to the lines, grades, and slopes shown on the Plans. All earth slopes shall be finished to neat, regular lines conforming to the Plans and typical sections. The work shall be done in proper sequence in relation to all other operations involved.

B. All available, suitable topsoil existing in areas where excavations or embankments are to be made shall be removed by the Contractor before excavation operations in any particular area are begun and used for topsoil on the completed site. The Contractor shall note however, that topsoil, which cannot be placed in its final position as it is being removed, shall be stockpiled in an approved location until such time as it can be incorporated in the final construction.

C. Drainage facilities shall be installed in such sequence as to maintain the construction areas in a well-drained condition at all times during the process of excavation.

D. Any bed or ledge rock, or boulders encountered at the planned subgrade shall be removed to a depth of at least three inches below the proposed lower limit of the subgrade for the full cross-sectional width of the required excavation. The removed material shall be replaced with material equal to select backfill or stone fill as approved by the Engineer.

E. All existing masonry foundations and walls encountered during excavation operations which interfere with new construction, shall be removed to at least one (1) foot below finished grade. All spaces resulting from the removal of existing masonry shall be backfilled with approved material.

3.05 BORROW EXCAVATION

A. If there is insufficient suitable material within the limits of the work for backfill and finished grading, borrow material will be required at the Contractor’s expense.

B. The Contractor shall notify the Engineer ten (10) days in advance of the opening of any borrow pit so that soil analysis and cross-sections (when required) may be made. Unless written permission from the Engineer is given to the Contractor to do otherwise, it is to be understood that after a pit is once opened, the material excavated is to be used only for the specific purpose and project intended.

C. Overburden unsuitable for incorporation in the work shall be stripped and disposed of at the Contractor's expense. If the disposal area is in sight of the project, all unsuitable material shall be placed in the disposal areas, trimmed, shaped and sloped to drain.

D. Approved materials provided under this item shall be incorporated in the work in conformity with the requirements of all the Contract Documents.

E. After the required quantity of material has been obtained from the borrow pit, the pit shall be trimmed and shaped so as to present a neat appearance. All slopes shall be trimmed on a "one to one" or flatter slope, and all parts of the pit shall be effectively drained.

3.06 BACKFILL FOR UNDERCUT AREAS

A. When excavations are made lower than the planned bottom of a structure or pipe, the bottom shall be raised by the placement of stone fill material. Undercut areas backfilled with stone fill shall be wrapped (all sides) with filter fabric in accordance with above requirements; placed with mechanical equipment or manually, depending on the volume of material involved.

B. If areas of foundation are soft, composed of mud, or are in the Engineer’s judgment unfit to receive pipe, conduit, structure, concrete, or masonry, such unacceptable material shall be removed and replaced with stone fill material at no additional cost to the Owner.

END OF SECTION

SECTION 02530

SANITARY SEWERS

PART 1 - GENERAL

1.01 DESCRIPTION

A. This section includes requirements for providing sanitary sewer and drain pipe and fittings, and precast concrete manholes, as indicated, in accordance with the Contract Documents.

1.02 SUBMITTALS

A. Layout drawings for all piping, including sizes, types, and locations. The drawings shall also indicate location of all fittings, wall and floor penetrations, valves, and pipe supports.

B. Catalog data for all pipe, fittings, couplings and appurtenances.

C. Manufacturer's instructions for installation and assembly of push-on and mechanical joints and accessories, including the manufacturer's recommended maximum deflection per joint.

D. Submit certificates of compliance for all pipe, fittings and appurtenances in this section.

E. Shop drawings for precast manholes, including plans, elevations, sections, details, and frames and covers.

1.03 PERFORMANCE REQUIREMENTS

A. Influent sewer, gravity-flow non-pressure piping shall have a pressure rating of 10-feet head of water minimum.

1.04 PROJECT CONDITIONS

A. Contractor shall not interrupt service to existing facilities without the Owner's written permission and then only after arranging to provide temporary service.

PART 2 - MATERIALS

2.01 DUCTILE IRON GRAVITY SEWER PIPE AND FITTINGS

A. Pipe: ANSI A21.51, Push-On Joints.

B. Fittings: ductile iron; ANSI A21.10 or A21.53, as applicable, Joints.

C. Push-On Joint Gaskets: ANSI A21.11, rubber.

2.02 PROTECTIVE COATINGS AND LININGS

A. Coat buried pipe and fittings with one mil thickness of asphaltic coating per AWWA C151, C110 and C153, as applicable.

B. Line ductile iron pipe and fittings with Ceramic Epoxy, Induron Protecto 401, or approved equal.

2.03 PVC DRAIN PIPE AND FITTINGS

A. Pipe: Cellular Core, ASTM F891.

B. Fittings: PVC DWV fittings, ASTM D2665.

C. Joints: Solvent-cemented, ASTM F656 and ASTM D2564.

2.04 MANHOLES

A. Standard Precast Concrete Manholes: ASTM C478, precast reinforced concrete, of depth indicated, with provision for sealant joints.

1. Diameter: 48-inches minimum, unless indicated otherwise.

2. Ballast: Increase thickness of precast concrete sections or add concrete to base section, as required to prevent flotation.

3. Base Section: 6-inch minimum thickness for bottom slab and 4-inch minimum thickness for walls and base riser section and having separate base slab or base section with integral bottom slab.

4. Riser Sections: 4-inch minimum thickness and of length to provide depth indicated.

5. Top Section: Eccentric-cone type, unless indicated otherwise. Top of cone of size that matches grade rings.

6. Joint Sealant: ASTM C990, bitumen or butyl rubber.

7. Resilient Pipe Connectors: ASTM C923, cast or fitted into manhole walls for each pipe connection/penetration.

8. Steps: Individual fiberglass-reinforced plastic (FRP) steps, or ASTM A615 deformed, ½-inch steel reinforcing rods encased in ASTM D4101 polypropylene plastic (PP), wide enough to allow both feet on one step and

designed to prevent lateral slippage off of step. Cast or anchor steps into sidewall at 12-inch intervals.

9. Grade Rings: Reinforced concrete rings, 6- to 9-inch total thickness, to match diameter of manhole frame and cover.

10. Protective Coating: Coat exterior surface of precast concrete units with Carboline Bitumastic 300-M, or approved equal, 32 mil minimum thickness.

11. Manhole Frames and Covers: Heavy duty, cast iron with solid lid and self-sealing gasket to make watertight, Neenah Model R-1557 frame and lid with self-sealing application, or approved equal.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Drawing plans and details indicate general location and arrangement of underground sanitary sewer piping. Location and arrangement of piping layout take design considerations into account. Install piping as indicated, to the extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.

B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves and couplings according to manufacturer's written instructions.

C. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.

D. Install influent sewer, gravity-flow non-pressure piping according to the following:

1. Install piping pitched down in direction of flow, at a minimum slope of 1-percent unless indicated otherwise.

2. Install piping NPS 6 and larger with restrained joints at tee fittings and at changes in direction. Use corrosion-resistant rods, pipe or fitting manufacturer's proprietary restraint system, or cast-in-place concrete supports or anchors.

3. Install ductile iron, gravity sewer piping according to ASTM A746.

4. Install ductile iron and special fittings according to AWWA C600 or M41.

E. Install buried PVC drain piping according to ASTM D2321 and ASTM F1668.

F. Clear interior of piping and manholes of dirt and superfluous material as work progresses. Maintain swab or drag in piping and pull past each joint as it is completed. Place plug in end of incomplete piping at end of day and when work stops.

3.02 PIPE JOINT CONSTRUCTION

A. Where specific joint construction is not indicated, follow piping manufacturer's written instructions.

B. Join influent sewer, gravity-flow non-pressure piping according to the following:

1. Join ductile iron gravity sewer piping according to AWWA C600.

2. Join ductile iron and special fittings according to AWWA C600 or M41.

C. Join PVC drain piping according to ASTM D2855 for solvent-cemented joints.

3.03 MANHOLE INSTALLATION

A. Install manholes complete with appurtenances and accessories indicated.

B. Install precast concrete manhole sections with sealants according to ASTM C891.

C. Set tops of frames and covers flush with asphalt or concrete surfaces and 3 inches above ground finished grade.

3.04 CONNECTIONS

A. Make connections to existing manholes by cutting opening into existing unit large enough to allow 3 inches of concrete to be packed around entering connection. Cut end of connection pipe passing through structure wall to conform to shape of, and be flush with, inside wall, unless indicated otherwise. On outside of manhole wall, encase entering connection in 6 inches of concrete for minimum length of 12 inches to provide additional support of collar from connection to undisturbed ground.

1. Use concrete that will attain minimum 28-day compressive strength of 3,000 psi.

2. Use epoxy bonding compound as interface between new and existing concrete and piping materials.

B. Protect existing piping and manholes to prevent concrete or debris from entering while making connections. Remove debris or other extraneous material that may accumulate.

3.05 CLOSING ABANDONED SANITARY SEWER SYSTEMS

A. Close open ends of abandoned underground piping with at least one (1) linear foot of Portland cement concrete. Ensure that closures are strong enough to withstand hydrostatic and earth pressures that may result after ends of abandoned piping have been closed.

3.06 IDENTIFICATION

A. Install green warning tape directly over piping.

3.07 FIELD QUALITY CONTROL

A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place and again at completion.

1. Submit a report for each inspection.

2. Defects requiring correction include the following:

a. Alignment: Less than full diameter of inside of pipe is visible between structures.

b. Crushed, broken, cracked, or otherwise damaged piping.

c. Infiltration: Water leakage into pipe.

d. Exfiltration: Water leakage from or around pipe.

3. Replace defective piping using new materials and repeat inspections until defects are within allowances specified.

4. Re-inspect and repeat procedure until results are satisfactory.

B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired for leaks and defects.

1. Do not enclose, cover, or put into service before inspection and approval.

2. Schedule tests and inspections with the Owner at least 24 hours advance notice.

3. Hydrostatic Tests: Test sanitary sewer according to the Frederick County General Conditions and Standard Specifications for Water Mains, Sanitary Sewer and Related Structures and the following:

a. Allowable leakage is a maximum of 10.48 gpd/mile/inch of nominal pipe diameter.

b. Close openings in system and fill with water.

c. Purge air and refill with water.

d. Disconnect water supply.

e. Test and inspect joints for leaks.

f. Option: Test ductile iron piping according to AWWA C600, “Hydrostatic Testing” Section. Use test pressure of at least 10 psig.

4. Manholes: Perform hydraulic test according to ASTM C969.

C. Leaks and loss in test pressure constitute defects that must be repaired.

D. Replace leaking piping using new materials and repeat testing until leakage is within allowances specified.

3.08 CLEANING

A. Clean interior of piping of dirt and superfluous material.

END OF SECTION

SECTION 02740

ASPHALT PAVEMENT

PART 1 - GENERAL

1.01 SUMMARY

A. The work to be performed under this section includes, but is not limited to, the removal of existing macadam and/or asphalt concrete and furnishing of all materials, labor, tools and equipment necessary for the asphalt paving as shown on the Contract Drawings.

1.02 DESCRIPTION

A. Provide asphalt paving according to materials, workmanship, and other applicable requirements of Maryland Department of Transportation State Highway Administration (MDSHA) *Standard Specifications for Construction and Materials* Category 500.

1.03 SUBMITTALS

A. Product Data: For each type of product required. Include technical data and tested physical and performance properties.

B. Job-Mix Designs: For each job mix proposed for the work.

C. Qualifications: For pavement manufacturer.

D. Material Test Reports: For each paving material.

E. Material Certificates: For each paving material, signed by its manufacturer.

1.04 QUALITY ASSURANCE

A. Manufacturer shall be a paving-mix manufacturer registered with, and approved by, the MDSHA.

B. Testing Agency shall be qualified according to ASTM D3666 for testing indicated, as documented according to ASTM E548.

C. Comply with MDSHA requirements for asphalt paving work.

D. Comply with AI MS-22, “Construction of Hot Mix Asphalt Pavements”, unless more stringent requirements are indicated.

1.05 PROJECT CONDITIONS

A. Do not apply asphalt materials if subgrade is wet or excessively damp or if the following conditions are not met:

1. Prime and Tack Coats: Minimum surface temperature of 40 deg F.

2. Slurry Coat: Comply with weather limitations of ASTM D3910.

3. Asphalt Base Course: Minimum surface temperature of 40 deg F and rising at time of placement.

4. Asphalt Surface Course: Minimum surface temperature of 40 deg F at time of placement.

5. Polymer-modified Surface Course: Minimum ambient air and surface temperatures are at least 50 deg F at time of placement.

B. Do not apply new asphalt pavement until all existing macadam and/or asphalt concrete pavement is removed and the subgrade is prepared.

PART 2 - MATERIALS

2.01 AGGREGATES

A. Use materials and gradations that have performed satisfactorily in previous installations.

B. Aggregates shall be in accordance with MDSHA *Standard Specifications for Construction and Materials* Section 901.

2.02 ASPHALT MATERIALS

A. Asphalt binder shall be in accordance with AASHTO MP1.

B. Asphalt cement, prime coat and tack coat shall be in accordance with MDSHA *Standard Specifications for Construction and Materials* Section 904.

C. Water shall be potable.

2.03 DESIGN MIXES

A. Design mixes shall be developed by the Contractor in conformance with MDSHA *Standard Specifications for Construction and Materials* Section 904.

B. Design mixes shall be submitted to the Engineer for approval.

2.04 AUXILIARY MATERIALS

A. Herbicide shall be commercial chemical for weed control, registered with the EPA. Provide in granular, liquid, or wettable powder form.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that all existing macadam and/or asphalt concrete has been removed and subgrade is dry and in suitable condition to support paving and imposed loads.

B. Proof-roll subgrade and/or subbase using heavy, pneumatic-tired roller to locate areas that are unstable or that require further compaction.

C. Proceed with paving only after unsatisfactory conditions have been corrected.

3.02 SURFACE PREPARATION

A. General: Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces. Ensure that prepared subgrade is ready to receive paving. Sweep loose granular particles from surface of unbound-aggregate base course. Do not dislodge or disturb aggregate embedded in compacted surface of base course.

B. Herbicide Treatment: Apply herbicide according to manufacturers recommended rates and written application instructions. Apply to dry, prepared subgrade or surface of compacted-aggregate base before applying paving material.

C. Prime Coat: Apply uniformly over surface of compacted unbound-aggregate base course at a rate of 0.15 to 0.50 gal/sq. yd. Apply enough material to penetrate and seal but not flood surface. Allow prime coat to cure for 72 hours minimum.

1. If prime coat is not entirely absorbed within 24 hours after application, spread sand over surface to blot excess asphalt. Use enough sand to prevent pickup under traffic. Remove loose sand by sweeping before pavement is placed and after volatiles have evaporated.

2. Protect primed substrate from damage until ready to receive paving.

D. Tack Coat: Apply uniformly at a rate of 0.05 to 0.15 gal/sq. yd.

1. Allow tack coat to cure undisturbed before applying asphalt paving.

2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

3.03 ASPHALT PLACING

A. Place asphalt on prepared surface, spread uniformly, and strike off in a manner that prevents segregation of mix. Place each course to required grade, cross section, and thickness when compacted.

B. Spread mix at a minimum temperature of 225 deg F, beginning on the high side.

C. Promptly correct surface irregularities in paving course. Use suitable hand tools to remove excess material forming high spots. Fill depressions with asphalt to prevent segregation of mix and use suitable hand tools to smooth surface.

3.04 COMPACTION

A. General: Begin compaction as soon as placed paving will bear roller weight without excessive displacement. Compact paving with hand tampers or vibratory-plate compactors in areas inaccessible to rollers. No traffic is permitted on the pavement after rolling until it has cooled to less than 140 deg F.

B. Breakdown Rolling: Complete breakdown or initial rolling immediately after rolling joints and outside edges. Examine surface immediately after breakdown rolling for required grade and smoothness.

C. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling while asphalt is still hot enough to achieve specified density. Continue rolling until asphalt course has been uniformly compacted to an average density of 92 percent of reference maximum theoretical density according to ASTM D2041, but not less than 90 percent nor greater than 96 percent.

D. Finish Rolling: Finish roll paved surfaces to remove roller marks while asphalt is still warm.

E. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while asphalt is still warm and compact thoroughly.

F. Repairs: Remove paved areas that are defective or contaminated with foreign materials and replace with fresh asphalt. Compact by rolling to specified density and surface smoothness.

G. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

3.05 INSTALLATION TOLERANCES

A. Thickness: Compact each course to produce the thickness indicated within the following tolerances:

1. Base Course: Plus or minus, ½-inch.

2. Surface Course: Plus ¼-inch, no minus.

B. Surface Smoothness: Compact each course to produce a surface smoothness within the following tolerances as determined by using a 10-foot straightedge applied transversely or longitudinally to paved areas:

1. Base Course: ¼-inch.

2. Surface Course: ⅛-inch.

3.06 FIELD QUALITY CONTROL

A. Testing Agency: The Contractor shall engage a qualified independent testing and inspecting agency to perform field tests and inspections and to prepare test reports. Testing agency shall conduct and interpret tests and state in reports whether tested work complies with or deviates from the specified requirements.

B. Thickness: In-place compacted thickness of asphalt courses shall be determined according to ASTM D3549.

C. Surface Smoothness: Finished surfaces of each asphalt course shall be tested for compliance with smoothness tolerances.

D. Testing agency shall take samples of uncompacted paving mixtures and compacted pavement according to ASTM D979 or AASHTO T168.

1. Reference maximum theoretical density shall be determined by averaging results from four samples of asphalt paving mixture delivered to site, prepared according to ASTM D2041, and compacted according to job-mix specifications.

2. In-place density of compacted pavement shall be determined by testing core samples according to ASTM D1188 or ASTM D2726.

a. One core sample shall be taken for every 1,000 sq. yds. or less of installed pavement, with no fewer than 3 cores taken.

b. Field density of in-place compacted pavement may also be determined by nuclear method according to ASTM D2950 and correlated with ASTM D1188 or ASTM D2726.

E. Remove and replace or install additional asphalt where test results or measurements indicate that it does not comply with specified requirements.

END OF SECTION

SECTION 02750

TEMPORARY BYPASS PUMPING SYSTEMS

PART 1 - GENERAL

1.01 DESCRIPTION

A. This section includes requirements to furnish all materials, labor, equipment, power, maintenance, etc. to implement a temporary pumping system for the purpose of diverting sewage flows.

1.02 QUALITY ASSURANCE

A. The design, installation and operation of the temporary pumping system shall be the Contractor's responsibility. The Contractor shall employ the services of a vendor who can demonstrate to the Engineer that he specializes in the design and operation of temporary bypass pumping systems. The vendor shall provide at least five (5) references to the Engineer of projects similar in size and complexity to this project that have been performed by his firm within the past three (3) years. The bypass pumping system shall meet the requirements of all codes and regulatory agencies having jurisdiction.

1.03 SUBMITTALS

A. The Contractor shall submit detailed plans and descriptions outlining all provisions and precautions to be taken by the Contractor regarding the handling of wastewater flows. This plan must be specific and complete, including such items as schedules, locations, elevations, capacities of equipment, materials and all other incidental items necessary and/or required to insure proper protection of the facilities, including protection of the access and bypass pumping locations from damage due to the discharge flows, and compliance with the requirements and permit conditions specified in these Contract Documents. No construction shall begin until all provisions and requirements have been reviewed by the Engineer.

B. The Contractor shall submit working plans for the bypass pumping location, which shall include but not be limited to details of the following:

1. Staging area for pump(s).

2. Sewer plugging methods and type of plugs.

3. Number, size, material, location and method of installation of suction piping.

4. Number, size, material, method of installation and location of installation of discharge piping.

5. Bypass pump sizes, and power requirements.

6. Calculations of static lift, friction losses, and flow velocity (pump curves showing pump operating range shall be submitted).

7. Standby power generator size and location.

8. Force main tapping and connection plan.

9. Thrust and restraint block sizes and locations, if necessary.

10. Sections showing suction and discharge pipe depth, embedment, select fill and special backfill.

11. Method of noise attenuation for pump(s) and/or generator.

12. Any temporary pipe supports, and anchoring required.

13. Design plans and computations for access to bypass pumping locations indicated on the drawings.

14. Calculations for selection of bypass pumping pipe sizes.

15. Schedule for installation and maintenance of bypass pumping system.

16. Plan indicating bypass pumping line locations.

C. The Contractor shall be responsible for the design of a complete support and protection of excavation plan, including any dewatering that may be required, in order to excavate the force main to perform line tapping and stopping services, as necessary to provide a connection for the temporary bypass pumping and to complete the pumping station improvements work. This support and protection of excavation plan shall include design calculations and complete working drawings prepared and sealed by an experienced Professional Engineer registered in the State of Maryland.

PART 2 - MATERIALS

2.01 EQUIPMENT AND PIPING

A. All pumps used shall be fully automatic self-priming units that do not require the use of foot-valves or vacuum pumps in the priming system. The pumps shall be diesel powered. All pumps used must be constructed to allow dry running for long periods of time to accommodate the cyclical nature of sewage flows. The use of electric pumps in any capacity will not be approved.

B. The Contractor shall provide the necessary start, stop, and variable speed pump controls. Each diesel pump shall have a soft start with automatic ramping of speed to minimize flow and pressure spikes in the piping systems. Diesel pumps shall have a control panel, supplied by the bypass pump vendor at each pump location to provide means to control pump system flows, provide start/stop operation, and protect pump and piping system from high system pressure or deadhead operating conditions. The control panel shall allow for manual/auto speed control with infinite speed adjustment capability. The system shall also incorporate pressure-sensing devices to allow for automatic speed control as well as automatic low pressure start, and high pressure stop capability. The pressure sensing system shall also provide for automatic shutdown of pumping system in the event of high operating pressure or deadhead conditions. The Contractor is responsible for providing all instrumentation and control equipment necessary for monitoring the bypass pumping system. In the event of an overflow due to influent flow to the station being in excess of the required bypass pumping capacity, the Contractor will have to produce data showing the bypass system was pumping the required capacity at the time of the spillage or overflow.

C. The Contractor shall include one stand-by pump of equal capacity to the largest primary pump, to be maintained on site. The stand-by-pump shall be piped and on-line, isolated from the primary system by a valve.

D. Discharge Piping: In order to prevent the accidental spillage of flows, all discharge systems shall be constructed of rigid pipe with leak proof joints, suitable for the intended use. Under no circumstances will aluminum "irrigation" type piping or glued PVC pipe be allowed. Contractor shall also be responsible for any damage to the force main as a result of this work and shall be responsible for all sewage overflows and/or spills and clean up thereof, including all costs associated with such clean up. The Contractor shall also be liable for any civil and/or criminal penalties associated with any overflows and/or spills.

E. Each bypass pump’s control system shall include 8 programmable relays and 66 selectable features, including pump running, pump failure and others as directed by the Owner, as well as RS-232 and RS-485 communication ports which shall enable communication with SCADA and remote alarm equipment. The control system shall maintain an “event history” of up to 32 warning alarms.

F. Bypass pumping system shall be provided with a wireless, remote alarm monitoring and notification system (WRTU) capable of remotely notifying the Contractor and the Owner of any problem with the bypass pumping system in time to prevent a sewage overflow. The WRTU shall be capable of monitoring and remotely notifying the Contractor and Owner of at least 8 different alarms and shall be installed in a NEMA 4X enclosure. The WRTU shall be a RACO AlarmAgent or approved equal. All temporary power, wireless network service plans, and programming for the remote alarm monitoring and notification system shall be the Contractor’s responsibility.

2.02 DESIGN REQUIREMENTS

A. Bypass pumping systems shall be capable of pumping all flows up to, and including, the capacity indicated on Dwg. T1. The Contractor shall provide all pipeline plugs, pumps of adequate size to handle all flows conveyed to the pumping station during the work, and temporary suction and discharge piping to ensure that all flow can be safely diverted around the pumping station for the duration of the work. The Contractor shall develop a system curve for the bypass pumping system.

B. The Contractor shall have adequate back-up equipment available and ready for immediate operation and use in the event of an emergency or breakdown. One back-up pump shall be installed at the bypassing location, ready for use in the event of primary pump failure. This back-up pump is in addition to the stand-by pump specified in Paragraph 2.01.C and does not have to be piped and on-line. The standby pump controls and alarms shall be independent of the primary pumping system controls and alarms.

C. The bypass pumping system shall be capable of bypassing the flow around the work area and of releasing any amount of flow up to full available flow into the work area as necessary for satisfactory performances of work.

D. The Contractor shall make all arrangements for bypass pumping during the time when the pumping station is shut down for any reason. The bypass pumping system must overcome any force main pressure on discharge.

E. The bypass pumping system shall be sound attenuated and shall not produce noise levels greater than 70 dBA at 30 feet at any time. Contractor shall provide noise level testing at the start of bypass pumping operations and at least once a month thereafter for the duration of the project to demonstrate that these noise levels are being met. If noise levels are not being met at any time during the bypass pumping operation, the Contractor shall take necessary remedial actions and provide additional noise level tests to demonstrate compliance at no additional cost to the Owner.

2.03 PERFORMANCE REQUIREMENTS

A. It is essential to the operation of the existing sewerage system that there be no interruption in the flow of sewage throughout the duration of the project. To this end, the Contractor shall provide, maintain and operate all temporary facilities such as dams, plugs, pumping equipment (both primary and back-up units as required), conduits, all necessary power and fuel, and all other labor and equipment necessary to intercept the sewage flow before it reaches the point where it would interfere with his work, and return it to the force main.

B. The design, including TDH requirements, installation and operation of the temporary bypass pumping system shall be the Contractor's responsibility. The bypass system shall meet the requirements of all codes and regulatory agencies having jurisdiction.

C. The Contractor shall provide all necessary means to safely intercept the sewage before it reaches the work area. The Contractor will not be permitted to stop or impede the flows under any circumstances.

D. The Contractor shall maintain sewer flow in a manner that will not cause surcharging of sewers or damage to sewers, and that will protect public and private property from damage and flooding.

E. The Contractor shall protect water resources, wetlands and other natural resources.

PART 3 - EXECUTION

3.01 PRECAUTIONS

A. Contractor is responsible for locating any existing utilities in the area where the Contractor selects to locate the bypass suction and discharge pipes. The Contractor shall locate his bypass pipes to minimize any disturbance to existing utilities and shall obtain approval of the pipe locations from the Owner and the Engineer. All costs and approvals associated with relocating utilities shall be the Contractor's responsibility.

B. During all bypass pumping operations, the Contractor shall protect the pumping station, force main and all sewer lines from damage inflicted by any equipment. The Contractor shall be responsible for all physical damage to the pumping station and force main and all sewer lines caused by human or mechanical failure.

3.02 INSTALLATION AND REMOVAL

A. The Contractor shall make connections to the existing sewer and force main and install temporary bypass pumping equipment only within the limits of disturbance indicated on the Drawings and as may be required to provide adequate suction conduit. Contractor shall be responsible for obtaining any additional temporary easements as may be required to provide the necessary bypass pumping operations. All coupons removed from existing piping shall be salvaged and stored at the pumping station for inspection by the Owner.

B. Provide thrust blocking and permanent support of tapping valve.

C. When plugging or blocking is no longer needed for performance and acceptance of work, it is to be removed in a manner that permits the sewage flow to slowly return to normal without surge, to prevent surcharging or causing other major disturbances downstream.

D. The Contractor shall exercise caution and comply with OSHA requirements when working in the presence of sewer gases, combustible or oxygen-deficient atmospheres, and confined spaces.

E. All bypass alarm and control wiring shall be installed in conduit or cable assemblies. All cables and fuel lines shall be neatly routed and adequately supported between equipment. Supports shall be spaced a maximum distance of two feet.

F. Upon completion of the project and just prior to placing the pumping station in service, the Contractor shall hydraulically flush the impacted gravity sewer system upstream of the bypass pumping system using a high-pressure water jet or equivalent technique to remove all grease and debris. All solids, trash, debris, grease, etc. shall be collected and disposed of by a vacuum pump truck service before allowing flow back into the pumping station wetwell. Disposal of collected material shall be at an acceptable offsite facility. The Contractor shall thoroughly clean pipes, manholes, junction chambers, influent chambers, wetwells and any other structures from which the bypass pumping system draws suction or that is allowed to surcharge at any time during the temporary bypass pumping operations.

3.03 FIELD QUALITY CONTROL, OPERATION AND MAINTENANCE

A. TESTS

1. The Contractor shall perform leakage and pressure tests of the bypass pumping discharging piping using clean water prior to actual operation. The Engineer will be given 48 hours' notice prior to testing.

2. The minimum hydrostatic test pressure of the bypass pumping discharge piping shall be 1.5 times the operating pressure or the rated working pressure of the pipe, whichever is greater. The discharge piping system shall be hydrostatically tested for two hours without loss of pressure. Leakage shall be determined by loss of pressure. The Contractor shall provide dished heads, blind flange or bulkheads as necessary to isolate and test the bypass piping.

3. Once the bypass pumping system is set-up and operational, it shall be operated for a minimum of 72 continuous, trouble-free hours prior to the Contractor shutting off power to, or otherwise disrupting operation of, the existing pumping station. Should there be any problem with the operation of the bypass pumping system during this 72-hour test period, the problem shall be remedied, and the 72-hour test period started over. The Contractor shall demonstrate that the temporary bypass pumping system is installed as intended by operating the primary pump(s), stand-by pump, control system, remote alarming equipment, and all ancillary equipment. The temporary bypass pumping system shall be exercised on a weekly basis to ensure all components are fully operational.

4. Upon completion of the testing, all modifications to the bypass pumping system shall be brought to the Owner's attention.

B. OPERATION AND MAINTENANCE

1. The Contractor shall ensure that the temporary pumping system is properly maintained and that the remote alarm system is operational at all times. The Contractor shall respond to all alarms and rectify all situations in sufficient time to prevent sewage overflows. All alarms shall be sent to the Owner by the remote alarm system for informational purposes only. The Contractor shall have a competent and responsible bypass pumping system operator onsite within 30 minutes of alarm notification.

1. Batteries for all bypass pumps, including stand-by and back-up pumps, shall be equipped with a battery maintainer to provide a trickle charge to keep all batteries charged at all times without overcharging the batteries.

2. The Contractor shall be responsible for maintaining daily records of flow and maintenance activities, which shall be readily accessible for review by the Owner upon request.

3.04 EXTRA MATERIALS

A. Any spare parts for pumps and piping necessary to ensure continuous operation to handle the specified sewage flows for the necessary duration of bypass pumping shall be kept on site as required. The Contractor shall be responsible, and liable, for any sewage backups or overflows that occur due to failure or shutdown of the bypass pumping system.

B. Adequate hoisting equipment for pump(s) and accessories shall be maintained on the site.

END OF SECTION

SECTION 02821

CHAIN-LINK FENCE AND GATES

PART 1 - GENERAL

1.01 DESCRIPTION

A. This Section includes requirements for providing chain-link fence, gates, and accessories, as indicated herein and as shown on the drawings, to include the tie in to the existing fencing and posts that are to remain in order to provide a completely functional system. Fence fabric shall be galvanized.

1.02 SUBMITTALS

A. Submit the following shop drawings:

1. Plan layout including spacing of posts and other components, locations of gates, post foundation dimensions, abrupt changes in grade, locations of corner, end and pull posts, hardware anchorage, and schedule of components.

2. Cross sectional dimensions of posts, braces, rails, fittings, gates and accessories.

3. Design of gates and details of gate hardware and accessories.

B. Product data on fabric, post, fittings, accessories and hardware. Contractor shall take accurate field measurements to confirm existing fence fabric mech opening size and fabric height prior to submission to the Engineer for approval.

C. Two (2) samples of fence fabric, 12 x 12 inches in size, illustrating construction.

1.03 PROJECT RECORD DOCUMENTS

A. Submit as-built drawings of the fence and gates.

B. Accurately record actual locations of perimeter posts relative to property lines.

1.04 PRODUCT DELIVERY, STORAGE AND PROTECTION

A. Materials shall be delivered to the site in an undamaged condition. Materials shall be carefully stored off the ground to provide proper protection against oxidation caused by ground contact. Defective or damaged materials shall be replaced by the Contractor at no expense to the Owner.

PART 2 - PRODUCTS

2.01 FENCE FABRIC

A. Fence fabric shall be made from galvanized fabric in accordance with ASTM A392. Fence fabric shall be woven in 2-inch mesh. Contractor shall take accurate field measurements to confirm existing fence fabric mesh opening size prior to submission to the Engineer for approval. Fabric shall be fabricated of 9-gauge wire. Fabric height shall be 7-feet. Contractor shall take accurate field measurements to confirm and match existing fabric height prior to product submission to the Engineer for approval. Fabric shall be knuckled on the top and bottom selvages.

2.02 GATES

A. Gates shall be the types and sizes as shown on the drawings. Gate frames shall be ASTM 1043 Group 1C pipe with zinc external coating Type B, minimum nominal pipe size (NPS) 1 5/8-inch. Swing gates shall be galvanized steel welded fabrication in accordance with ASTM F900 and horizontal slide gate shall be in accordance with ASTM F1184. Gates shall be same height as fencing.

B. Swing gate leaves more than 8-feet wide shall have either intermediate members and diagonal truss rods or shall have tubular members as necessary to provide rigid construction, free from sag or twist. Gate leaves less than 8-feet wide shall have truss rods or intermediate braces.

C. Gate fabric shall be same as specified for fence fabric. Gate fabric shall be attached to the gate frame by method standard with the manufacturer, except that welding will not be permitted.

D. Latches, hinges, stops, keepers, rollers, and other hardware items shall be furnished as required for the operation of the gates. Latches shall be arranged for padlocking so that the padlocks will be accessible from both sides of the gates. Stops shall be provided for holding the gates in the open position.

2.03 SLIDE GATES

A. Slide gates shall be the cantilever type with sizes as shown on the drawings. Slide gates shall be in accordance with ASTM F1184, Type II, Class 2 - Internal Roller Design. Gate frames shall be ASTM F1043 Group 1C steel pipe with zinc external coating Type B minimum nominal pipe size (NPS) 2 3/8-inch. Gates shall be same height as adjacent chain link fencing.

B. Design Criteria:

1. Gate track system shall be keyed to interlock into gate frame member. When interlocked with and welded to the “keyed” frame top member, gate track shall form a composite structure.

2. Gate shall have a minimum counterbalance length of 50% of the opening.

3. Gate shall have intermediate vertical members with spacing less than 50% of the gate frame height.

4. Entire gate frame, including the counterbalance section, shall include two adjustable stainless steel cables (minimum 3/16-inch diameter) per bay to allow complete gate frame adjustment.

5. Gate truck assemblies shall be tested for continuous duty and shall have zinc plated steel bearings meeting ASTM B117 salt spray test with no red rust after 790 hours. Bearings shall be specifically designed for roller applications with full complement ball bearings, shock resistant outer races, and captured seals.

6. Gate truck assemblies shall be supported by a minimum 5/8-inch diameter zinc plated steel bolt with self-aligning capability, rated to support a 2,000-pound reaction load.

7. Hanger brackets shall be hot-dipped galvanized steel with a minimum 3/8-inch thickness and gusseted.

8. Gate top track and supporting hanger bracket assemblies shall be designed to withstand a 2,000-pound vertical reaction load without exceeding allowable stresses.

C. Gate frame shall be fabricated from 6063-T6 aluminum alloy extrusions. The top member shall be a 3” x 5” aluminum structural tube extrusion weighing not less than 3.0 lb/ft. This frame member shall be keyed to interlock with a keyed track member. If fabricated as a single horizontal piece, the bottom members shall be a 2” x 5” aluminum structural tube weighing not less than 2.0 lb/ft. If fabricated in two horizontal pieces, the bottom member shall be a 5” aluminum structural channel weighing not less than 2.65 lb/ft.

D. Major vertical members at the ends of the opening portion of the frame shall be “P” shaped in cross section with a nominal base dimension of no less than 2” x 2” and weighing not less than 1.6 lb/ft. Major members shall separate each bay and be spaced at intervals less than the gate height. Intermediate vertical members weighing not less than 0.82 lb/ft shall alternate between the 2” x 2” major members.

E. The gate frame shall have separate semi-enclosed keyed tracks extruded from 6005A-T61 or 6105-T5 aluminum alloy, and weighing not less than 2.9 lb/ft. Track members are to be located on each side of the top member. When interlocked and welded to the keyed top member, it shall form a composite structure with the top of the gate frame. Welds shall be placed alternately along the top and side of the track at 9-inch centers with welds being a minimum of 2-inch long. All welds shall conform to AWS D1.2 Structural Welding Code and all welders shall be certified to AWS D1.2 Structural Welding Code.

F. Gate Mounting:

1. Gate frame shall be supported from the track by four (4) swivel type, self-aligning, 4-wheeled, sealed lubricant, ball-bearing truck assemblies.

2. The bottom of each support post shall have a bracket equipped with a pair of 3-inch UHMW guide wheels. Wheel cover protectors shall be included with bottom guides to comply with UL325.

3. Gap protectors compliant with ASTM F2200 shall also be provided.

4. The slide gate shall slide on the inside of the fence.

5. Provide lockable catch assembly. Latches, catches, keepers, rollers, and other hardware items shall be furnished as required for the fully functional operation of the gate. Latches shall be arranged for padlocking so that the padlocks will be accessible from both sides of the gates.

G. Gate fabric shall be same as specified for fence fabric. Gate fabric shall be attached at each end of the gate frame by standard fence industry tension bars and tied at each 2” x 2” vertical member with standard fence industry ties. There shall be no leading or bottom edge protrusions in accordance with ASTM F2200.

2.04 POSTS

A. Posts shall be zinc-coated Group IC steel pipe conforming to the requirements of ASTM F1043 and F1083. Minimum sizes shall be as shown on the drawings. Line posts and terminal (corner, gate, and pull) posts selected shall be of the same designation throughout the fence. Gate posts shall be for the gate type indicated to the limitations specified in ASTM F900 and ASTM F1184, with minimum NPS of 2 1/2-inch for line posts, 3-inch for terminal posts, and 4-inch for gate posts.

2.05 BRACES AND RAILS

A. Braces and top rails shall be zinc coated Group IC steel pipe minimum NPS 1 5/8-inch conforming to the requirements of ASTM F1043.

2.06 WIRE

A. Tension wire shall be 0.177-inch diameter, Type II, Class 2 coating, in accordance with ASTM A824.

2.07 ACCESSORIES

A. All accessories shall be in accordance with ASTM F626. Ferrous accessories shall be zinc-coated with minimum thickness of 0.006-inch and maximum thickness of 0.015-inch.

B. Tension and brace bands shall be galvanized pressed steel complying with ASTM F626, minimum steel thickness of 12 gauge, minimum width of 3/4 inch and minimum zinc coating of 1.20 oz/ft2.

C. Truss rods shall be furnished for each terminal post. Truss rods shall be provided with turnbuckles or other equivalent provisions for adjustment. Truss rods shall be minimum 3/8-inch diameter steel with a minimum zinc coating of 1.2 oz/ft2, assembly capable of withstanding a minimum tension of 2,000 lbs.

D. Tension bars shall be galvanized steel with minimum zinc coating of 1.2 oz/ft2. Bars for 2 inch mesh shall be a minimum cross section of 3/16 inch by 3/4 inch.

E. Tie wire for attaching fabric to rails, braces, and posts shall be 9-gauge steel wire and match the coating of the fence fabric.

F. Miscellaneous hardware coatings shall conform to ASTM A153 unless modified.

G. Barbed wire arms shall be corrosion-resistant, with clips, slots, or other means for attaching strands of barbed wire, and means for attaching to posts or integral with post cap; for each post. Line posts shall have arms that accommodate top rail or tension wire. Fence corner posts shall have corner arms. Barbed wire arms shall be Type I, single slanted arm.

2.08 BARBED WIRE

A. Zinc-coated steel barbed wire shall be in accordance with ASTM A121, chain-link fence grade for standard three-strand barbed wire. Barbed wire shall consist of 0.099-inch diameter line wire with 0.080-inch diameter, 4-point round barbs spaced not more than 5-inches on center.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Fence shall be installed to the lines and grades indicated. Line posts shall be spaced equidistant at intervals not exceeding 10 feet. Terminal (corner, gate, and pull) posts shall be set at abrupt changes in vertical and horizontal alignment. Fabric shall be continuous between terminal posts; however, runs between terminal posts shall not exceed 500 feet. Any damage to galvanized surfaces, including welding, shall be repaired with paint containing zinc dust in accordance with ASTM A780.

3.02 EXCAVATION

A. Post holes shall be cleared of loose material. Waste material shall be disposed of by the Contractor. Ground surface irregularities along the fence line shall be eliminated to the extent necessary to maintain no clearance between the bottom of the fence fabric and finish grade.

3.03 POSTS

A. Posts shall be set plumb and in alignment. Posts shall be set in concrete to the depth indicated on the Contract Drawings. Hole diameters shall be not less than 16-inches for terminal posts and not less than 12-inches for line posts. Concrete and grout shall be thoroughly consolidated around each post, shall be free of voids and finished to form a dome. Concrete and grout shall be allowed to cure a minimum of seventy-two (72) hours prior to attachment of any item to the posts.

3.04 RAILS, TENSION WIRE, BRACES AND TRUSS RODS

A. Top rails shall be supported at each post to form a continuous brace between terminal posts. Where required, sections of top rail shall be joined using sleeves or couplings that will allow expansion or contraction of the rail.

B. Tension wire shall be installed in accordance with ASTM F567, maintaining plumb position and alignment of fencing. Pull wire taut, without sags. Fasten fabric to tension wire with 0.120-inch diameter hog rings of same material and finish as fabric wire, spaced a maximum of 24 inches o.c. Install bottom tension wire within 6 inches of bottom of fabric and tie to each post with not less than same diameter and type of wire.

C. Braces and truss rods shall be installed as indicated and in conformance with the standard practice for the fence furnished. Horizontal compression braces and diagonal tension truss rods shall be installed. Braces and truss rods shall extend from terminal posts to line posts. Diagonal braces shall form an angle of approximately 40 to 50 degrees with the horizontal.

3.05 FABRIC

A. Chain-link fabric shall be installed on the side of the post indicated. Fabric shall be attached to terminal posts with stretcher bars and tension bands. Bands shall be spaced at approximately 15-inch intervals. The fabric shall be installed and pulled taut to provide a smooth and uniform appearance free from sag, without permanently distorting the fabric diamond or reducing the fabric height. Fabric shall be fastened to line posts at approximately 15-inch intervals and fastened to all rails and tension wires at approximately 12-inch intervals. Fabric shall be cut by untwisting and removing pickets. Splicing shall be accomplished by weaving a single picket into the ends of the rolls to be joined. The bottom of the installed fabric shall be to the finished grade, but not more than 2-inch above the ground.

3.06 GATES

A. Gates shall be installed at the locations shown on the drawings. Hinged gates shall be mounted to swing as indicated. Latches, stops, and keepers shall be installed as required. Hinge pins, and hardware shall be welded or otherwise secured to prevent removal. Slide gate shall be installed in accordance with ASTM F1184, and as recommended by the manufacturer.

3.07 EXISTING FENCE AND MESH

A. Take extreme caution to not damage the existing fence, to include all posts and mesh to remain in order to tie in the new fence mesh and all other necessary fence components to the nearest fence post to the 100-year floodplain line on the property (and outside of the 100-year floodplain) as shown on the drawings. This would include the nearest fence post near Property Corner Coordinate 8 and the nearest fence post nearest Control Coordinate 1029 and not within the 100-year floodplain.

B. Provide all components as necessary to complete the fence tie in so that there is no gap in the fencing between the existing and new fence and mesh. Ensure existing fence is securely fastened to the existing post to remain.

3.08 ERECTION TOLERANCES

A. Maximum Variation from Plumb: 1/4-inch.

B. Maximum Offset from True Position: 1-inch.

3.09 GROUNDING

A. Install fence grounding at maximum intervals of 750-feet by driving a grounding rod vertically until the top is 6-inches below finished grade. Connect rod to fence with No. 6 AWG conductor. Connect conductor to each fence component at the grounding location. Ground fence on each side of gate openings. Bond metal gates to gate posts using No. 2 AWG wire and bury it at least 18-inches below finished grade. Connect bonding jumper between gate post and gate frame. Make connections so possibility of galvanic action or electrolysis is minimized.

3.10 BARBED WIRE

A. Install barbed wire uniformly spaced and angle outward. Pull wire taut and install securely to extension arms and secure to end post or terminal arms.

3.11 ADJUSTING AND DEMONSTRATION

A. Adjust gate to operate smoothly, easily, and quietly, free of binding, warping, excessive defection, distortion, non-alignment, misplacement, disruption, or malfunction, throughout the entire operating range. Confirm that latches and locks engage accurately and securely without forcing or binding.

B. Lubricate hardware and other moving parts.

END OF SECTION

SECTION 03300

CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.01 DESCRIPTION

A. The work of this section includes, but is not limited to:

1. Concrete Reinforcement

2. Concrete Formwork

3. Cast-In-Place Concrete

4. Concrete Accessories

5. Concrete Curbing and Gutters

6. Watertightness Testing of Structures

B. Work on this Project shall conform to all requirements of ACI 350.5, “Specifications for Environmental Concrete Structures,” published by the American Concrete Institute, Farmington Hills, Michigan, except as modified by these Contract Documents.

C. Work on this Project shall conform to all requirements of ACI 350.1-10, “Tightness Testing of Environmental Engineering Concrete Containment Structures,” published by the American Concrete Institute, Farmington Hills, Michigan, except as modified by these Contract Documents.

D. Work on this Project shall conform to all requirements of ACI 117-10, “Specification for Tolerances for Concrete Construction and Materials”, published by the American Concrete Institute, Farmington Hills, Michigan, except as modified by these Contract Documents.

E. Work on this Project shall conform to all requirements of ACI 301-16, “Specifications for Structural Concrete”, published by the American Concrete Institute, Farmington Hills, Michigan, except as modified by these Contract Documents.

F. Alternate to Cast-In-Place Concrete Structures:

If the Contractor proposes any construction type other than Cast-In-Place Concrete, the structures under consideration shall be designed by the Contractor or the Contractor's fabricator/manufacturer and the design shall be in accordance with the Engineers requirements. Alternate design shall be signed and sealed by a registered Professional Engineer in the State of Maryland and submitted to the Engineer.

1.02 REFERENCED STANDARDS AND SPECIFICATIONS

A. American Concrete Institute (ACI)

1. 117 Standard Specifications for Tolerances for Concrete Construction and Materials
2. 301 Specifications for Structural Concrete for Buildings
3. 304R Guide for Measuring, Mixing, Transporting, and Placing Concrete
4. 305R Guide to Hot Weather Concreting
5. 305.1 Specification for Hot Weather Concreting
6. 306R Guide to Cold Weather Concreting
7. 306.1 Specification for Cold Weather Concreting
8. 308.1 Specification for Curing Concrete
9. 309R Guide for Consolidation of Concrete
10. 315 Details and Detailing of Concrete Reinforcement
11. 318 Building Code Requirements for Structural Concrete
12. 347.R Guide to Formwork for Concrete
13. 350 Code Requirements for Environmental Engineering Concrete Structures
14. 350.1 Specification for Tightness Testing of Environmental Engineering Concrete Containment Structures and Commentary
15. 350.5 Specifications for Environmental Concrete Structures

B. American Society for Testing and Materials (ASTM)

1. A276 Standard Specification for Stainless Steel Bars and Shapes

2. A615 Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement

3. A775 Standard Specification for Epoxy-Coated Steel Reinforcing Bars

4. A1064 Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plan and Deformed, for Concrete

5. C31 Standard Practice for Making and Coring Concrete Test Specimens in the Field

6. C33 Standard Specification for Concrete Aggregate

7. C39 Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

8. C42 Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete

9. C94 Specification for Ready-Mixed Concrete

10. C138 Standard Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete

11. C143 Standard Test Method for Slump of Hydraulic Cement Concrete

12. C150 Specification for Portland Cement

13. C171 Specification for Sheet Materials for Curing Concrete

14. C172 Standard Practice for Sampling Freshly Mixed Concrete

15. C173 Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method

16. C227 Standard Test Method for Potential Alkali Reactivity of Cement-Aggregate Combinations (Mortar-Bar Method)

17. C231 Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method

18. C260 Specification for Air-Entraining Admixtures for Concrete

19. C309 Specification for Liquid Membrane-forming Compounds for Curing Concrete

20. C457 Standard Test Method for Microscopial Determination of Parameters of the Air-Void System in Hardened Concrete

21. C494 Specification for Chemical Admixtures for Concrete

22. C595 Standard Specification for Blended Hydraulic Cements

23. C618 Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete

24. C666 Standard Test Method for Resistance of Concrete to Rapid Freezing and Thawing

25. C881 Specification for Epoxy-Resin-Base Bonding Systems for Concrete

26. C920 Standard Specification for Elastomeric Joint Sealants

27. C989 Standard Specification for Slag Cement for use in Concrete and Mortars

28. C1012 Standard Test Method for Length Change of Hydraulic-Cement Mortars Exposed to a Sulfate Solution

29. C1064 Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete

30. C1077 Standard Practice for Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation

31. C1116 Standard Specification for Fiber-Reinforced Concrete

32. C1202 Standard Test Method for Electrical Indication of Concrete's Ability to Resist Chloride Ion Penetration

33. C1240 Standard Specification for Silica Fume Used in Cementitious Mixtures

34. C1567 Standard Test Method for Determining the Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregates (Accelerated Mortar-Bar Method)

35. D226 Standard Specification for Asphalt-Saturated Organic Felt used in Roofing and Waterproofing

36. D227 Standard Specification for Coal-Tar-Saturated Organic Felt used in Roofing and Waterproofing

37. D448 Standard Classification for Sizes of Aggregates for Road and Bridge Construction

38. D638 Standard Test Method for Tensile Properties of Plastics

39. D994 Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type)

40. D1751 Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)

41. D1752 Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction

42. D3963 Standard Specification for Fabrication and Jobsite Handling of Epoxy-Coated Steel Reinforcing Bars

43. E154 Standard Test Methods for Water Vapor Retarders used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover

44. E329 Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection

45. E1643 Standard Practice for Selection, Design, Installation, and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs

46. E1745 Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs

C. American Welding Society (AWS)

1. D1.4 Structural Welding Code - Reinforcing Steel

D. Corps of Engineers

1. CRD C572 Specification for Polyvinyl Chloride Waterstop

E. Government Services Administration (GSA)

1. TT-S-00227E - Sealing Compound: Elastomeric Type, Multi-Component (For Caulking, Sealing, and Glazing in Buildings and Other Structures)

F. American Association of State Highway and Transportation Officials (AASHTO)

1. T303 Accelerated Detection of Potentially Deleterious Expansion of Mortar Bars Due to Alkali-Silica Reaction

2. M85 Standard Specification for Portland Cement (Chemical and Physical)

3. M182 Standard Specification for Burlap Cloth Made from Jute or Kenaf and Cotton Mats

G. Concrete Reinforcing Steel Institute (CRSI)

1. Manual of Standard Practice

1.03 QUALITY ASSURANCE

A. Design Criteria:

1. Design each required concrete group to meet the physical properties specified in this Section.

2. In addition to structural strength and stability requirements, design and construct concrete in structures to ensure:

a. Maximum density and impermeability - these quantities are achieved with low water cement ratios and a slow, moist cure.

b. Maximum resistance to reaction of chemicals, alternate wetting and drying, and exposure to the elements.

c. Well-formed and smooth surfaces to minimize resistance to flow.

B. Testing Agency Qualifications: An independent agency, acceptable to the Engineer, qualified according to ASTM C1077 and ASTM E329 for testing indicated.

1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.

2. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician - Level I. Testing Agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician - Level II.

Testing Agency: Concrete testing for slump, compressive strength, and air content shall be performed by a testing laboratory engaged and paid by the Contractor and

approved by the Engineer. No concrete shall be poured unless the testing agency is on-site.

C. Mix Designer: Person responsible for developing concrete mixture proportions certified as NRMCA Concrete Technologist Level 2 or DOT certified mix designer in the jurisdiction of the work.

D. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C94 requirements for production facilities and equipment. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

E. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.

F. Construct and erect concrete formwork and accessories in accordance with ACI 301, ACI 347.R, ACI 350, and ACI 350.5.

G. Perform concrete reinforcing work and cast-in-place concrete work in accordance with ACI 117, 301, ACI 350, and ACI 350.5.

H. All field joints in waterstops shall be free of misalignment, bubbles, inadequate bond, porosity, cracks, offsets, and other defects which would reduce the potential resistance of the material to water pressure at any point. All defective joints shall be replaced with material which shall pass said inspection, and all faulty material shall be removed from the site and disposed of by the Contractor as its own expense.

1.04 SUBMITTALS

A. Shop Drawings: Submit detailed reinforcing drawings prepared in accordance with ACI 315, including bar schedule with bar marks and bends indicated. Indicate all openings, including additional reinforcing at openings and corner bar arrangements at intersecting beams, walls and footings indicated in the typical details and structural drawings, indicate proposed construction joint layout.

B. Design Mix:

1. Prior to start of placing concrete, submit for review design mix for each type of concrete, indicating that the concrete ingredients and proportions will result in a concrete mix meeting the physical requirements for each concrete specified in this Section.

2. Do not vary proportions of the ingredients or source of material of the approved mix without submitting corresponding test result documentation to the Engineer for approval.

3. When a water reducing admixture is to be used, the Contractor shall furnish mix designs for concrete both with and without the admixture.

   Each concrete mix submittal shall contain the following information, as applicable:

   a. Documentation of average strength for each proposed mix design in accordance with ACI 301.

   b. Location and purpose of the mix.

   c. Slump on which the design is based.

   d. Total gallons of water per cubic yard, and the water/cement ratio.

   e. Brand, type, composition and quantity of cement.

   f. Brand, type, composition and quantity of fly ash.

   g. Specific Gravity, source and gradation of each aggregate.

   h. Ratio of fine to total aggregate per cubic yard.

   i. Weight (surface dry) of each aggregate per cubic yard.

   j. Brand, type, and ASTM designation, active chemical ingredients and quantity of each admixture.

   k. Air content.

   l. Time of initial and final set.

   m. Certificate of Compliance for Cement.

   n. Concrete pour sequence.

   o. Letter of Certification that concrete producer has verified compatibility of constituent materials in design mix.

4. Submit field or laboratory test records used to document that proposed mixture will achieve the required average compressive strength and other specified requirements, for each class and mix of concrete.

C. Certificates

1. Submit a certification attesting that reinforcing steel meets the requirements of ASTM A615, and that welded steel wire fabric meets the requirements of ASTM A1064.

2. Submit, with the concrete mix design, laboratory test reports and manufacturer's certificates attesting the conformance of ingredients with these specifications.

3. Submit a certification or delivery ticket from the concrete supplier for each batch delivered to the site (ASTM C94). The delivery ticket shall list: name of ready-mix batch plant, serial number of ticket, date and truck number, name of Contractor, specific designation of job, batch number, amount of concrete, time loaded or of first mixing of cement and aggregates, number of revolutions, water added by receiver of concrete and receivers initials, type and name of admixtures and amount of same, type and brand of cement, amount of cement, total water content by producer, maximum size of aggregate, weights of fine and coarse aggregate, and indication that ingredients are as previously certified or approved.

4. The Contractor shall furnish a Certificate of Compliance signed by the supplier identifying the type of fly ash and stating that the fly ash complies with ASTM C618 and these specifications, together with all supporting test data prior to the use of the fly ash the sample represents. The supporting data shall also contain test results confirming that the fly ash in combination with the cement and water to be used meets all strength requirements and is compatible with air-entraining agents and other admixtures.

D. Test Reports: Submit four (4) copies of required slump tests, air content tests, and strength tests.

1. Water-Soluble Chloride-Ion Content in Hardened Concrete:

   a. Supplier's Certificate of Compliance that each admixture does not include any intentionally added chlorides and/or that their chloride content does not exceed trace amounts.

   b. Verification that potable water is used in the concrete mix or test data documenting the chloride content of the water.

   c. Letter from the concrete supplier stating that fine and coarse aggregates are from sources that are not known to be susceptible to chlorides in the aggregates.

2. Alkali silica reactivity in accordance with ASTM C1567.

3. Indication of permeability in accordance with ASTM C1202.

4. Freeze-thaw durability in accordance with ASTM C457 or ASTM C666.

E. Aggregates:

1. Percent of fine aggregate weight to total aggregate weight.

2. Deleterious substances in fine aggregate:

a. Clays and friable
b. Percent passing No. 200 sieve

c. Percent of coal and lignite in fine aggregate

3. Deleterious substances in coarse aggregate.

F. Pour Schedules: Submit concurrently with the steel reinforcing drawings six (6) copies of concrete pour schedules showing sequence of pours and all contraction, expansion and construction joints.

G. Watertightness test procedures and test results data.

H. Product Data: For each type of product indicated.

I. Formwork Shop Drawings: Prepared by or under the supervision of a qualified Professional Engineer registered in the State of Maryland.

1. Indicate detailing, fabrication, assembly, and support of formwork.

2. Shoring and Reshoring: Indicate proposed schedule and sequence of stripping formwork, shoring removal, and reshoring installation and removal.

3. Joints in forms shall not leak water, cement and fines, or concrete mortar during placing and vibrating of concrete.

4. Limit panel deflections to l/240 of each panel span to meet required tolerances.

5. Forms shall be designed for predetermined placing rates per hour, considering expected air temperatures and setting rates.

6. Adequate clean-out holes shall be provided at the bottom of each lift of forms. Temporary openings shall be provided at the base of column forms and wall forms and at other points to facilitate cleaning and observation immediately before the concrete is deposited. The size, number and location of such clean-outs shall be as acceptable to the Engineer.

J. Material Certificates: For each of the following, signed by manufacturers:

1. Cementitious materials
2. Aggregates
3. Admixtures
4. Form materials and form-release agents
5. Mix water
6. Steel reinforcement and accessories
7. Fiber reinforcement
8. Waterstops
9. Curing compounds
10. Floor and slab treatments
11. Bonding agents
12. Adhesives
13. Vapor retarders
14. Semirigid joint filler
15. Joint-filler strips
16. Repair materials

K. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:

1. Aggregates. Include service record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity.

L. Field quality control reports.

M. Proposed curing methods.

N. Detailed plan for cold weather curing and protection of concrete placed and cured in weather below 40 degrees F or near 40 degrees F and falling. The details shall include, but not be limited to, the following:

1. Procedures for protecting the subgrade from frost and the accumulation of ice or snow on reinforcement and other metallic embedments or forms prior to concrete placement.

2. Methods for temperature protection during placement.

3. Types of covering, insulation, housing, or heating to be provided.

4. Curing methods to be used during and following the protection period.

5. Use of strength accelerating admixtures.

6. Methods for verification of in-place strength.

7. Documentation of embedments that must be at a temperature above freezing prior to placement of concrete.

8. Procedures for measuring and recording concrete temperatures.

9. Procedures for preventing drying during dry, windy conditions.

O. Detailed plan for hot weather placements, including curing and protection for concrete placed in ambient temperatures over 80 degrees F.

1.05 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Reinforcing Steel:

1. For reinforcing steel fabricated on-site, ship from the mill in bundles, limited to one size and length, tagged with a waterproof tag showing the name of the mill, heat number, grade and size of the bars, and identifying number.

2. For reinforcing steel fabricated off-site, deliver in bundles identified as to structure and shop drawing number. Identify each individual bar with a waterproof tag showing the grade, size and bar mark from the approved bar schedule.

3. Deliver, store, and handle steel reinforcement to prevent bending and damage, and in accordance with CRSI publication “Placing Reinforcing Bars.” Avoid damaging coatings on reinforcing steel.

B. Concrete Ingredients: Handle, control and store concrete materials in accordance with ACI 304, Chapter 2.

C. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

PART 2 - PRODUCTS

2.01 GENERAL

A. Products shall be in accordance with requirements of ACI 301 unless otherwise noted.

2.02 FORM MATERIALS

A. Forms for Exposed Finish Concrete: Plywood, metal, metal-framed plywood faced, or other acceptable panel-type materials, to provide continuous, straight, smooth, exposed surfaces. Furnish in largest practicable sizes to minimize number of joints and to conform to joint system shown on drawings. Materials shall be new or in an undamaged condition.

1. Use plywood complying with US Product Standard PS-1 “B-B (Concrete Form) Plywood”, Class I, Exterior Grade or better, mill-oiled and edge-sealed, with each piece bearing legible inspection trademark.

2. Forms for Unexposed Finish Concrete: Plywood, lumber, metal, or other acceptable material. Provide lumber dressed on at least two edges and one side for tight fit.

3. Form Coatings: Provide commercial formulation form-coating compounds that will not bond with, stain, nor adversely affect concrete surfaces, and will not impair subsequent treatments of concrete surfaces.

4. Form Ties: Factory-fabricated, adjustable-length, removable or snap off metal form ties, designed to prevent form deflection and to prevent spalling concrete upon removal. Provide units that will leave no metal closer than 1½-inch to surface.

5. Provide ties which, when removed, will leave holes not larger than 1-inch diameter in concrete surface.

B. Earth cuts shall not be used as forms for vertical surfaces unless written approval is received by the Engineer.

C. Chamfer Strips: Wood, metal, PVC, or rubber strips, (¾-inch by ¾-inch), minimum, unless noted otherwise.

D. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

1. Formulate form-release agent with rust inhibitor for steel form-facing materials.

E. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.

1. Furnish units that will leave no corrodible metal closer than 1½-inch to the plane of exposed concrete surface.

2. Furnish ties that, when removed, will leave holes no larger than ⅞-inch in diameter in concrete surface.

3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing, and walls that will be in contact with liquids in the completed structure. Orient waterstop perpendicular to tie and symmetrical about center of tie.

4. Wire ties are not permitted.

F. Beveled Edge Corner Strips: Nonabsorbent material, compatible with form surface, fully sealed on all sides prohibiting loss of paste or water between the two surfaces.

2.03 REINFORCING MATERIALS

A. Reinforcing Bars: ASTM A615, Grade 60, deformed, epoxy coated in accordance with ASTM A775.

B. Welded Wire Reinforcement: ASTM A1064, fabricated and furnished in flat sheets.

C. Supports for Reinforcement: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire fabric in place. Use wire bar type supports complying with CRSI specifications.

1. For slabs-on-grade, use supports with sand plates or horizontal runners where base material will not support chair legs.

2. For exposed-to-view concrete surfaces, where legs of supports are in contact with forms, provide supports with legs which are plastic protected (CRSI, Class 1) or stainless steel protected (CRSI, Class 2).

D. Joint Dowel Bars: ASTM A615, Grade 60, plain-steel bars, cut true to length with ends square and free of burrs.

E. Epoxy Repair Coating: Liquid, two-part, epoxy repair coatings; compatible with epoxy coating on reinforcement and complying with ASTM A775.

F. Stainless Joint Dowel Bar: ASTM A276, Type 316L.

2.04 CONCRETE MATERIALS

A. Materials: Unless otherwise specified, materials shall be in accordance with ACI 301 and ACI 350.5.

B. Portland Cement: ASTM C150, Type I or Type II:

1. Conforming to the chemical requirements in AASHTO M 85 for a maximum alkali content of 0.60%.

2. Portland Cement shall not contain more than 8% tricalcium aluminate and more than 12% tetracalcium aluminoferrite.

3. Use one brand of cement from one manufacturing source and mill throughout project, unless written approval is received by the Engineer.

4. Blended Hydraulic Cement:

a. Unless otherwise specified, blended hydraulic cements shall conform to the requirements of ASTM C595.

b. Portland cement used in blended hydraulic cement shall conform to the requirements of ASTM C150.

c. Blended cements shall be Type IP (Portland Fly Ash Cement) or Type IS (Portland Slag Cement) conforming to ASTM C595.

(1) Type IP cement shall be an interground blend of Portland Cement and fly ash in which the fly ash constituent is between 15% and 25% of the weight of the total blend.

(2) Type IS cement shall be an interground blend of Portland Cement and slag cement in which the slab constituent is between 35% and 50% of the weight of the total blend.

C. Normal Weight Aggregates: ASTM C33, and as herein specified. Provide aggregates from a single source.

1. Fine Aggregate shall be clean, sharp, natural or manufactured sand, free from loam, clay lumps, or other deleterious substance within allowable standards.

2. Coarse Aggregate shall be clean, uncoated, graded aggregate, containing no clay, mud, loam or foreign matter and free of excessively flat or elongated pieces.

a. Maximum size of course aggregate shall not exceed:

(1) 0.2 narrowest dimension between forms.

(2) ¾ minimum clear spacing between reinforcing.

(3) ⅓ thickness of slab.

D. Supplementary Cementitious Materials (SCM):

1. Fly Ash (Pozzolan): Class F fly ash in accordance with ASTM C618, except as modified herein:

a. ASTM C618, Table 1, Loss on Ignition: Maximum 3 percent.

b. ASTM C618, Table 2, Water Requirement: Maximum 100 percent of control.

c. ASTM C618, Table 3, Expansion of Test Mixture. Results shall be evaluated using either Procedure A or Procedure B and as follows:

(1) Procedure A after 6-month sulfate exposure, maximum 0.10 percent.

(2) Procedure B, expansion of test mixture as a percentage of sulfate resistance cement control, after at least 6-month exposure, maximum 100 percent.

d. Where fly ash is specified to be used with Portland cement, fly ash shall meet one of the following requirements:

(1) CaO: Maximum 15 percent.

(2) Test cementitious materials as follows:

(a) In accordance with ASTM C1012.

(b) Furnish test data confirming fly ash in combination with cement used meets strength requirements, is compatible with air-entraining agents and other additives, provides increased sulfate resistance equivalent to or better than Type II cement.

(c) Conduct tests using proposed fly ash and cement samples together with control samples using Type II cement without fly ash.

e. Additional fly ash shall not be included in concrete mixed with Type IS or IP cement.

2. Slag Cement: In accordance with ATSM C 989, Grade 100 or Grade 120, including tests for effectiveness of slag in preventing excessive expansion due to alkali-aggregate reactivity as described in Appendix X-3 of ASTM C989.

a. Additional slag cement shall not be included in concrete mixed with Type IS or IP cement.

E. Silica Fume: ASTM C1240, amorphous silica.

F. Water: ASTM C94 and Potable

G. Admixtures:

1. General: Total Chloride ions from admixtures and other measures shall be no greater than 0.1 percent by weight of cement in the concrete mix immediately prior to service exposure.

2. Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.

H. Air-Entraining Admixture: ASTM C260, certified by manufacturer to be compatible with other required admixtures.

1. Available Products: Subject to compliance with requirements, products that may be incorporated in the work include, but are not limited to, the following:

a. “Sika AER-C”; Sika Corp.

b. “MasterAir VR-10 or MasterAir AE-90”; BASF.

c. “Darex AEA” or “Daravair”; GCP Applied Technologies.

I. Water-Reducing Admixture: ASTM C494, Type A, and containing not more than 0.1 percent chloride ions.

1. Available Products: Subject to compliance with requirements, products which may be incorporated in the work include, but are not limited to, the following:

a. “WRDA with Hycol”; GCP Applied Technologies.

b. “MasterPozzolith 210”; BASF.

c. “Plastocrete 161”; Sika Chemical Corp.

J. High Range Water Reducing Admixture (Super Plasticizer): ASTM C494, Type F or Type G and containing not more than 0.1 percent chloride ions.

1. Available Products: Subject to compliance with requirements, products which may be incorporated in the work include, but are not limited to, the following:

a. “Daracem”; GCP Applied Technologies.

b. “Sikament”; Sika Chemical Corp.

c. “MasterRheobuild”; BASF.

K. Water Reducing, Non-Chloride Accelerator Admixture: ASTM C494, Type E, and containing not more than 0.1 percent chloride ions.

1. Available Products: Subject to compliance with requirements, products which may be incorporated in the work include, but are not limited to, the following:

a. “Accelguard 80”; Euclid Chemical Co.

b. “MasterSet FP 20”; BASF.

c. “A-40”; Specco Industries.

L. Water Reducing, Retarding Admixture: ASTM C494, Type D, and containing not more than 0.1 percent chloride ions.

1. Available Products: Subject to compliance with requirements, products which may be incorporated in the work include, but are not limited to, the following:

a. “MasterPozzolith”; BASF.

b. “Eucon Retarder 75”; Euclid Chemical Co.

c. “Daratard”, GCP Applied Technologies.

M. Integral Crystalline Waterproofing Admixture: Provide an Integral Crystalline Waterproofing Admixture for concrete in liquid containment structures.

1. Available products: Subject to compliance with requirements, products which may be incorporated in the work include, but are not limited to, the following:

a. “Krystol KIM”; Kryton

b. “Xypex Admix C”; Xypex

c. “AQUAFIN-IC ADMIX”; Aquafin
d. “MasterLife 300D”; BASF

e. “ADI-CON CW PLUS”; W.R. Meadows

f. “CWS ADMIX”; Concrete Waterproofing Systems LTD

N. Shrinkage Reducing Admixture:

1. Shrinkage reducing admixture is permitted to be used in the mix to meet shrinkage limitations provided that specified strength is met and there is no reduction in sulfate resistance and no increase in permeability. Quantity of shrinkage reducing admixture used in the mix shall be added to the quantity of water for purposes of determining the water/cementitious materials ratio.

2. Available products: Subject to compliance with requirements, products which may be incorporated in the work include, but are not limited to, the following:

a. “Masterlife SRA20”; BASF

b. “PREVent-C”; Premier CPG

c. “Eclipse 4500”; GCP Applied Technologies

d. “Eucon SRA”; Euclid Chemical Company

O. Prohibited Admixtures: Calcium chloride thyocyanates or admixtures containing more than 0.1 percent chloride ions are not permitted.

P. Synthetic Fiber: Uniformly disperse in concrete mixture at manufacturer's recommended rate, but not less than 1.5 lb/cu. yd. Use Fibermesh 150 only 100 percent virgin polypropylene multifilament fibers containing no reprocessed olefin materials and specifically engineered and manufactured in an ISO 9001:2000 certified facility for use as concrete secondary reinforcement. Application per cubic yard shall equal a minimum of 1.5 lb per cubic yard. Fibers are for the control of cracking due to plastic shrinkage, plastic settlement and thermal

expansion/contraction, lowered permeability, increased impact, abrasion and shatter resistance. Fiber manufacturer shall document evidence of ten-year satisfactory performance history, ISO 9001:2000 certification of manufacturing facility, compliance with applicable building codes and ASTM C1116, Type III fiber reinforced concrete. Fibrous concrete reinforcement shall be manufactured by Propex Concrete Systems, Euclid Chemical Company, or approved equal. Synthetic fiber shall only be used at locations indicated on the contract drawings.

2.05 RELATED MATERIALS

A. Waterstops:

1. Cast-In-Place PVC/TPV Waterstops.

a. Material:

(1) Polyvinyl Chloride: Corps of Engineers CRD-C 572; Extruded from elastomeric plastic compound of which resin shall be prime virgin polyvinyl chloride (PVC). Compound shall not contain scrapped material, reclaimed material, or pigment. Chemical extenders in the PVC are not permitted.

(a) Tensile Strength - 1,750 psi min. (ASTM D638)

(b) Ultimate Elongation - 280% min. (ASTM D638)

(2) Manufacturers: BoMetals, Inc.; DuraJoint Concrete Accessories; or Sika Greenstreak.

(3) Thermoplastic Vulcanizate: Fully cross-liked Thermoplastic Vulcanizate (TPV), containing no plasticizer, mineral fillers, scrap or reclaimed material.

(a) Manufacturers: Wirestop ® Paul Murphy Plastics Company; Earth Shield TPV/TPE-R by JP Specialties, Inc.; TPE-R by BoMetals, Inc.; Westec TPE-R by Westec Barrier Technologies; or TPE-R by DuraJoint Concrete Accessories.

b. Provide 9-inch wide by ⅜-inch thick waterstop unless noted otherwise on the Contract Drawings. Provide 9-inch x ⅜-inch flat ribbed or flat dumbbell type waterstops at construction joints; and 9-inch x ⅜-inch centerbulb ribbed or centerbulb dumbbell type waterstops at expansion and contraction joints. Waterstop shall maintain a consistent thickness.

c. Waterstops shall be manufactured with factory-installed galvanized or stainless steel wireloops, or metal eyelets, along the edge of both side, integral to the waterstop; for proper positioning of waterstop in forms at time of concrete placement, to facilitate securing the waterstop to reinforcing steel to prevent displacement during concrete placing operations and to ensure accurate location of waterstop in center of joint. The waterstops shall be wired to the reinforcement in accordance to the manufacturer's recommendations. If no manufacturer recommendations are available, then the waterstop shall be wired a maximum of two (2) feet on center.

d. Factory fabricated corners, intersection, and directional changes shall be used. Waterstops shall be heat spliced using an appropriate splicing device provided by the manufacturer. Splicing shall occur outside the reinforcing steel assembly. Provide at all construction, contraction and expansion joints and at other joints as indicated on the Contract Drawings.

e. When waterstop is to be installed in concrete that is to be in contact with drinking water, waterstop shall be certified for use in potable water per NSF/ANSI Standard 61. Third-party certified documentation to be provided by the Manufacturer.

f. Corrugated or tapered type waterstops are not acceptable.

2. Self-Expanding Butyl Strip Waterstops: Manufactured rectangular or trapezoidal strip, butyl rubber with sodium bentonite or other hydrophilic polymers, for adhesive bonding to concrete, ¾-inch by 1-inch.

a. Available Products:

(1) Colloid Environmental Technologies Company; Volclay Waterstop-RX.

(2) Concrete Sealants Inc.; Conseal CS-231.

(3) Greenstreak; Swellstop.

(4) Henry Company, Sealants Division; Hydro-Flex.

(5) JP Specialties, Inc.; EarthShield Type 20.

(6) Or approved equal.

3. Self-Expanding Rubber Strip Waterstops: Manufactured rectangular or trapezoidal strip, bentonite-free hydrophilic polymer modified chloroprene rubber, for adhesive bonding to concrete, ⅜-inch by ¾-inch.

a. Available Products:

(1) Deneef Construction Chemicals; SwellSeal.

(2) Greenstreak; Hydrotite.

(3) Mitsubishi International Corporation; Adeka Ultra Seal.

(4) Or approved equal.

4. "Tee" Shaped Waterstop:

a. Provide split "Tee" shaped waterstops as manufactured by Paul Murphy Plastic Co. or approved equal. Where "Tee" waterstops are to be used, the following procedures shall be used:

(1) Apply FX-752 All Purpose Bonding Agent as manufactured by Simpson Strong-Tie, or approved equal, to the existing structure where the waterstop is to be installed.

(2) Apply FX-263 Rapid Hardening Vertical/Overhead Repair Mortar as manufactured by Simpson Strong-Tie, or approved equal, to a depth of not less than ¼" to the existing structure where the waterstop is to be installed.

(3) Allow the trowelable mortar to set a minimum of 48 hours. Apply FX-523 Flexibilized Epoxy Adhesive as manufactured by Simpson Strong-Tie, or approved equal, to adhere the waterstop to the troweled mortar surface. New concrete shall not be placed until the FX-523 Flexibilized Epoxy Adhesive, or approved equal, and waterstop have been in place for a minimum of one hour.

b. If a manufacturer other than Simpson Strong-Tie is used, all components to install the split "Tee" waterstop shall be from the same approved manufacturer.

B. Vapor Retarder:

1. Plastic Vapor Retarder: ASTM E1745, Class A, provide sheet vapor retarder cover over prepared base material where indicated below slabs on grade. Use only materials, which are resistant to decay when tested in accordance with ASTM E154, as follows:

a. Vapor retarder sheet membrane not less than 10 mils thick, as specified in Section 07190 Under-Slab Vapor Retarder.

2. Granular Fill: Clean mixture of crushed stone or crushed or uncrushed gravel; ASTM D448, Size 57, with 100 percent passing a 1½-inch sieve and 0 to 5 percent passing a No. 8 sieve.

3. Fine-Graded Granular Material: Clean mixture of crushed stone, crushed gravel, and manufactured or natural sand; ASTM D448, Size No. 10, with 100 percent passing a ⅜-inch sieve, and 10 to 30 percent passing a No. 100 sieve. Material shall have a uniform distribution of particle sizes ranging from No. 4 to the No. 200 sieve. Refer to ASTM C33, Table 1, for limitation of deleterious substance limits for fine aggregates.

C. Absorptive Cover: Burlap cloth made from jute or kenaf, weighing approximately 9 oz. per square yard, complying with AASHTO M182, Class 2.

D. Moisture Retaining Cover: One of the following, complying with ASTM C171.

1. Polyethylene film, or

2. White burlap-polyethylene sheet.

E. Liquid Membrane Forming Curing Compound: Liquid type membrane forming curing compound complying with ASTM C309, Type I, Class A or Class B. Moisture loss not more than 0.055 gr./sq. cm. when applied at 200 sq. ft./gal.

1. Available Products: Subject to compliance with requirements, products which may be incorporated in the work include, but are not limited to, the following:

a. “MasterKure”; BASF,

b. “Kurez”; Euclid Chemical Co., or

c. “Clear Resin Cure J11W”; Dayton Superior.

F. Bonding Compound: Polyvinyl acetate or acrylic base.

1. Available Products: Subject to compliance with requirements, products which may be incorporated in the work include, but are not limited to, the following:

2. Acrylic or Styrene Butadiene:

a. “Burke Bonding Agent J40”; Dayton Superior,

b. “SBR Latex”; Euclid Chemical Co., or

c. “Daraweld C”; GCP Applied Technologies.

G. Epoxy Adhesive: ASTM C881, two-component material suitable for use on dry or damp surfaces. Provide material “Type”, “Grade”, and “Class” to suit project requirements. Types III, IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

1. Available Products: Subject to compliance with requirements, products which may be incorporated in the work include, but are not limited to, the following:
   a. “Epobond”; L & M Construction Chemicals,

   b. “Sikadur Hi-Mod”; Sika Chemical Corp, or

   c. “Duralcrete”; Euclid Chemical Co.

H. Fasteners:

1. Fasteners and Anchors shall be of the type and size shown on the Drawings, and are specified as follows:

   Anchors with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E488, conducted by a qualified independent testing agency.

   a. Anchor Bolts:

      (1) 304 Stainless Steel, unless noted otherwise on the Drawings.

      (2) Size and configuration as shown on the Drawings.

   b. Mechanically Fastened Anchors:

      (1) Expansion anchors shall have embedment lengths as shown in the Contract Drawings.

         (a) 304 Stainless Steel, Condition CW1 or CW2, unless noted otherwise on the Drawings.

         (b) Acceptable manufacturers: “Kwik Bolt TZ” by Hilti, Inc., or approved equal.

      (2) Request for an alternate expansion anchor shall include the following:

         (a) Building Code Compliance Certifications

         (b) International Code Council Approvals

(c) Product Description

(d) Material Specifications

(e) Allowable Tension and Shear Static Loads

(f) Technical Data

(g) Anchor Spacing and Edge Distance Reduction Factors

c. Chemically Fastened Anchors/Reinforcing Bars:

(1) Sizes and embedments of chemically fastened anchors/reinforcing bars shall be as shown in the Contract Drawings.

(a) Acceptable manufacturers: “HIT RE 500 Epoxy Anchoring System” as manufactured by Hilti, Inc., or approved equal.

(2) Request for an alternate fastening system shall include the following:

(a) Product Description

(b) Material Specifications

(c) Technical Data

(d) Allowable Loads

(e) Ultimate Strengths

(f) Spacing and Edge Distance Reduction Factors

(g) Influence of Temperature on Strength

(h) Resistance to Chemicals

(i) Installation Guidelines

2. Substitution of the anchor types shown on the Drawings shall not be permitted without approval of the Engineer.

I. Pre-molded Joint Fillers:

1. Pre-molded Joint Fillers and Bond Breakers: Unless otherwise noted on the Drawings, the materials shall conform to the following:

a. Pre-formed Non-extruding Filler: ASTM D994, ASTM D1751, asphalt-saturated cellulosic fiber, or ASTM D1752 self-expanding cork.

b. Manufactured clear adhesive tape to break bond between sealant and joint filler.

J. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.

1. Available Products: Subject to compliance with requirements, products which may be incorporated in the work include, but are not limited to, the following:

a. “AquaFilm”; Dayton Superior,

b. “VaporAid”; Kaufman Products, Inc., or

c. “SikaFilm”; Sika Corporation.

K. Bond Breaker: Non-staining liquid product which imparts a waterproof film to prevent adhesion of concrete and will not leave a paint-impeding coating on the face of the concrete.

L. Joint Sealant - In accordance with the following for joints intended to be submerged and/or in contact with process liquids. Joint types include: Control, construction, expansion, contraction, and isolation. For joint sealant accessories and installation, see Section 07900 “Sealants and Caulking.”

1. Comply with ASTM C920, Type M, Class 25, Grade NS/Grade P/Grade SL, Use NT, I, G, A, O, T, M; GSA TT-S-00227E Type 1/Type 2, Class A.

2. Sealant shall be a two-component base system, polysulfide. Sealant shall be conforming to NBS and GSA TT-S-0227E (1970); FX-572/573 Polysulfide Joint Sealant as manufactured by Simpson Strong-Tie, or Thiokol 2235M/2235SL Polysulfide Joint sealant as manufactured by ITW PolySpec or approved equal.

3. Joint Sealant Color: To match adjacent concrete work, unless otherwise directed by the Owner.

M. Backing Rod:

1. Backing rod shall be an extruded closed-cell, polyethylene foam rod. The material shall be compatible with the joint sealant material used and shall have a tensile strength of not less than 40 psi and a compression deflection of approximately 25 percent at 8 psi. The rod shall be ⅛-inch larger in diameter than the joint width except that a 1-inch diameter rod shall be used for a ¾-inch wide joint.

N. Roofing Felt: ASTM D226, Type II, #30 asphalt-saturated or approved equal weight of ASTM D227 coal-tar saturated felt.

O. Granular Base Subgrade: Provide layer of AASHTO No. 57 stone with thicknesses as shown on the Contract Drawings.

2.06 FLOOR AND SLAB TREATMENTS

A. Unpigmented Mineral Dry-Shake Floor Hardener: Factory packaged dry combination of Portland cement, graded quartz aggregate, and plasticizing admixture.

1. Available Products: Subject to compliance with requirements, products which may be incorporated in the work include, but are not limited to, the following:

a. “Quartz Tuff”; Dayton Superior,

b. “Surflex”; Euclid Chemical Company, or

c. “Quartzplate FF”; L&M Construction Chemicals, Inc.

2.07 PROPORTIONING AND DESIGN OF MIXES

A. General: Concrete shall be composed of cement, admixtures, aggregates and water. These materials shall be of the qualities specified. The exact proportions in which these materials are to be used for different parts of the work will be determined during the trial batch/mix design. In general, the mix shall be designed to produce a concrete capable of being deposited so as to obtain maximum density and minimum shrinkage and, where deposited in forms, to have good consolidation properties and maximum smoothness of surface. Mix designs with more than 41 percent of sand of the total weight of fine and course aggregate shall not be used. The aggregate gradations shall be formulated to provide fresh concrete that will not promote rock pockets around reinforcing steel or embedded items. The proportions shall be changed whenever necessary or desirable to meet the required results at no additional cost to the Owner. All changes shall be subject to review by the Engineer.

B. Prepare design mixes for each type and strength of concrete by either laboratory trial batch or field experience methods as specified in ACI 301. If trial batch method is used, use an independent testing facility acceptable to Engineer for preparing and reporting proposed mix designs. The testing facility shall not be the same as used for field quality control testing. Prepare design mixes for the following minimum 28-day compressive strengths and applications:

1. 3,500 psi air entrained use for all pipe encasements, reaction backings, Fill Concrete and Structural Foundation Backfill.

2. 4,500 psi use for all structural concrete unless otherwise noted. Submit separate mixes for each condition i.e., air entrained, non-air entrained, pumped.

C. Submit design mixes and proof of performances for each type and strength of concrete in accordance with ACI 301 and ACI 318.

1. When field tests are available, follow the Field Test Data design method per ACI 301.

   a. Provide thirty (30) consecutive tests (or two groups of the same design mix totaling 30 or more), and compute the standard deviation per ACI 301, Section 4.2.3.2.

   b. When only 15 to 29 tests are available, compute the increased standard deviation per ACI 301, Section 4.2.3.2.

2. When field tests are not available, supplier shall supply the trial mix design following the restrictions of ACI 301, Section 4.2.3.3. and 4.2.3.4.

   Trial mixtures shall be tested by an independent testing facility and shall not be the same at the facility used or field quality control testing.

3. Upon written approval by the Engineer, where field test records for trial data are not available, the concrete mix design may follow the Empirical Method of ACI 301.

4. When permitted by Engineer, materials certificates in lieu of materials laboratory test reports can be submitted. Materials certificates shall be signed by manufacturer and Contractor, certifying that each material item complies with or exceeds specified requirements.

5. Provide certification from admixture manufacturers that chloride content complies with specification requirements.

D. Submit written reports to Engineer of each proposed mix for each class of concrete at least 15 days prior to start of work. Do not begin concrete production until mixes have been reviewed and approved by Engineer.

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

F. Limit water-soluble, chloride-ion content in hardened concrete to 0.10 percent by weight of cement.

G. Admixtures:

1. Use water-reducing admixture or high range water-reducing admixture (superplasticizer) in concrete as required for placement and workability.

2. Use non-chloride accelerating admixture in concrete slabs placed at ambient temperatures below 50 degrees F.

3. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.

4. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.

5. Use air-entraining admixture in exterior exposed concrete, unless otherwise indicated. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having total air content with a tolerance of plus or minus 1½ percent within following limits:

a. Concrete structures and slabs exposed to freezing and thawing, deicer chemicals, or hydraulic pressure.

(1) 4.5 percent (moderate exposure); 5.5 percent (severe exposure) 1½-inch max. aggregate.

(2) 4.5 percent (moderate exposure); 6.0 percent (severe exposure) 1-inch max. aggregate.

(3) 5.0 percent (moderate exposure); 6.0 percent (severe exposure) ¾-inch max. aggregate.

b. Other concrete (not exposed to freezing, thawing, or hydraulic pressure) or to receive a surface hardener: 2 percent to 4 percent air.

c. Use admixtures for water reduction and set control in strict compliance with manufacturer's directions.

H. Cement Content: Provide concrete for following conditions with maximum water-cement (W/C) ratios, by weight, as follows:

1. All 4,500 psi concrete mixes shall have a max: W/C 0.45.

2. All other concrete mixes shall have a max W/C 0.42.

3. The cement factor shall not be less than:

   a. 515 lb/yd3 of concrete with 1½-inch max. aggregate.

   b. 535 lb/yd3 of concrete with 1-inch max. aggregate.

   c. 560 lb/yd3 of concrete with ¾-inch max. aggregate.

I. Slump Limits: Proportion and design mixes to result in concrete slump at point of placement as follows:

1. Maximum slump.

   a. Reinforced concrete foundation slabs and substructure walls - 3-inch.

   b. Reinforced concrete, slabs, beams, walls, columns - 4-inch.

   c. Pipe encasements - 4-inch.

   d. Structural foundation backfills - 6-inch.

   e. Concrete containing HRWR admixture (super-plasticizer): Not more than 8-inch after addition of HRWR to site-verified 2-inch - 3-inch slump concrete.

2. Minimum slump for all concrete shall be 1-inch.

3. Use admixtures for water-reducing and set control in strict compliance with manufacturer's directions.

4. Slump may be increased for workability by adding High Range water reducing admixture.

2.08 MIX DESIGNS USING POTENTIALLY REACTIVE AGGREGATE

A. Aggregate Evaluation:

1. Test aggregates according to AASHTO T 303. Aggregates that develop expansion greater than 0.10% after 14 days in solution (16 days – age of bar) are considered potentially reactive with cement alkalis. The Contractor may test aggregates according to ASTM C227 to confirm potential reactivity of fine or coarse aggregate, but not to classify an aggregate as "nonreactive." If ASTM C227 mortar bars are made with cement having an alkali content greater than 0.80%, aggregates are considered to be "reactive" if expansion is greater than 0.05% at 3 months or greater than 0.10% at 6 months.

2. Use aggregates that are deemed potentially reactive only with cements or cement-pozzolan combinations as specified. If one or both of the aggregates (coarse or fine) used in a mix is reactive, mitigation is required as specified. This requirement applies to all concrete.

B. Cement/Cement-Pozzolan Requirements: For use with aggregate deemed potentially reactive as specified. Provide Portland cement or Portland cement-pozzolan combinations conforming to the requirements of this Section.

1. Portland Cement. Conforming to the optional chemical requirement in AASHTO M 85 for a maximum alkali content of 0.60%.

2. Portland Cement-Pozzolan Combination. Furnish a combination of Portland cement with an alkali content no greater than 1.40% and silica fume.

   Silica Fume - Use a quantity of silica fume between 5% and 10%, by mass, of the total cementitious material. Use of silica fume will be allowed on an experimental basis only, until sufficient experience is gained.

2.09 CONCRETE MIXING

A. Job Site Mixing: Mix materials for concrete in appropriate drum type batch machine mixer. For mixers of one cubic yard, or smaller capacity, continue mixing at least 1½ minutes, but not more than five minutes after ingredients are in mixer, before any part of batch is released. For mixers of capacity larger than one cubic yard, increase minimum 1½ minutes of mixing time by 15 seconds for each additional cubic yard, or fraction thereof. Job site mixing is limited to small quantities with approval of the Engineer.

B. Provide batch ticket for each batch discharged and used in work, indicating project identification name and number, date, mix type, mix time, quantity, and amount of water introduced.

C. Ready Mix Concrete: Comply with requirements and recommended practices of ASTM C94, ACI 304R, and as specified.

1. When air temperature is between 85 degrees F. and 90 degrees F., reduce mixing and delivery time from 1½ hours to 75 minutes, and when air temperature is above 90 degrees F, reduce mixing and delivery time to 60 minutes.

2. Plant Equipment and facilities shall conform to the "Checklist for Certification of Ready Mixed Concrete Production Facilities" of the National Ready-Mixed Concrete Association.

3. During hot weather, or under conditions contributing to rapid setting of concrete, a shorter mixing time than specified in ASTM C94 may be required.

PART 3 - EXECUTION

3.01 GENERAL

A. Execution shall be in accordance with requirements of ACI 301 and ACI 350.5 unless otherwise noted.

B. Unless otherwise specified, conform to ACI 304R, 305R, and 306R for concrete installation requirements, such as preparation, mixing, conveying, depositing, curing, and cold and hot weather requirements. Consolidate concrete in accordance with ACI 309R.

C. Concrete not placed within 90 minutes or 300 revolutions, whichever occurs first, after the first mixing of the cement and aggregates will be rejected.

D. Conduits, pipes, or items other than those specified in this Section are not to be embedded in concrete of water bearing structures unless specifically shown in the contract documents or by written approval by the Engineer.

3.02 COORDINATION

Examine the drawings and specifications for work of other sections or other contractors and coordinate such work with the requirements of this Section. Make provisions for installation of such items as sleeves, pipes, conduits, inserts and hangers in a manner that will not impair or weaken concrete construction.

3.03 REINFORCEMENT

A. Unless otherwise specified, place reinforcing steel in accordance with CRSI Recommended Practice for Placing Reinforcing Bars.

B. The Contractor shall not cut embedded reinforcing steel that is cast into structural concrete without prior written approval by the Engineer.

C. Cleaning and Bending:

1. Reinforcing bars shall be fabricated in accordance with the standard fabricating tolerances in Fig. 2.1(a) and Fig 2.1(b) in ACI 117.

2. When it is necessary to move bars to avoid interference with the reinforcement, conduits, or embedded items exceeding the specified placing tolerances, the resulting arrangement of bars shall be subject to acceptance by the Engineer.

3. All reinforcement shall be bent cold. Perform all reinforcement bending and cutting operations in the shop. Do not bend or straighten bars in a manner that will damage the reinforcement.

4. All reinforcement, at the time it is placed, shall be free of mud, oil, or other materials that may adversely affect or reduce the bond. Reinforcement with rust, mill scale, or a combination of both shall be considered satisfactory provided the minimum dimensions, weight, and height of deformations of a hand-wire-brushed test specimen conforms to the requirements of ASTM A615.

D. Placement:

Place reinforcing steel in accordance with CRSI Recommended Practice for Placing Reinforcing Bars, unless otherwise specified.

1. Arrange and place reinforcement in accordance with the approved shop drawings.

2. Reinforcement shall be placed to the tolerances indicated in ACI 301, Section 3.3.

3. All reinforcement shall be supported and fastened before concrete is placed and shall be secured against displacement.

4. Reinforcement supported from the ground shall rest on precast concrete blocks having a compressive strength equal to or greater than the specified compressive strength of the concrete being placed.

5. Reinforcement supported from formwork shall rest on bar supports made of concrete, metal, plastic, or other acceptable materials. Where the concrete surface will be exposed to the weather in the finished structure, the portions of all bar supports within ½-inch of the concrete surface shall be non-corrosive or protected against corrosion.

6. Templates shall be furnished for placement of all column dowels and anchor bolts.

7. All splices shall be as indicated on the Contract Drawings.

8. Bending or straightening of bars partially embedded in concrete shall not be permitted.

9. Welding of crossing bars (tack welding) for assembly of reinforcement is prohibited.

10. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

11. Epoxy-Coated Reinforcement: Repair cut and damaged epoxy coatings with epoxy repair coating according to ASTM D3963. Use epoxy-coated steel wire ties to fasten epoxy-coated steel reinforcement.

12. Place reinforcement a minimum of 2” clear of any metal pipe or fitting.

E. Splicing

1. Furnish reinforcing bars in full lengths as indicated on the Contract Drawings and approved shop drawings.
2. Do not splice bars unless indicated on the Contract Drawings or approved by the Engineer in writing.

3. When authorized, make splices in accordance with ACI 318 or ACI 350. Perform welding in accordance with AWS D1.4.

4. Lap welded wire reinforcement not less than one mesh space plus 2", and tie.

F. Concrete Cover

1. Provide clearance and spacing indicated on the Contract Drawings.

2. Where no clearances are indicated, the thickness of concrete cover over reinforcement shall be:

a. 3" for concrete placed against ground without the use of forms.

b. 2" for concrete placed in forms that will be exposed to ground or weather.

c. 1½" for formed concrete not exposed to ground or weather.

d. ¾" for slabs not exposed to ground or weather

G. Cleaning and Replacing Existing Reinforcing Steel:

Existing reinforcing steel that is to be incorporated into the proposed work as shown in the Contract Drawings shall be cleaned until free of all concrete, scale, rust and dust. If reinforcing bar has lost more than 20% of its original cross-sectional area, provide a new bar with size that matches the bar under repair, lapping the existing reinforcing steel per chart shown in Contract Drawings. Where the required bar lap is not available or limits of concrete removal to achieve bar lap are too great, use an approved mechanical splice.

H. Cutting New Openings in Existing Concrete:

Where existing reinforcing has been cut when cutting new openings in existing concrete walls or slabs, reinforcing shall be chipped a minimum of 2 inches below proposed finished surface and covered with minimum 10,000 psi non-shrink grout.

3.04 FORMWORK

A. Responsibility:

1. The design and construction of formwork are the sole responsibility of the Contractor.

2. The Contractor shall remove and replace forms which no longer have smooth surfaces and/or are weak resulting in intrusions or extrusions in the concrete face.

B. Design Criteria:

1. Design formwork system which is adequately braced and has strength and stability to ensure finished concrete within the tolerances specified in ACI 347.R, and construct in accordance with ACI 301.

a. Class A, ⅛-inch for smooth-formed finished surfaces.

b. Class B, ¼-inch for rough-formed finished surfaces.

2. Provide formwork sufficiently tight to prevent leakage of mortar.

3. Chamfer external corners ¾-inch, unless noted otherwise in the Contract Documents.

4. Curved portions of walls shall not be formed in a segmented fashion. Curves shall be formed using flexible systems as manufactured by Symons ‘Flex-Form’, PERI Form Works or approved equal.

5. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wreaking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.

   a. Install joints, reglets, recesses, and the like, for easy removal.

   b. Do not use rust-stained steel form-facing materials.

6. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.

7. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

8. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

9. Forms at Joints and Corners: Ties or bolts shall be provided three to six inches (3" to 6") from each side of concrete construction joints for tightening the forms against the hardened adjacent concrete prior to placing fresh concrete. At joints where forms have been removed and reconstructed, the form surface shall extend over the concrete already in place; and the forms shall be drawn tightly against the previously placed concrete prior to the placing the fresh concrete. Forms shall be filleted at all sharp corners, except when otherwise specified in the Contract Documents and shall be given a bevel or draft in the case of all projections. All exposed corners of concrete shall be chamfered with three-quarters inch by three-quarters inch (¾" x ¾") milled chamfer strips, except on unexposed footings or where specified in the Contract Documents.

10. The surface of the steel forms in contact with the concrete shall be smooth and free of bolts, bolt heads, nuts, rivet heads, welding seams and surface irregularities. Forms that produce unacceptable concrete surfaces will be rejected and shall not be reused.

11. Form Ties: Only form ties approved by the Engineer shall be used. Ties shall leave no metal closer than one and a half inches (1½") from the surface. They shall not be fitted with lugs, cones, washers or other devices which act as spreaders within the form or for any purpose that leaves a hole larger than seven-eighths inch (⅞") diameter. When prefabricated steel girder forms are used, tapered ties up to one and one half-inch (1½") maximum diameter shall be used. Ties shall be clean and free of rust. When ties are removed, the holes shall be pressure grouted with a non-shrink mortar mixed to match the color and texture of the concrete.

12. Portions of ties to be removed from the concrete shall be coated with a clear lubricant or other approved material to facilitate removal. Care shall be exercised during removal of form ties to avoid spalling the concrete on the exposed surface. Cutting back from the face is prohibited.

13. All formwork shall be temporary and removed by the Contractor as part of this Work, unless written approval is given by the Engineer; or unless noted otherwise in the Contract Drawings.

14. Brace formwork as required to prevent distortion during concrete placement.

15. Prior to form removal, provide thermal protection for concrete being placed under the requirements of cold weather concreting.

C. Coating Forms:

1. Coat forms with bond breaker prior to the placement of reinforcing steel.

2. Do not allow excess form coating material to stand in puddles in the forms or to come in contact with concrete against which fresh concrete is to be placed.

3. Clean reinforcing steel that has become contaminated with bond breaker to the satisfaction of the Engineer prior to placing concrete.

D. Embedded Items:

1. Clean items to be embedded in concrete free from oil or foreign matter that would weaken the bond of the concrete to these items.

2. Install in the formwork requisite inserts, anchors, sleeves, and other items specified under other sections of these specifications. Close ends of conduits, piping, and sleeves embedded in concrete with caps or plugs.

3. Embedded items shall be positioned accurately and supported against displacement.

4. Conduit and pipes embedded in concrete shall be located in accordance with ACI 350, 6.3.

5. Anchor bolts/rods shall be accurately set and shall be maintained in position by templates while being embedded in concrete.

E. Joints:

1. Make contraction, expansion, and construction joints where indicated on the Contract Drawings. Additional construction joints are subject to prior approval of the Engineer. Locate additional construction joints to least impair the strength of the structure.

2. Continue reinforcing steel and welded wire reinforcement across construction joints.

3. Install premolded joint filler at locations indicated. Extend filler from bottom of concrete.

4. Make splices in premolded filler in manner to preclude penetration of concrete between joint faces.

5. The surface of the concrete at all joints shall be thoroughly cleaned and all latency removed prior to placing adjoining concrete.

6. Before bonding concrete is placed, clean the surface of loose or soft particles or other objectionable materials and keep wet for a minimum period of 12 hours.

7. The hardened concrete of construction joints and of joints between footings and walls or columns, between walls or columns and beams or floors they support, joints in unexposed walls and all others not mentioned below shall be dampened (but not saturated) immediately prior to placing of fresh concrete.

8. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.

9. The surface of the hardened concrete at construction joints shall be cleaned and kept moistened until the additional concrete is placed. The top surface of concrete shall be leveled using a grade strip, unless otherwise specified. At chamfers the top surface of the concrete shall be steel troweled adjacent to the chamfer using the top surface for the chamfer strip as a guide.

10. The Contractor shall place an epoxy bonding compound on the surface areas of existing concrete (concrete that existed prior to the beginning of the Contract) which will be in contact with new concrete. The surfaces to be coated shall be clean, sound, and dry and bonding compound shall be mixed and applied in conformance with the manufacturer's recommendations.

F. Waterstops:

1. Install waterstops of the sizes and shapes indicated. Support and protect that portion of the waterstop, which extends beyond the bulkhead during placing of concrete and subsequent removal of forms.

2. Waterstops shall be continuous at construction, contraction and expansion joints to form a watertight compartment.

3. Minimum Width: 9 inches.

4. Make field splices by heat-sealing, maintaining the continuity of the ribs and bulbs, and allow the splice to cool before stressing. Field splice must be watertight. Repair damaged waterstops per manufacturer's instructions.

5. Waterstop shall be installed in accordance with the manufacturer's guidelines and written instructions.

6. Splice in accordance with waterstop manufacturer's written instructions using Teflon-coated thermostatically controlled heating iron, heated to the manufacturer's recommended splicing temperature. Field splices permitted only for straight butt welds.

7. Install waterstop in longest lengths possible. Splices shall be made by certified, trained personnel using approved equipment and procedures. Inspect waterstop and field splices for defects. Replace any damaged or unacceptable waterstop and dispose of defective material.

8. Exposed waterstops shall be protected during application of form release agents to avoid being coated.

9. Position waterstop to ensure clearance between waterstop and reinforcing steel of a minimum two times the largest aggregate size, to prevent rock pockets, air voids and honeycombing.

10. Carefully place concrete without displacing waterstop from proper position. Thoroughly and systematically vibrate concrete in the vicinity of the joint, and to maximized intimate contact between concrete and waterstop.

11. Prior to second placement of concrete, clean exposed waterstop leg to ensure full contact of second concrete placement. Remove laitance, spillage, form oil and dirt.

12. When any waterstop is installed in the concrete on one side of a joint, while the other half or portion of the waterstop remains exposed to the atmosphere for more than 2 days, suitable precautions shall be taken to shade and protect the exposed waterstop from direct rays of the sun during the entire exposure and until the exposed portion of the waterstop is embedded in concrete.

13. Use only factory made waterstop fabrications for all intersections, changes of directions and transitions.

14. Center waterstop on joint.

15. Waterstop at vertical joints shall terminate 3 inches below the top of exposed wall. Where waterstop with a center bulb is used, the end of the center bulb shall be plugged with a flexible material, such as foam rubber, to prevent concrete intrusion at ends where the bulb will be exposed to concrete extrusions.

16. Waterstops shall be manufactured with factory-installed galvanized or stainless steel wireloops, or metal eyelets, along the edge of both side, integral to the waterstop; for proper positioning of waterstop in forms at time of concrete placement, to facilitate securing the waterstop to reinforcing steel to prevent displacement during concrete placing operations and to ensure accurate location of waterstop in center of joint. The waterstops shall be wired to the reinforcement in accordance with the manufacturer's recommendations. If no manufacturer recommendations are available, then the waterstop shall be wired a maximum of two (2) feet on center.

17. Horizontal Waterstops: Ensure space beneath waterstop is completely filled with concrete. During concrete placement, make visual inspection of waterstop area. Limit concrete placement to elevation of waterstop, vibrate concrete under waterstop, lift waterstop to confirm full consolidation without voids, then place remaining concrete.

18. Swellable Waterstop: Install in accordance with manufacturer's written instructions. Provide minimum cover over waterstop as recommended by manufacturer. Splice waterstop and fabricate joints and intersections per the manufacturers written recommendations.

3.05 VAPOR RETARDERS

A. Plastic Vapor Retarders: Place, protect, and repair vapor retarders according to ASTM E1643 and manufacturer's written instruction.

1. Lap joints 12 inches, unless otherwise specified by the manufacturer, and seal with manufacturer's recommended tape.

B. Granular Course: Cover vapor retarder with granular fill, moisten, and compact with mechanical equipment to elevation tolerances of plus 0-inch or minus ¾- inch. Place and compact a ½-inch thick layer of fine-graded granular material over granular fill.

3.06 PREPARATION OF EQUIPMENT AND PLACE OF DEPOSIT

A. Before placement, clean equipment for mixing and transporting the concrete. Remove debris and ice from the places to be occupied by the concrete. Clean reinforcement of dirt, loose rust, and mill scale, or other coatings.

B. Remove water from place of deposit before concrete is placed. Remove laitance and unsound material from hardened concrete before additional concrete is added.

C. Thoroughly wet the stone based on which slabs are to be placed where no vapor retarder is indicated.

3.07 MIXING

A. Mix and deliver ready-mixed concrete in accordance with ASTM C94. Plant equipment and facilities shall conform to “Certification of Ready-Mixed Concrete Production Facilities (Checklist with Instructions)” of the National Ready-Mixed Concrete Association.

B. Do not over-mix. Do not use concrete which is retained in mixers so long as to require additional water in excess of design mix water to permit satisfactory placing.

C. Use preparation methods capable of producing concrete with a temperature not more than 85 degrees F, and not less than 55 degrees F, at the time of placement.

D. Do not heat concrete ingredients to a temperature higher than that necessary to keep the temperature of the mixed concrete, as placed, within the specified temperatures.

E. Do not heat water in excess of 140 degrees F.

F. Control of Admixtures:

1. Air-entraining admixtures and other required and/or approved admixtures shall be charged into the mixer as solutions and shall be measured by means of an acceptable mechanical dispensing device. The liquid shall be considered a part of the mixing water. Admixtures that cannot be added in solution may be weighed or may be measured by volume if so recommended by the manufacturer.

2. If two or more admixtures are used in the concrete, they shall be added separately to avoid possible interaction that might interfere with the efficiency of either admixture or adversely affect the concrete.

3. Addition of retarding admixtures shall be completed within 1 minute after addition of water to the cement has been completed, or prior to the beginning of the last three-quarters of the required mixing, whichever occurs first.

G. Tempering and Control of mixing water:

1. Concrete shall be mixed only in quantities for immediate use. Concrete, which has set, shall be discarded and shall not be retempered.

2. When concrete arrives at the project with slump below that suitable for placing, as indicated by the Specifications, water may be added only if either the maximum permissible water-cement ratio or the maximum slump is exceeded. The water shall be incorporated by additional mixing equal to at least half of the total mixing required. Discharge of the concrete shall be completed within 1½ hours, or before the truck drum has revolved 300 revolutions, whichever comes first, after the introduction of the mixing water to the cement and aggregates or the introduction of the cement to the aggregates. Truck batch slips must include time of batching, total drum revolutions upon arrival at site, and quantity of water (in gallons) per cubic yard available to be added to attain the maximum design water-cement ratio.

H. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C94. Mix concrete materials in appropriate drum-type batch machine mixer.

1. For mixer capacity of 1 cu. yd. or smaller, continue mixing at least 1½ minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.

2. For mixer capacity larger than 1 cu. yd., increase mixing time by 15 seconds for each additional 1 cu. yd.

3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixture time, quantity, and amount of water added. Record approximate location of final deposit in structure.

3.08 CONVEYING

Convey concrete from the mixer to the final deposit by methods that will prevent segregation or loss of materials.

A. Preparation Before Placing:

1. Hardened concrete and foreign materials shall be removed from the inner surfaces of the conveying equipment.

2. Formwork shall be completed; snow, ice and water shall be removed; reinforcement shall be secured in place; expansion joint material, anchors, waterstops and other embedded items shall be positioned; and the entire preparation shall be accepted.

3. Concrete shall not be placed on frozen ground.

B. Conveying:

1. Concrete shall be handled from the mixer to the place of final deposit as rapidly as practicable by methods which will prevent segregation or loss of ingredients and in a manner, which will assure that the required quality of the concrete is maintained.

2. Conveying equipment shall be of a size and design such that detectable setting of concrete shall not occur before adjacent concrete is placed. Conveying equipment shall be cleaned at the end of each operation or workday. Conveying equipment and operations shall conform to the following additional requirements:

a. Truck mixers, agitators and non-agitating units and their manner of operation shall conform to the applicable requirements of ASTM C94.

b. Belt conveyors shall be horizontal or at a slope which will not cause excessive segregation or loss of ingredients. Concrete shall be protected against undue drying or rise in temperature. An acceptable arrangement shall be used at the discharge end to prevent segregation. Mortar shall not be allowed to adhere to the return length of the belt. Long runs shall be discharged into a hopper or through a baffle.

c. Chutes shall be metal or metal-lined and shall have a slope not exceeding 1 vertical to 2 horizontal and not less than 1 vertical to 3 horizontal. Chutes more than 20 feet long and chutes not meeting the slope requirements may be used provided they discharge into a hopper before distribution.

d. Pumping or pneumatic conveying equipment shall be capable of pumping the specified mix with adequate pumping capacity. Pneumatic placement shall be controlled so that segregation is not apparent in the discharged concrete. The loss of slump in pumping or pneumatic conveying equipment shall not exceed 2 inches. Concrete shall not be conveyed through pipe made of aluminum or aluminum alloy.

3.09 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.

B. Remove water, debris, and foreign material from within forms.

C. Provide sufficient illumination in the interior of forms so concrete deposition is visible, permitting confirmation of consolidation quality.

D. Do not use aluminum conveying devices.

E. Do not add water to concrete during delivery, at Project site, or during placement unless approved by the Engineer.

F. Concrete Temperature: The concrete temperature at the time of placement shall be 65 deg F +/- 15 deg F.

G. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.

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

H. Deposit concrete as nearly as practical in its final position to avoid segregation due to rehandling or flowing. Do not use vibrators to move concrete horizontally with the forms.

I. Do not use tempered concrete or concrete contaminated by foreign material.

J. Plan and conduct concrete placement to ensure that the concrete is kept plastic and that the concrete is free of cold joints.

K. Where there is a time delay greater than 45 minutes between adjacent concrete placement, a bulkhead construction joint, complete with waterstops where required, must be installed.

L. Remove temporary spreaders in forms when concrete has reached an elevation rendering their service unnecessary.

M. Do not commence placing when the sun, heat, wind or limitations of facilities provided prevent proper finishing or curing.

N. Concrete shall be deposited continuously, or in layers of such thickness that no concrete will be deposited on concrete which has hardened sufficiently to cause the formation of seams or planes of weakness within the section. If a section cannot be placed continuously, construction joints shall be located as indicated on the Contract Drawings. Placing shall be carried on at such a rate that the concrete

which is being integrated with fresh concrete is still plastic. Concrete which has partially hardened or has been contaminated by foreign materials shall not be deposited. Temporary spreaders in forms shall be removed when the concrete placing has reached an elevation rendering their service unnecessary. They may remain embedded in the concrete only if made of metal or concrete and if prior acceptance has been obtained.

1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.

2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 309R.

3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

O. Placing - Placing of concrete in supported elements shall not be started until the concrete previously placed in columns and walls is no longer plastic and has been in place at least two hours.

P. Segregation - Concrete shall be deposited as nearly as practicable in its final position to avoid segregation due to re-handling or flowing. Concrete shall not be subjected to any procedure, which will cause segregation.

Q. Where placing operations would involve dropping the concrete more than 5 feet, it shall be deposited through a tube made of sheet metal, canvas or other approved materials. Aluminum hoppers or tubes shall not be used. Lower ends shall be kept as close as possible to the newly placed concrete and not more than 3 feet above the concrete. All tubes shall have a minimum diameter of 6 inches unless otherwise directed by the Engineer. Concrete shall be placed to avoid segregation of the material and the displacement of the reinforcement. The use of troughs, chutes and pipes for conveying concrete more than fifteen feet (15') from the mixer to the forms will be permitted only when acceptable by the Engineer. Open troughs and chutes shall be metal, or metal lined. Where segregation occurs due to steep slopes, chutes shall be equipped with baffles.

R. Where vertical placements have horizontal construction joints, succeeding lifts shall not be placed until the lower placement has set for twelve (12) hours. Prior to subsequent placement, all accumulations of mortar splashed upon the reinforcement shall be cleaned. Care shall be exercised not to injure or break the concrete seal bond near and at the surface of the concrete while cleaning the reinforcement.

S. When the ambient air temperature in below forty degrees (40º) F, the temperature of the air in contact with the reinforcement shall be raised to forty degrees (40º) F prior to placing the concrete. When the ambient air temperature is above seventy degrees (70º) F and the reinforcement is exposed to the direct rays of the sun, the reinforcement shall be cooled to seventy degrees (70º) F or less by means of a water spray prior to placing concrete. When the ambient air temperature is above seventy degrees (70º) F and the steel forms that remain in place are exposed to the direct rays of the sun, the forms shall be cooled by means of water spray prior to placing concrete.

T. When abnormal wind or storms are forecast locally by the National Weather Service, concrete other than foundation concrete shall not be placed during the period covered by the forecast.

U. Cast-In-Place concrete shall be homogeneous throughout the structural element. The methods used to place shall prevent segregation.

3.10 CONSOLIDATION

A. All concrete shall be consolidated by vibration, spading, rodding or forking so that the concrete is thoroughly worked around the reinforcement, around embedded items, and into corners of forms, eliminating all air or stone pockets which may cause honeycombing, pitting, or planes of weakness. Internal vibrators used shall be the largest size and most powerful that can be properly used in the work. Competent workmen shall operate the vibrators. Use of vibrators to transport concrete within forms shall not be allowed. Vibrators shall be inserted and withdrawn at points approximately 18 inches apart. At each insertion, the duration shall be sufficient to consolidate the concrete but not sufficient to cause segregation, generally from 5 to 15 seconds. A spare vibrator shall be kept on the job site during all concrete placing operations. Where the concrete is to have an as-cast finish, a full surface of mortar shall be brought against the form by the vibration process, supplemented if necessary by spading to work the coarse aggregate back from the formed surface.

B. Consolidate concrete thoroughly as it is placed in order to secure a dense mass. Work concrete well around the reinforcement and embedded items and into the corners of the forms.

C. Use internal vibrators inserted vertically over the entire area of the placement.

D. Vibrate until voids are eliminated, coarse aggregate is suspended in mortar, and entrapped air bubbles begin to rise to the surface. Concrete should move back into the space vacated by the vibrator.

E. Space vibrator insertions such that the area visibly affected by the vibrator overlaps the adjacent just-vibrated area by a few inches.

F. Penetrate at least 6" into previously placed layers in order to bond between layers and avoid cold joints.

G. Form vibrators may not be used.

H. Take care not to over-vibrate air entrained concrete. Place vibrator to eliminate honeycombing but avoid excess vibrating that bleeds all entrapped air from the mix.

I. Do not use vibrators to transport concrete.

J. Care shall be used in placing concrete around waterstops. The concrete shall be carefully worked by rodding and vibrating to make sure that all air and rock pockets have been eliminated. Where flat-strip type waterstops are placed horizontally, the concrete shall be worked under the waterstops by hand, making sure that all air and rock pockets have been eliminated. Concrete surrounding the waterstops shall be given additional vibration, over and above that used for adjacent concrete placement to assure complete embedment of the waterstops in the concrete.

3.11 JOINTS

A. Construct expansion, contraction, construction, control, and isolation joints where indicated on the drawings and at additional locations approved by the Engineer as shown in the Contract Documents.

B. Where the placing of concrete is discontinued, clean off laitance and other objectionable material to a sufficient depth to expose sound concrete as soon as concrete is firm enough to retain its form. Smooth the top surface of concrete adjacent to the forms with a trowel to minimize visible joints on exposed faces.

C. Immediately after the work of placing concrete is halted, remove accumulations splashed upon the reinforcement and the surfaces of the forms. Perform this removal before concrete takes its initial set. Clean reinforcing steel carefully to prevent damage to the concrete steel bond.

D. Do not halt work within 18" of the top of any face.

E. For bonded horizontal joint construction, roughen the surface and expose the aggregate. Clean the surface thoroughly by wet sandblasting, by cutting with high-pressure water jet or by other approved methods. Perform cleaning after the concrete has hardened to prevent raveling of the surface below the desired depth.

F. Roughened construction joints in new concrete:

1. Roughen and clean surface to minimum of ¼-inch amplitude using one of the following:

a. Sandblast/mechanically roughen after concrete has fully cured.

b. Water blast after concrete has partially cured.

c. Green cut fresh concrete with high-pressure water and hand tools.

d. Perform roughening so as not to damage waterstop, if one is present.

G. Roughened construction joints in existing concrete:

1. Thoroughly clean and mechanically roughen existing concrete surfaces to roughen profile of ¼-inch.

H. Before bonding concrete is placed, clean the surface of loose or soft particles or other objectionable materials and keep wet for a minimum period of 12 hours.

I. Cover the cleaned and saturated surface with a coating of neat cement grout and deposit new concrete before the grout has attained its initial set.

J. The hardened concrete of construction joints and of joints between footings and walls or columns, between walls or columns and beams or floors they support, joints in unexposed walls and all others not mentioned below shall be dampened (but not saturated) immediately prior to placing of fresh concrete.

K. The hardened concrete of horizontal construction joints in exposed work; horizontal construction joints in the middle of beams, girders, joists, and slabs; and horizontal construction joints in work designed to contain liquids shall be dampened (but not saturated) and then thoroughly covered with a coat of cement grout of similar proportions to the mortar in the concrete. The fresh concrete shall be placed before the grout has attained its initial set.

L. Joint Finishing:

1. Edge or lightly stone the edges of expansion and contraction joints after the forms are stripped and before the adjacent slab is placed.
2. Leave joints in the completed work carefully tooled and free of mortar and concrete.

3. Leave joint filler exposed for its full length with clean and true edges.

4. Apply sealant at joints where indicated.

3.12 CONCRETE PROTECTION

A. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperature and mechanical injury. Maintain with minimum moisture loss and relatively constant temperature for the period necessary for hydration of the cement and hardening of the concrete.

B. After the concrete has hardened, loosen forms as soon as possible without damage to the concrete, and run curing water continuously down inside the form.

C. Unless adequate protection is provided, concrete shall not be placed during rain, sleet or snow.

D. Rainwater shall not be allowed to increase the mixing water or damage the surface finish.

E. The temperature of the concrete as placed shall not be so high as to cause difficulty from loss of slump, flash set, or cold joints and should not exceed 90 degrees F. When the temperature of the steel is greater than 120 degrees F, steel forms and reinforcement shall be sprayed with water just prior to placing the concrete.

F. Protection from Mechanical Injury - During the curing period, the concrete shall be protected from damaging mechanical disturbances, such as load stresses, heavy shock, and excessive vibration. All finished concrete surfaces shall be protected from damage by construction equipment, materials or methods, by application of curing procedures, and by rain or running water. Self-supporting structures shall not be loaded in such a way as to overstress the concrete.

G. Loads shall not be applied to the concrete structure until the Contractor has completed curing, removing forms and placed concrete has reached the 28-day compressive strength, f'c.

3.13 REMOVAL OF FORMS

A. Form removal shall be in accordance with the requirements of ACI 301 and ACI 350.5.

B. Forms for sides of beams, walls, columns, and other vertical faces which do not sustain loads may be removed after cumulatively curing at not less than 50 degrees F for 24 hours after the last portion of concrete in the section has been placed, if the concrete is hard enough to not be damaged by form-removal operations and curing and protection operations are maintained.

1. Leave formwork for beam soffits, joists, slabs and other structural elements that supports weight of concrete in place until concrete has achieved its 28-day design compressive strength.

2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.

3. Schedule form removal to maintain surface appearances that matches approved work.

4. Cut off and grind glass-fiber-reinforced plastic form ties flush with surface of concrete.

C. In cold weather, all forms must remain in place for 5 days.

D. Notify the Engineer before forms are removed in order that an examination of the newly-stripped surfaces may be made prior to patching.

E. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.

F. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Engineer.

G. An accurate record shall be maintained by the Contractor of the dates of concrete placements and the exact location thereof and the dates and times of removal of forms, including any form loosening. These records shall be available for inspection at all times at the site, and two copies shall be furnished to the Engineer upon completion of the concrete work.

3.14 REPAIR OF SURFACE DEFECTS

A. Repair immediately after form removal.

B. Defective Concrete: Repair and patch defective areas when approved by Engineer. Remove and replace concrete that cannot be repaired and patched to Engineer's approval.

C. Patching Mortar: Mix dry-pack patching mortar, consisting of one part Portland cement to two and one-half parts fine aggregates passing a No. 16 Sieve, using only enough water for handling and placing.

D. Repair of Defective Areas: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.

1. All honeycombed and other defective concrete shall be removed down to sound concrete. If chipping is necessary, the edges shall be perpendicular to the surface or slightly undercut. No featheredges will be permitted. The area to be patched and an area at least 6 inches wide surrounding it shall be dampened to prevent absorption of water from the patching mortar. A bonding grout shall be prepared using a mix of approximately 1 part cement to 1 part fine sand passing a No. 30 mesh sieve, mixed to the consistency of thick cream, and then well brushed into the surface.

2. The patching mixture shall be made of the same materials and of approximately the same proportions as used for the concrete, except that the course aggregate shall be omitted, and the mortar shall consist of not more than 1 part cement to 2½ parts sand by damp loose volume. White Portland cement shall be substituted for a part of the gray Portland cement on exposed concrete in order to produce a color matching the color of the surrounding concrete, as determined by a trial patch. The quantity of mixing water shall be no more than necessary for handling and placing. The patching mortar shall be mixed in advance and allowed to stand with frequent manipulation with a trowel, without addition of water, until it has reached the stiffest consistency that will permit placing.

3. After surface water has evaporated from the area to be patched, the bond coat shall be well brushed into the surface. When the bond coat begins to lose the water sheen, the pre-mixed patching mortar shall be applied. The mortar shall be thoroughly consolidated into place and struck off so as to leave the patch slightly higher than the surrounding surface. To permit initial shrinkage, it shall be left undisturbed for at least 1 hour before being finally finished. The patched area shall be kept damp for 7 days. Metal tools shall not be used in finishing a patch in a formed wall, which will be exposed.

E. Tie Holes - After being cleaned and thoroughly dampened, the tie holes shall be filled solid with patching mortar.

F. Proprietary Materials - if approved by the Engineer, proprietary compounds for adhesion or as patching ingredients may be used in lieu of or in addition to the foregoing patching procedures. Such compounds shall be used in accordance with the manufacturer's recommendations.

G. Perform patching before curing compound is applied.

H. Cure patched areas in the same way as adjacent concrete.

I. Make repairs uniform in color and finish with surrounding concrete.

J. Crack Repair: Where cracks in existing or new concrete are deemed by Engineer as requiring repair, repair the cracks using epoxy injection or polyurethane grout injection.

K. Perform structural repairs of concrete, subject to Engineer’s approval, using epoxy adhesive and patching mortar.

L. Repair materials and installation not specified above may be used, subject to Engineer’s approval.

3.15 CURING

A. Keep concrete moist for at least 7 curing days after placement.

B. A curing day is defined as 24-hour day when the concrete surfaces are kept moist and the uniform temperature of the concrete mass is between 55 degrees F and 75 degrees F.

C. Curing may be achieved by water curing or application of a liquid membrane-forming curing compound. Curing compounds may not be used on surfaces that are to receive additional concrete, paint, sealers, hardeners, tile, or other special coatings.

D. Water curing is the preferred method of protection. Cover exposed surfaces with a saturated material (burlap or cotton mats) and keep wet continuously with a soil soaker hose for 7 days. Leave covering in place, without wetting, for an additional 3 days.

E. The use of curing compound (ASTM C309) is permissible. Keep surfaces moist after the forms are removed and the form tie holes repaired. After the surfaces are finished, apply the curing compound according to the manufacturer's recommendations. Do not remove too much forming at one time.

F. Slabs: Immediately following slab finishing, apply liquid membrane-forming curing compound or begin water curing before the surface becomes dry.

G. Vertical Surfaces: When the forms are removed entirely, spray the surface with water and allow to reach a uniform damp appearance with no free water on the surface. Apply curing compound or begin water curing.

H. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.

I. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

J. Unless adequate protection is provided, concrete shall not be placed during rain, sleet or snow.

K. Rainwater shall not be allowed to increase the mixing water or damage the surface finish.

L. Formed surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.

M. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.

N. Curing shall start as soon as the concrete has set sufficiently. Cure concrete according to ACI 308.1, or one or a combination of the following methods:

1. All footings shall be cured for five days using the method specified in the following paragraph 3.17.O.1 thru 3.17.O.5.

2. Vertical surfaces shall be cured in the forms for seven (7) days. However, the forms may be removed after twenty-four (24) hours for structural elements six feet (6') or less in height, or after forty-eight (48) hours for structural elements greater than six feet (6') high, with the following provisions. The surface shall be cured as specified in the following paragraph 3.17.O.4 for the remainder of the seven (7) day curing period. The forms shall not be removed when cold weather protection is required. Forms, falsework, centering, etc., carrying loads shall remain in place for a minimum of seven (7) days and until the concrete has attained a compressive strength of three thousand five hundred (3500) psi. Internal bulkheads used for forming construction joints, etc. may be removed after the concrete has been in place for twenty-four (24) hours if it is necessary to do so to continue the Work without interruption. When a higher strength concrete than specified is used, forms, falsework, centering, etc., carrying loads shall remain in place for three and a half (3½) days and until the concrete has attained a compressive strength of three thousand five hundred (3500) psi.

3. Fiber column forms may be removed at times specified above, but no later than ten (10) days after placing concrete.

4. Tops of end walls, end support walls, etc., shall be cured for three (3) days with burlap or cotton mats as specified in the following paragraphs 3.17.O.2 or 3.17.O.4, respectively.

5. Horizontal surfaces shall be cured for seven (7) days as specified in 3.17.O.2 or 3.17.O.5.

O. Curing Methods

1. Flooding. Units of structures that will be below water in the completed structure, i.e., bottom slabs of culverts, footings, struts, etc., may be gradually flooded when approved by the Engineer after the concrete is

twelve (12) hours old, provided the curing water conforms to the aforementioned. The temperature of this water shall be maintained at thirty-five degrees (35º) F or above for the specified curing time.

2. Burlap. Two (2) layers of burlap shall be used. Successive strips of burlap shall be overlapped a minimum of six inches (6”). The second burlap layer shall be placed not less than forty-five degrees (45º) to the first layer, or in lieu of this, the six inches (6”) overlap of the second layer may be placed midway between the first layer. This material shall be thoroughly saturated by immersion in curing water for at least twenty-four (24) hours prior to placement and shall be kept saturated throughout the time specified for curing.

3. White Opaque Polyethylene Backed Nonwoven Fabric. One (1) layer of white opaque polyethylene backed fabric shall be used. Successive strips shall be overlapped a minimum of six inches (6”). This material shall be thoroughly saturated by immersion in curing water for at least twenty-four (24) hours prior to placement and shall be kept saturated throughout the time specified for curing.

4. Cotton Mats. One (1) layer of cotton mat material shall be used and shall be kept thoroughly saturated with curing water prior to placement and throughout the time specified for curing. The material shall be kept in tight contact with the concrete.

5. White Opaque Burlap Polyethylene or White Opaque Polyethylene Film. The white opaque burlap polyethylene sheeting shall be placed on no less than one (1) layer of wet burlap with the burlap side of the sheeting facing down. White opaque polyethylene film, if used, shall be placed on no less than two (2) layers of wet burlap. Only one (1) layer of cotton mats is required in any usage. These materials may only be used atop the wet burlap or cotton mats on unobstructed flat and reasonably level surfaces.

    a. Adjacent mats or sheets shall be lapped no less than one foot (1’). The ends shall be brought down around the sides of the concrete being cured and securely fastened to make an airtight seal.
    b. The white opaque burlap polyethylene sheeting or the white opaque polyethylene film shall remain in place for the same length of time as required for burlap or cotton mats. These protective coverings need not be wetted down; however, the covered burlap or cotton mats shall be kept wet for the time interval specified.

6. Liquid Membrane. Liquid membrane forming compounds shall be applied in conformance with manufacturer’s recommendations or as directed by the Engineer. The material shall be applied by sprayers and shall be thoroughly agitated before and during use.

3.16 FINISHING FORMED SURFACES

A. Concrete faces shall be finished with one of the following types. All concrete Work shall have a Smooth-Formed Finish as described below unless otherwise specified.

1. Rough-Formed Finish (RFF): As-cast concrete texture imparted by form - facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

2. Apply to concrete surfaces not exposed to public view.

B. Smooth-Formed Finish (SFF): As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

1. Apply to concrete surfaces exposed to public view, to receive a rubbed finish, or to be covered with a coating or covering material applied directly to concrete.

C. Rubbed Finish: Apply the following to smooth-formed finished as-cast concrete where indicated:

1. Smooth-Rubbed Finish (SRF): Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.

2. Grout-Cleaned Finish (GCF): Wet concrete surfaces and apply grout of a consistency of thick paint to coat surfaces and fill small holes. Mix one part Portland cement to one and one-half parts fine sand with a 1:1 mixture of bonding admixture and water. Add white Portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Scrub grout into voids and remove excess grout. When grout whitens, rub surface with clean burlap and keep surface damp by fog spray for at least 36 hours.

3. Cork-Floated Finish (CFF): Wet concrete surfaces and apply a stiff grout. Mix one part Portland cement and one part fine sand with a 1:1 mixture of bonding agent and water. Add white Portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Compress grout into voids by grinding surface. In a swirling motion, finish surface with a cork float.

D. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

3.17 CONCRETE SLAB FINISHING

A. Complete screeding and darbying slabs before excess moisture or bleeding water is present on the surface.

B. Do not begin subsequent finishing operations until surface water has disappeared and the concrete will sustain foot pressure with only approximately ¼" indentation.

C. Scratch Finish (SF): While still plastic, texture concrete surface that has been screeded and bull-floated or darbies. Use stiff brushes, brooms, or rakes to produce a profile amplitude of ¼-inch in one direction.

D. Float Finish (FF):

1. Use for base slabs of wetwells, tanks and other structures that contain liquid.

2. Consolidate concrete with a power-drive disc-type float or a combination floating-troweling machine with metal float shoes attached.

3. Machines which have a water attachment for wetting the concrete during the finishing operation are prohibited.

4. Check and level surface plane to a tolerance not exceeding ¼" in 10 feet when tested with a 10-foot straightedge. Cut down high spots and fill low spots. Immediately after re-leveling, refloat surface to a uniform, smooth, granular texture.

5. Where slab drainage is indicated, take care to maintain accurate slopes for drainage.

E. Steel Troweling: After float finishing, steel trowel surface as specified to increase compaction of fines and to provide maximum density and wear resistance. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance.

1. Apply a trowel finish to surfaces indicated, exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.

2. Finish and measure surface so gap at any point between concrete surface and an unleveled, freestanding, 10-ft long straightedge resting on two high spots and placed anywhere on the surface does not exceed ¼-inch.

F. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces indicated or where ceramic or quarry tile is to be installed by either thickset or thin-set method. While concrete is still plastic, slightly scarify surface with a fine broom.

1. Comply with flatness and levelness tolerances for trowel finished floor surfaces.

G. Non-slip Broom Finish: In addition to floating and troweling, provide walks, ramps, steps, and exposed floor areas subject to foot traffic and likely to be wet with a final non-slip broom finish. Draw broom over previously finished finish.

H. Dry-Shake Floor Hardener Finish: After initial floating, apply dry-shake floor hardener to surfaces according to manufacturer's written instruction and as follows:

1. Uniformly apply dry-shake floor hardener at a rate of 100 lb/100 sq. ft. unless greater amount is recommended by manufacture.

2. Uniformly distribute approximately two-thirds of dry-shake floor hardener over surface by hand or with mechanical spreader and embed by power floating. Follow power floating with a second dry-shake floor hardener application, uniformly distributing remainder of material, and embed by power floating.

3. After final floating, apply a trowel finish. Cure concrete with curing compound recommended by dry-shake floor hardener manufacturer and apply immediately after final finishing.

I. Abrasive Aggregate Non-Slip Finish:

1. Screed and float concrete to the required finish level with no coarse aggregate visible.

2. Uniformly sprinkle abrasive aggregate over the floated surface at a rate of not less than ¼ pound per square foot.

3. Steel trowel surface to a smooth even finish.

4. Immediately after curing, remove cement coating covering the abrasive aggregate by steel brushing, rubbing with an abrasive stone or sandblasting to expose abrasive particles.

Concrete Finish Schedule	
Interior slabs	Dry-Shake Floor Hardener
Interior elevated walkway slabs	Broom Finish
Interior and exterior walls not receiving formliner finish and exposed to public view (1)	Smooth-Rubbed Finish
Exterior walkways/slabs, ramps, stairs, slabs on grade and slabs exposed to weather.	Broom Finish
Beams and columns	Smooth-Formed Finish
Concrete surfaces not exposed to public view	Rough-Formed Finish
Concrete not listed above and exposed to public view (1)	Smooth-Formed Finish
Base slabs of wet tanks/structures	Float Finish

(1) All concrete surfaces that are visible to any person walking through the treatment plant, pumping station, vault, facility buildings, galleries, rooms, platforms, etc. is “exposed to public view”.

3.18 HOT WEATHER REQUIREMENTS

A. Conform to ACI 305R and ACI 305.1 when concreting during hot weather.

B. Hot weather conditions are deemed to exist when the temperature in the forms is 75 degrees F or above, or a combination of high air temperature, low relative humidity and wind velocity impairs the quality of fresh or hardened concrete. Take protective measures for mixing, transporting and placing concrete in accordance with ACI 305.1.

C. The temperature of the concrete at the place of discharge may not exceed 85 degrees F.

1. If ice is used to lower temperature, place crushed, shaved or chipped ice directly into the mixer as part or all of the mixing water. Mix until ice is completely melted.

2. Record the concrete temperature at the time of discharge.

D. Do not add water that will cause the proportions to exceed the maximum water-cement ratio.

1. Notify the resident project representative before adding any water to the concrete mix.

2. Record the amount of water added to the concrete at the jobsite.

E. Discharge concrete within 45 minutes or 100 revolutions, whichever occurs first, after the first mixing of cement and aggregates.

F. Placing and Curing:

1. Place concrete promptly upon arrival.

2. Provide at least one standby vibrator for each 3 vibrators in use.

a. Protect concrete from direct sunlight. Keep forms covered and moist by means of water sprinkling or the application of continuously wetted burlap or cotton mats for a minimum of 24 hours.

3. When forms are removed, provide wet cover to the newly exposed surfaces to avoid exposure to hot sun and wind.

4. Continue specified water curing methods for 10 days. Leave covering in place 4 additional days. Do not permit alternate wetting and drying cycles.

5. For slabs on grade, beam and deck concrete, and other horizontal placements, protect the surface between finishing operations using one or more of the following methods:

a. Careful use of a fog nozzle.

b. Spreading and removing polyethylene sheeting between finishing operations.

c. Application of monomolecular film after the strike off.

3.19 COLD WEATHER REQUIREMENTS

A. Conform to ACI 306R and ACI 306.1 when concreting during cold weather.

B. Cold weather is defined any time when the daily temperature is 40 degrees F or lower during placement and the protection period.

C. Protect concrete surfaces from freezing for at least 24 hours after placement.

D. All surfaces in contact with newly-placed concrete including formwork, reinforcement and subgrade must be above 35 degrees F.

E. Place concrete at a temperature of not less than 55 degrees F. Mix concrete at a temperature between:

1. 60 degrees F and 70 degrees F when outside air temperature is above 30 degrees F.

2. 65 degrees F and 75 degrees F when outside air temperature is between 0 degrees F and 30 degrees F.

3. 70 degrees F and 80 degrees F when outside air temperature is below 0 degrees F.

F. Follow concrete placement with tarpaulins or other readily movable coverings, so only a few feet of concrete are exposed to the outside air at any time.

G. Maintain the temperature and moisture conditions specified in all parts of the newly-placed concrete by covering, insulating, housing or heating. Arrange for protection methods in advance of placement.

H. Maintain concrete at a temperature of not less than 50 degrees F or more than 70 degrees F for a period of 3 days after placement. Maintain concrete at a temperature of not less than 50 deg F nor more than 70 deg F for a period of 7 days after placement. At the end of the heating period, the concrete surfaces shall be cooled to the temperature of the outside air by slowly reducing the artificial heat at a uniform rate until the temperature of the outside air is reached within a twenty-four (24) hour period.

I. Do not remove forms during the initial protection period.

J. Protect insulation against wetting that will impair its insulating value using moisture-proof cover material. Keep insulation in close contact with concrete.

K. Construct enclosure to withstand wind and snow loads and be reasonably air-tight. Provide sufficient space between the concrete and enclosure to permit free circulation of heated air.

L. Use vented heaters. Do not permit heaters to heat or dry concrete locally.

M. Maintain relative humidity above 40% within heated enclosures before construction supports are removed.

N. Monitor temperature to ensure concrete is kept within specified limits recording time and concrete temperature every 8 hours.

O. Assure concrete has developed necessary strength before removing forms. Provide additional test cylinders with the same protection as the structure they represent to verify concrete strength before construction supports are removed.

P. If water curing is used, terminate at least 12 hours before end of temperature protection period. Permit concrete to dry.

Q. After the required protection period, gradually reduce the concrete temperature within an enclosure or insulation at a rate not to exceed 20o per day until the outside temperature has been reached.

R. Apply membrane-forming curing compound to concrete surfaces during the first period of above-freezing temperatures after forms are stripped and before air temperature rises to 50 degrees. Apply membrane-forming curing compound to slabs as soon as finishing operations are completed, except where live steam curing is used.

S. The Contractor shall have tarpaulins, insulating devices, and other suitable materials at the site to enclose or protect all portions of the concrete requiring protection. Materials shall be installed as close as possible to keep exposure to cold weather to a minimum. Where heating is required, the spaces to be heated shall be completely enclosed and the temperature kept at required levels by the use of heaters approved by the Engineer.

T. The Contractor shall provide a sufficient number of maximum/minimum recording thermometers to record temperature in each concrete placement undergoing cold weather protection.

U. The curing period for all structure concrete requiring cold weather protection shall conform to the cold weather protection period except when the normal curing period is longer.

3.20 CURBING AND SIDEWALKS

A. Shall be installed using materials and practices set forth in these specifications.

B. Shall be as detailed on the contract documents.

3.21 TESTING AND FIELD QUALITY CONTROL

A. General - Concrete materials and operations will be tested and inspected as the work progresses. Failure to detect any defective work or material shall not in any way prevent later rejection when either such defect is discovered, nor shall it obligate the Owner for final acceptance.

B. Testing Services - The following testing services shall be performed by the designated testing agency:

1. Perform compressive strength, slump and air content tests of the concrete during construction in accordance with the following procedures:

a. Secure composite samples in accordance with ASTM C172. Each sample shall be obtained from a different batch of concrete on a random basis, avoiding any selection of the test batch other than by a number selected at random before commencement of concrete placement.

b. Mold and cure one set of ten-cylinder specimens from each sample in accordance with ASTM C31. Any deviations from the requirements of this standard shall be recorded in the test report. Specimens shall be 6-inch diameter by 12-inch high cylinders.

c. Of each set of ten cylinders, laboratory cure five cylinders and field cure five cylinders. Test field and laboratory cylinder specimens in accordance with ASTM C39. Test 2 of each cylinder at 7 days; test 2 of each cylinder at 28 days. Hold the remaining cylinder for testing in the event that any of the other cylinders are damaged prior to testing. The acceptance test results shall be the average of the strengths of the two cylinders tested at 28 days. If one cylinder in a test manifests evidence of improper sampling, molding or testing, it shall be discarded, and the strength of the remaining cylinder shall be considered the test result. Should both cylinders in a test show any of the above defects, the entire test shall be discarded.

d. Make at least one strength test for each 50-cu. yd., or fraction thereof, of each mixture design of concrete placed in any 1 day. When the total quantity of concrete with a given mix design is less than 20 cu. yd., the strength tests may be waived by the Engineer if, in the Engineer's judgment, adequate evidence of satisfactory strength is provided, such as strength test results for the same kind of concrete supplied on the same day and under comparable conditions to other work or other projects.

2. Determine slump of the concrete at point of placement for each composite sample for each strength test and whenever consistency of concrete appears to vary, using ASTM C143.

3. Determine air content of the concrete sample for each strength test in accordance with ASTM C231, ASTM C173, or ASTM C138. One test for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform a minimum of one test per 50 CY of concrete placed.

4. Determine temperature of the concrete sample for each strength test. ASTM C1064: one test hourly when air temp is 40 deg F and below and when 80 deg F and above.

5. High Range Water Reducer (Superplasticizer) Admixture Segregation Test: Test each truck prior to use on job.

a. Segregation Test Objective: Concrete with 4-inch to 8-inch slump must stay together when slumped. Segregation is assumed to cause mortar to flow out of mix even though aggregate may stay piled enough to meet slump test.

b. Test Procedure: Make slump test and check for excessive slump and observe to see if mortar or moisture flows from slumped concrete.

c. Reject concrete if mortar or moisture separates and flows out of mix.

C. Additional Services When Required - The following services shall be performed by the testing agency when required by the Owner at the Contractor's expense:

1. Inspect concrete batching, mixing and delivery operations to the extent deemed necessary by the Owner.

2. Sample concrete at point of placement and perform required tests.

3. Review the manufacturer's report for each shipment of cement and reinforcing steel and conduct laboratory tests or spot checks of the materials as received for compliance with specifications.

D. Other Services as Needed - The following services shall be performed by the testing agency at the Contractor's expense:

1. Additional testing and inspection required because of changes in materials or proportions requested by the Contractor.

2. Additional testing of materials or concrete occasioned by their failure by test or inspection to meet specification requirements.

E. Duties and Authorities of Designated Testing Agency:

1. Representatives of the agency shall inspect, sample and test the materials and the production of concrete as required by the Owner. When it appears that any material furnished, or work performed by the Contractor fails to fulfill specification requirements, the testing agency shall report such deficiency to the Owner and the Contractor.

2. The agency shall report all test and inspection results to the Owner, Engineer and Contractor immediately after they are performed. All test reports shall include the exact location in the work at which the batch represented by a test was deposited. Reports of strength tests shall include detailed information on storage and curing of specimens prior to testing.

3. The testing agency and its representatives are not authorized to revoke, alter, relax, enlarge or release any requirement of the Contract Documents, nor to approve or accept any portion of the work.

F. Responsibilities and Duties of Contractor:

1. The Contractor shall provide the necessary testing services for the following:

a. Qualification of proposed materials and the establishment of mixture designs.

b. Other testing services needed or required by the Contractor.

2. The use of testing services shall in no way relieve the Contractor of the responsibility to furnish materials and construction in full compliance with the Contract Documents.

3. The Contractor shall submit to the Engineer the concrete materials and the concrete mix designs proposed for use with a written request for acceptance. This submittal shall include the results of all testing performed to qualify the materials and to establish the mix designs. No concrete shall be placed in the work until the Contractor has received such acceptance in writing.

4. To facilitate testing and inspection, the Contractor shall:

a. Furnish any necessary labor to assist the testing agency in obtaining and handling samples at the project or other sources of materials.

b. Advise the testing agency sufficiently in advance of operations to allow for completion of quality tests and for the assignment of personnel.

c. Provide and maintain for the sole use of the testing agency adequate facilities for safe storage and proper curing of concrete test specimens on the project site for the first 24 hours as required by ASTM C31.

3.22 WATERTIGHTNESS OF STRUCTURES

A. The provisions of this section are applicable to cast-in-place reinforced concrete water bearing and dry structures. Refer to Section 03410 for precast structural concrete specifications.

B. The Contractor shall provide all labor, materials, tools, equipment and devices for testing the water-tightness of new structures, constructed under this Contract. Testing shall be performed prior to the acceptance or placing the structure in operation, but in the case of concrete structures, after the concrete is at least seven days old and has achieved the 28-day minimum design strength. All structures, both water holding and dry, are meant to be watertight and free from discernible infiltration and exfiltration.

C. Structures Designed to Contain Liquid:

1. Structures designed to contain liquid shall be thoroughly cleaned prior to the introduction of water for test purposes. Before testing a structure, all pipelines connecting to the structure shall have been tested and approved for leakage. All structures shall be tested for leakage and shall be tested in accordance with ACI 350.1. Testing shall be conducted prior to back filling soil around structures, unless otherwise noted.

2. If any structure fails to meet the above requirements for water tightness, then the Contractor shall drain the structure, locate and repair all leaks and retest the structure as many times as is necessary to obtain a watertight structure as defined herein, all to the satisfaction of the Engineer and at no extra cost to the Owner.

D. Structures designed to be dry shall have the interior thoroughly cleaned below finished grade and pumped dry if necessary. Openings below grade shall be bulkheaded and made tight. After a period of 5 days, interior surfaces will be inspected for accumulation of moisture and any excess accumulation indicative of defects in the structure in the judgment of the Engineer shall be repaired by the Contractor at no cost to the Owner and to the satisfaction of the Engineer.

E. All leaks and defects in structures shall be repaired or remedied without additional compensation at whatever time during the course of the Contract they become apparent.

F. Potable water shall be used for filling structures for leakage tests.

G. No separate payment will be made for testing structures neither for water tightness nor for the cost of the water used. The cost thereof shall be considered as included in the lump sum and unit prices bid for this Contract.

3.23 EVALUATION AND ACCEPTANCE OF CONCRETE

A. Evaluation of Test Results:

1. Test results for standard molded and standard cured test cylinders shall be evaluated separately for each specified concrete mixture design. Such evaluation shall be valid only if tests have been conducted in accordance with procedures specified.

2. For evaluation, each specified mixture design shall be represented by at least five tests.

B. Acceptance of Concrete:

1. Strength - Concrete shall meet the minimum requirements of ACI 301 and ACI 350.5. The strength level of the concrete will be considered satisfactory so long as the averages of all sets of three consecutive strength test results equal or exceed the specified strength f'c, and no individual strength test result falls below the specified strength f'c by more than 500 psi.

2. Durability - The durability level of the concrete will be considered satisfactory so long as the requirements of ACI 301 and ACI 350.5 are met.

3. Dimensional Tolerances - The concrete will be considered satisfactory so long as the requirements of ACI 301 and ACI 350.5 are met.

4. Finishes and Appearance - The concrete will be considered satisfactory so long as the requirements of ACI 301 and ACI 350.5 are met.

C. Testing of Concrete in Place:

1. Testing by impact hammer, sonoscope, or other nondestructive device may be permitted by the Owner to determine relative strengths at various locations in the structure as an aid in evaluating concrete strength in place or for selecting areas to be cored. Such tests, unless properly calibrated and correlated with other test data, shall not be used as a basis for acceptance or rejection.

2. Core tests:

a. Where required, cores at least 2-inch in diameter shall be obtained and tested in accordance with ASTM C42. If the concrete in the structure will be dry under service conditions, the cores shall be air dried (temperature 60 degrees F to 80 degrees F, relative humidity less than 60 percent) for 7 days before testing and shall be tested dry. If the concrete in the structure will be more than superficially wet under service conditions, the cores shall be tested after moisture conditioning in accordance with ASTM C42.

b. At least three representative cores shall be taken from each member or area of concrete in place that is considered potentially deficient. The location of cores shall be determined by the Engineer to least impair the strength of the structure. If, before testing, one or more of the cores shows evidence of having been damaged

subsequent to or during removal from the structure, it shall be replaced with a new core.

c. The strength level of concrete in the area represented by a core test will be considered adequate if the average strength of the cores is equal to at least 85 percent of specified strength f'c and if no single core is less than 75 percent of the specified strength f'c.

d. Core holes shall be filled with low slump concrete or mortar. See Section 3.14, Repair of Surface Defects.

3.24 ACCEPTANCE OF STRUCTURE

A. General:

1. Completed concrete work shall meet all requirements of ACI 301, unless otherwise specified.

2. Completed concrete work which meets all applicable requirements will be accepted without qualification.

3. Completed concrete work, which fails to meet one or more requirements, but which has been repaired to bring it into compliance will be accepted without qualification.

4. Completed concrete work which fails to meet one or more requirements, and which cannot be brought into compliance may be accepted or rejected as provided in these Specifications or in the Contract Documents. In this event, modifications may be required to assure that the work complies with the design intent.

B. Dimensional Tolerances:

1. Formed surfaces resulting in concrete outlines smaller than permitted by the tolerances of ACI 117 shall be considered potentially deficient in strength and subject to the provisions of Section 3.23.

2. Formed surfaces resulting in concrete outlines larger than permitted by the tolerances of ACI 117 may be rejected and the excess material shall be subject to removal. If removal of the excess material is permitted, it shall be accomplished in such a manner as to maintain the strength of the section and to meet all other applicable requirements of function and appearance.

3. Concrete members cast in the wrong location may be rejected if the strength, appearance or function of the structure is adversely affected or misplaced items interfere with other construction.

4. Inaccurately formed concrete surfaces exceeding the limits of ACI 117, and which are exposed to view, may be rejected and shall be repaired or removed and replaced if required.

5. Finished slabs exceeding the tolerances of ACI 117 may be repaired provided that strength or appearance is not adversely affected. High spots may be removed with terrazzo grinder, low spots filled with a patching compound, or other remedial measures performed as permitted.

C. Appearance:

1. Other concrete exposed to view with defects which adversely affect the appearance of the specified finish may be repaired only by acceptable methods.

2. Concrete not exposed to view is not subject to rejection for defective appearance.

D. Strength of Structure:

1. The strength of the structure in place will be considered potentially deficient if it fails to comply with any requirements, which control the strength of the structure, including but not necessarily limited to the following conditions:

a. Low concrete strength as designated in Section 3.23.

b. Reinforcing steel size, quantity, strength, position, or arrangement at variance with the requirements of Section 3.03, Reinforcement, or the Contact Drawings.

c. Concrete, which differs from the required dimensions or location in such a manner as to reduce the strength.

d. Curing less than that specified.

e. Inadequate protection of concrete from extremes of temperature during early stages of hardening and strength development.

f. Mechanical injury (as defined in Section 3.12.F), construction fires, accidents or premature removal of formwork likely to result in deficient strength.

g. Poor workmanship likely to result in deficient strength.

2. Structural analysis and/or additional testing may be required when the strength of the structure is considered potentially deficient.

3. Core tests in accordance with Section 3.23.C.2 may be required when the strength of the concrete in place is considered potentially deficient.

4. If core tests are inconclusive or impractical to obtain or if structural analysis does not confirm the safety of the structure, load tests may be required, and the results evaluated in accordance with ACI 318.

5. Concrete work judged inadequate by structural analysis or by results of a load test shall be reinforced with additional construction if so directed by the Owner, or shall be replaced, at the Contractor's expense.

6. The Contractor shall pay all costs incurred in providing the additional testing, analysis and/or engineering services required by this section.

E. Durability of Structure:

The durability level of the structure will be considered satisfactory so long as the requirements of ACI 301 are met.

END OF SECTION

SECTION 03410

PRECAST STRUCTURAL CONCRETE

PART 1 - GENERAL

1.01 SUMMARY

A. Contractor shall provide all materials, labor, equipment and services necessary to design, construct and install precast concrete structures, as shown on the Contract Drawings.

B. The structures shall be constructed of precast reinforced concrete. They shall be watertight, non-corrosive, durable and structurally sound. All inlet and outlet connections shall be sealed.

1.02 SUBMITTALS

A. Shop Drawings: Submit detailed fabrication and installation drawings certified by a Professional Engineer registered in the State of Maryland prior to fabrication. Show plans, elevations, dimensions, cross sections, openings, joint design, and indicate location, size and type of reinforcing steel.

B. Calculations: Submit manufacturer's complete design calculations certified by a Professional Engineer registered in the State of Maryland, including load calculations, buoyancy calculations, and concrete mix design.

C. Certifications: Submit manufacturer's certifications and laboratory test reports including mill certification for the reinforcing steel, certificates of compliance for all flexible connectors and/or inlet and outlet seals, and certified test reports specified in referenced ASTM Standards.

D. Watertightness test procedures and test results data.

1.03 DESIGN CRITERIA

A. All precast structures shall be designed in accordance with ACI 350 "Building Code Requirements for Environmental Engineering Concrete Structures."

B. Top slab must be separate and removable from structure. Structures shall be designed to accommodate pumps, piping, valves and other equipment, as shown or specified.

C. Loads:

1. Live Load: MDSHA HS-27 (135% of AASHTO HS20-44 Loading).

2. Dead Load: Earth at 125-pcf with an at rest coefficient equal to 0.53. Hydrostatic pressure should be included as applicable.

D. Flotation design shall have a factor of safety of 1.5 minimum.

E. Wall thicknesses shown on Contract Drawings are the minimum.

F. All mechanical connections between precast units and any cast-in-place concrete or precast units shall be 316 stainless steel.

G. Precast structures shall be designed to account for all reaction loads resulting from hoisting equipment, handrails, hatches, and other equipment, either embedded or attached to the structure, with a minimum thickness to fully embed all sleeves, bases, frames, anchors and other items that will impact the design.

H. The base with riser walls and shelf shall be cast monolithically as a single unit. Rectangular vaults with an interior width dimension greater than 6’-0” or interior length dimension greater than 12’-0” may have a cast-in-place concrete bottom in-lieu of a monolithic cast bottom, provided the design is in accordance with the Contract Documents and is included in the design calculations as required above. The interface between the cast-in-place and precast units shall be sealed to provide a watertight structure, and all mechanical connections between the precast units and cast-in-place concrete bottom shall be 316 stainless steel.

1.04 QUALITY ASSURANCE

A. Fabricator Qualifications: Fabrication shall be by a firm experienced in the manufacturing of precast concrete units similar to the ones indicated for this project and with a record of successful in-service performance.

B. Design Standards: Comply with ACI 350 "Building Code Requirements for Environmental Engineering Concrete Structures" and the design recommendations of PCI MNL 120, “PCI Design Handbook—Precast and Prestressed Concrete”.

1.05 DELIVERY, STORAGE AND HANDLING

A. Store precast concrete units at the project site in a manner to prevent cracking, distorting, warping, or other physical damage, and so that markings are visible.

B. Lift and support precast concrete units only at designated lifting and supporting points as shown on approved shop drawings.

1.06 JOB CONDITIONS

A. Verify dimensions at the project site and prepare shop drawings to reflect actual field conditions and dimensions.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Subject to compliance with requirements, manufacturers that may be used include:

1. Concrete Pipe & Precast,

2. Gillespie Precast,

3. Monarch Products Company, Inc.

2.02 MATERIALS

A. Concrete Materials

1. Portland Cement: ASTM C150, Type II.

2. Aggregates: Except as modified by PCI MNL 116, use ASTM C33 coarse aggregates.

3. Water: Potable, in accordance with ACI 318 and 350.

4. Air-Entraining Admixture: ASTM C260, certified by manufacturer to be compatible with other required admixtures.

5. Water-Reducing; Retarding; Water-Reducing and Retarding; High-Range, Water-Reducing; and High-Range, Water-Reducing and Retarding Admixtures: ASTM C494.

6. Fly Ash or Natural Pozzolans: ASTM C618.

7. Silica Fume: ASTM C1240.

8. Calcium chloride or admixtures containing chlorides shall not be used.

B. Reinforcing Steel

1. Reinforcing Bars: ASTM A615, Grade 60, deformed, epoxy coated.

2. Welded Wire Reinforcement: ASTM A1064, furnish in flat sheets, epoxy coated or galvanized.

3. Epoxy Coating: Epoxy coated reinforcing steel shall be fusion bonded epoxy powder. The epoxy protective coating shall be a one coat, heat curable, thermosetting powdered coating that is electro-statically applied on metal surfaces. For reinforcement steel the color shall be a bright color to contrast with the normal color of reinforcement steel and rust (e.g., orange, red,

green, yellow, etc., and not brown or any color in the rust family). If reinforcement steel is coated before fabrication, all hairline cracks and minor damage on fabrication bends shall be patched, even if there is no bond loss. Epoxy coatings shall conform to ASTM D3963.

C. Joints

1. Joints between precast concrete units shall comply with ASTM C990, and shall be sealed watertight using CS-102 as Manufactured by Concrete sealants, Inc., or approved equal.

2.03 CONCRETE MIXES

A. Compressive Strength: 5,000 psi at 28-days.

B. Maximum Water-Cement Ratio: 0.40.

C. Add air-entraining admixture at manufacturer's prescribed rate to result in normal-weight concrete at point of placement having an air-content as follows, with a tolerance of plus or minus 1½ percent:

1. Air Content: 5 percent for 1½-inch nominal maximum aggregate size.

2. Air Content: 6 percent for ¾-inch nominal maximum aggregate size.

3. Air Content: 7 percent for ½-inch nominal maximum aggregate size.

2.04 COATINGS

A. Coat exterior surface of precast concrete units with Carboline Bitumastic 300-M, or approved equal, 32 mil minimum thickness. Coat interior surfaces in accordance with Section 09900 unless drawings call for an interior coating in accordance with Section 09960.

2.05 FABRICATION

A. Reinforcement: Comply with recommendations in CRSI's "Manual of Standard Practice" for fabricating, placing and supporting reinforcement.

B. Mix concrete according to PCI MNL 116. After concrete batching, no additional water may be added.

C. Place concrete in a continuous operation to prevent seams or planes of weakness from forming in the precast concrete units. Comply with PCI MNL 116 for measuring, mixing, transporting, and placing concrete.

D. Thoroughly consolidate placed concrete by internal and external vibration without dislocating or damaging reinforcement and built-in items. Use equipment and procedures complying with PCI MNL 116.

E. Cure concrete, according to requirements in PCI MNL 116, by moisture retention without heat or by accelerated heat curing using low-pressure live steam or radiant heat and moisture.

F. Product tolerances: Fabricate precast concrete units straight and true to size and shape with exposed edges and corners precise and true so the finished units comply with PCI MNL 116 product tolerances.

G. Pipe Openings:

1. Pipe openings 12” and smaller can be core drilled in the field, provided that the Contractor coordinates the locations of pipe openings with the precast concrete manufacturer to ensure that the structural and watertight integrity of the unit remains intact. Modular casing seals shall be used to seal the annular space around pipe penetrations to maintain the watertight integrity of the unit. The distance of the core drilled hole from a riser joint, another hole, or edge of a wall or slab shall be a minimum of 4” in all directions. Otherwise, all pipe penetrations shall be cast into the precast units as described below.

2. All pipe openings cast into the precast units shall be provided with a gasket cast integrally into the structure. Gasket shall be rubber, meeting the requirements of ASTM C923, and manufactured by A-Lok Products Corp., Vertex Inc., or approved equal. Pipe opening elevations are fixed. Non-standard riser units shall be provided, as necessary, so that joints do not occur within 6” of pipe openings.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install precast concrete units on undisturbed soil with a stone bedding, which has been leveled and compacted as shown on the Contract Drawings. Excavation shall be free of standing water until backfilling is complete.

B. Install precast concrete units level, plumb, square and true, without exceeding the recommended erection tolerances in PCI MNL 127, “Recommended Practice for Erection of Precast Concrete”.

3.02 WATERTIGHTNESS OF STRUCTURES

A. The provisions of this section are applicable to precast concrete structures used as underground vaults that are intended to be dry, and precast concrete structures used as tanks that are intended to be wet.

B. The Contractor shall provide all labor, materials, tools, equipment and devices for testing the water-tightness of new structures, constructed under this Contract. Testing shall be performed prior to the acceptance or placing the structure in operation. All structures, both water holding and dry, are meant to be watertight and free from discernible infiltration and exfiltration.

C. Structures Designed to Contain Liquid

1. Structures designed to contain liquid shall be thoroughly cleaned prior to the introduction of water for test purposes. Before testing a structure, all pipelines connecting to the structure shall have been tested and approved for leakage. All structures shall be tested for leakage and shall be tested in accordance with ACI 350.1. Testing shall be conducted prior to back filling soil around structures, unless otherwise noted.

2. If any structure fails to meet the above requirements for water tightness, then the Contractor shall drain the structure, locate and repair all leaks and retest the structure as many times as is necessary to obtain a watertight structure as defined herein, all to the satisfaction of the Engineer and at no extra cost to the Owner.

D. Structures designed to be dry shall have the interior thoroughly cleaned below finished grade and pumped dry if necessary. Openings below grade shall be bulkheaded and made tight. After a period of 5 days, interior surfaces will be inspected for accumulation of moisture and any excess accumulation indicative of defects in the structure in the judgment of the Engineer shall be repaired by the Contractor at no cost to the Owner and to the satisfaction of the Engineer.

E. All leaks and defects in structures shall be repaired or remedied without additional compensation at whatever time during the course of the Contract they become apparent.

F. Potable water shall be used for filling structures for leakage tests. It shall be the Contractor’s responsibility to convey all water from hydrants or other approved source, as needed for the leak testing. The Contractor shall notify and coordinate with the appropriate Fire Department prior to using hydrants.

G. No separate payment will be made for testing structures neither for water tightness nor for the cost of the water used. The cost thereof shall be considered as included in the lump sum bid for this Contract.

END OF SECTION

SECTION 03600

GROUT

PART 1 - GENERAL

1.01 DESCRIPTION

A. The work of this section includes grouting as indicated on the drawings or specified in other sections. Unless otherwise specified, all grouting shall be done with non-shrinking grout.

B. This section also covers epoxy grouting of anchor bolts and threaded rod anchors to be installed in hardened concrete.

1.02 REFERENCES

A. American Concrete Institute:

1. ACI 308, Recommended Practice for Curing Concrete.

B. American Society for Testing and Materials:

1. ASTM C33; Concrete Aggregates.

2. ASTM C109; Test Method for Compressive Strength of Hydraulic Cement Mortars (Using two inch or 50-mm Cube Specimens).

3. ASTM C150; Specification for Portland Cement.

4. ASTM C191; Test Method for Time of Setting of Hydraulic Cement by Vicat Needle.

5. ASTM C596; Test Method for Drying Shrinkage of Mortar Containing Portland Cement.

6. ASTM C827; Test Method for Early Volume Change of Cementitious Mixtures.

7. ASTM C1107; Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Non-shrink).

1.03 SUBMITTALS

A. Submit a statement of compliance, together with supporting data, from the materials suppliers attesting to the conformance of products and ingredients with these specifications.

B. Submit manufacturer's instructions for mixing, handling, surface preparation, and placing the epoxy type and the non-shrink, non-metallic type grouts.

1.04 QUALITY ASSURANCE

A. Manufacturer’s Qualifications: Grout manufacturer shall furnish copies of current independent laboratory test results showing the non-shrink, non-metallic grout as non-shrink from time of placement according to the following:

1. The grout indicates no expansion after final set according to ASTM C827.

2. The grout indicates 4,000-psi strength developed with a trowelable mix within 24 hours according to ASTM C109.

3. The grout indicates placement time limitation based on initial set of not less than 60 minutes according to ASTM C191.

4. Test results, as supplied by the grout manufacturer, shall indicate that in projects of similar scope and size, the effective bearing area was between 95 and 100 percent.

1.05 DELIVERY, STORAGE AND HANDLING

A. Provide protection for the products to prevent moisture damage and contamination of the grout materials.

B. Store the grout in undamaged condition with seals and labels intact as packaged by the manufacturer.

1.06 PROJECT CONDITIONS

A. Protect freshly poured grout against high and low temperatures and unfavorable environmental conditions in accordance with ACI Standards 308.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Portland Cement: ASTM C150, Type II.

B. Water: Potable; containing no impurities, suspended particles, algae, organic substances, acids, alkalis, or dissolved natural salts in quantities that will cause:

1. Corrosion of steel,

2. Volume change that will increase shrinkage cracking,

3. Efflorescence, or

4. Excess air entraining.

C. Fine Aggregate:

1. Washed natural sand.

2. Gradation in accordance with ASTM C33 and represented by a smooth granulometric curve within the required limits.

3. Free from injurious amounts of organic impurities as determined by ASTM C40.

2.02 RAPID-CURING EPOXY GROUT

A. High strength, three-component epoxy grout formulated with thermosetting resins and inert fillers.

B. Grout shall be rapid curing, have high adhesion, and be resistant to ordinary chemicals, acids and alkalis.

C.

Physical Properties		Reference Spec.
Compressive Strength	12,000 psi (7-day)	ASTM C579
Tensile Strength	2,000 psi minimum	ASTM C307
Coefficient of Expansion	3 x 10^{-6} in/in/^{o}F	ASTM C531
Shrinkage	None	ASTM C827

2.03 NON-SHRINK, NON-METALLIC CEMENTITIOUS GROUT

A. Pre-mixed ready for use formulation requiring only the addition of water; non-shrink, non-corrosive, non-metallic, non-gas forming, no chlorides. No more water shall be used than is necessary to produce a flowable grout, and ASTM C1107.

B. Certified to maintain initial placement volume or expand after set and meet the following minimum properties when tested in accordance with Corps of Engineers Specification CRD-C621, for Type D non-shrink grout:

Setting Time:	Initial	2 hours (Approx.)
ASTM C191	Final	3 hours (Approx.)
Expansion:		0.4% Maximum
Compressive Strength:		

Time	Consistency		
	Plastic (PSI)	Flowable (PSI)	Fluid (PSI)
1 Day	4,000	3,000	2,500
7 Day	7,000	6,000	5,000
28 Day	10,000	8,500	7,500

PART 3 - EXECUTION

3.01 SURFACE PREPARATION

A. Remove defective concrete, laitance, dirt, oil, grease and other foreign material from concrete surfaces by brushing, hammering, chipping or other similar means until a sound, clean concrete surface is achieved. Perform additional surface preparation in accordance with non-shrink, non-metallic grout manufacturer's instructions.

B. Lightly roughen the concrete, but not enough to interfere with the proper placement of grout.

C. Remove foreign materials from metal surfaces in contact with grout.

D. Align, level and maintain final positioning of components to be grouted.

E. Take special precautions during periods of extreme weather conditions in accordance with the manufacturer's written instructions.

F. Saturate concrete surfaces with clean water; remove excess water, leave none standing.

3.02 FORMWORK

A. Construct leakproof forms anchored and shored to withstand grout pressures, so that no movement is possible.

B. Provide clearance between the formwork and the area to be grouted to permit proper placement of grout.

C. Forms shall be provided where structural components of baseplates or bedplates will not confine the grout.

D. Pre-treat wood forms with forming oils so that they do not absorb moisture.

E. Remove supports only after grout has hardened.

3.03 MIXING

A. Portland Cement Grout:

1. Prepare grout composed of Portland cement, sand and water; do not use ferrous aggregate or staining ingredients in grout mix.

2. Use proportions of 2 parts sand and 1 part cement, measured by volume.

3. Prepare grout with sufficient water to obtain consistency to permit placing and packing.

4. Mix water and grout in two steps; pre-mix using approximately ⅔ of the water; after partial mixing, add the remaining amount of water to bring mix to the desired placement consistency and continue mixing 2-3 minutes.

5. Mix only that quantity of grout that can be placed within 30 minutes after mixing.

6. After the grout has been mixed, do not add more water for any reason.

B. Epoxy Grout & Non-Shrink Cementitious Grout: Mix and prepare epoxy grout and non-shrink cementitious grout in strict accordance with the manufacturer's instructions.

C. Mix grout components as close to the work area as possible and transport the mixture quickly and in a manner that does not permit segregation of materials.

3.04 PLACING

A. Unless otherwise specified or indicated on the drawings, the thickness of grout under baseplates shall be 1½ inches. Grout shall be placed in strict accordance with the directions of the manufacturer so that all spaces and cavities below the top of baseplates and bedplates are completely filled, without voids.

B. Place grout material quickly and continuously.

C. Do not use pneumatic-pressure or dry-packing methods (Plastic Consistency).

D. Apply grout from one side only to avoid entrapping air. The final installation shall be thoroughly compacted and free of air pockets.

E. Do not vibrate the placed grout mixture or permit it to be placed if the area is being vibrated by nearby equipment.

F. In all locations where the edge of the grout will be exposed to view, the grout shall be finished smooth after it has reached its initial set. Except where shown to be finished on a slope, the edges of grout shall be cut off flush at the baseplate, bedplate, member, or piece of equipment.

G. Do not remove leveling shims for at least 48 hours after grout has been placed.

H. Unless otherwise noted in the drawings, anchor bolts and threaded rod anchors shall be epoxy grouted in holes drilled into hardened concrete. Diameters of holes shall be as follows:

Item	Diameter of Hole
Threaded Rod Anchors	⅛-inch larger than the bar or rod outside diameter
Anchor Bolts	Per manufacturer's instructions

I. The embedment depth for epoxy grouted anchor bolts and threaded rod anchors, shall be not less than 15 bolt or rod diameters, unless otherwise indicated on the drawings. Holes shall be prepared for grouting as recommended by the grout manufacturer.

J. Anchor bolts and threaded rod anchors shall be clean, dry, and free of grease and other foreign matter at time of installation. The bolts, rods, and bars shall be set and positioned, and the epoxy grout shall be placed and finished in accordance with the recommendations of the grout manufacturer. Particular care shall be taken to ensure that all space and cavities are filled with epoxy grout, without voids.

K. During assembly of all threaded stainless steel components, anti-seize thread lubricant shall be liberally applied to the threaded portion not embedded in concrete.

3.05 CURING

A. After grout has attained its initial set, keep damp for a minimum of 3 days.

B. Prevent rapid loss of water from the grout during the first 48 hours by the use of an approved membrane-curing compound or with the use of the wet burlap method.

END OF SECTION

SECTION 05500

METAL FABRICATIONS

PART 1 - GENERAL

1.01 SUMMARY

A. This Section specifies steel supports, loose bearing and leveling plates, steel weld plates and angles, fixed metal bollards, loose steel lintels, anchor bolts, steel pipe sleeves, and other miscellaneous metal fabrications and accessories.

B. All metal fabrications that are to be located within the pumping station wetwell, manholes, and other similar structures containing sewage and/or hydrogen sulfide gases, shall be stainless steel Type 316.

C. No attempt is made to enumerate each item required, but to indicate parts and describe general construction and certain special items; perform work in strict conformity with the Contract Documents, approved Shop Drawings, and the Specifications; and obtain field measurements of adjoining work required to locate and fit work.

1.02 PERFORMANCE REQUIREMENTS

A. Structural Performance of Ladders: Provide ladders capable of withstanding the effects of loads and stresses within limits and under conditions specified in ANSI A14.3.

B. Structural Performance of Stairs: Provide metal stairs and a complete stair system, capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Uniform Load: 100 lbf/sq. ft.

2. Concentrated Load: 300 lbf applied on an area of 4 sq. in.

3. Uniform and concentrated loads need not be assumed to act concurrently.

4. Stair Framing: Capable of withstanding stresses resulting from railing loads in addition to loads specified above.

5. Limit deflection of treads, platforms, and framing members to L/360 deflection ratio or ¼ inch, whichever is less.

C. Structural Performance of Railings: Provide railings capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Handrails:

   a. Uniform loads of 50 lbf/ft. applied in any direction.

   b. Concentrated load of 200 lbf applied in any direction.

   c. Uniform and concentrated loads need not be assumed to act concurrently.

2. Top Rails of Guards:

   a. Uniform load of 50 lbf/ft. applied in any direction.

   b. Concentrated load of 200 lbf applied in any direction.

   c. Uniform and concentrated loads need not be assumed to act concurrently.

3. Infill of Guards:

   a. Concentrated load of 50 lbf applied horizontally on an area of 1 sq. ft.

   b. Uniform load of 25 lsf/sq. ft. applied horizontally.

   c. Infill load and other loads need not be assumed to act concurrently.

D. Seismic Performance: Provide metal stairs capable of withstanding the effects of earthquake motions determined according to ASCE 7, “Minimum Design Loads for Buildings and Other Structures.”

E. Thermal Movements: Provide exterior metal fabrications that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

1.03 SUBMITTALS

A. Shop Drawings: Show fabrication and installation details for all metal fabrications.

1. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.

2. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld.

3. Indicate type, size, and length of bolts, distinguishing between shop and field bolts.

4. Provide templates for anchors and bolts. Unless otherwise noted in the drawings, all anchors bolts shall be plumb after installation.

5. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the licensed Professional Engineer registered in the State of Maryland and responsible for their preparation.

6. Post-Installed Concrete Anchors:

a. Product specifications with recommended design values and physical characteristics for epoxy dowels, and expansion and undercut anchors.

b. Quality Assurance Submittals:

(1) Test Reports: Certified test reports showing compliance with specified performance characteristics and physical properties.

(2) Certificates:

(a) ICC ES Evaluation Reports

(3) Manufacturer’s Installation Instructions.

(4) Installer Qualifications and Procedures: Submit installer qualifications and letter of procedure stating method of drilling, the product proposed for use, the complete installation procedure, manufacturer training date, and a list of the personnel to be trained on anchor installation.

B. Mill Certificates: Signed by manufacturer certifying that products furnished comply with requirements.

C. Welding certificates.

D. Qualification Data: For Professional Engineer.

1.04 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to the following:

1. AWS D1.1, “Structural Welding Code—Steel”

2. AWS D1.2, “Structural Welding Code—Aluminum”

3. AWS D1.3, “Structural Welding Code—Sheet Steel”

4. AWS D1.6, “Structural Welding Code—Stainless Steel”

B. Post-Installed Concrete Anchors:

1. Installer Qualifications: Drilled-in anchors shall be installed by a contractor with at least five years of experience performing similar installations.

2. Installer Training: Conduct thorough training with the manufacturer or the manufacturer’s representative for the Contractor on the project. Training to consist of a review of the complete installation process for drilled-in anchors, to include but not be limited to:

a. Hole drilling procedure

b. Hole preparation and cleaning technique

c. Adhesive injection technique and dispenser training/maintenance

d. Reinforcing dowel preparation and installation

e. Proof loading/torqueing

3. Certifications: Anchors shall have ICC ES Evaluation Report indicating conformance with current applicable ICC ES Acceptance Criteria.

1.05 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication and indicate measurements on Shop Drawings.

1.06 COORDINATION

A. Coordinate installation of anchorages for metal fabrications. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry.

B. Coordinate installation of steel weld plates and angles for casting into concrete.

1.07 PRODUCT DELIVERY, HANDLING AND STORAGE

A. Deliver all materials in good condition. Store in a dry place, off ground. Keep dry at all times. Handle materials to prevent damage to product or structure.

B. Deliver all materials to the job site properly marked to identify the structure for which they are intended and at such intervals to insure uninterrupted progress of the work. Marking shall correspond to markings indicated on the shop drawings.

PART 2 - PRODUCTS

2.01 METALS, GENERAL

A. Provide materials with smooth, flat surfaces, unless otherwise indicated. For metal fabrications exposed to view in the completed work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

2.02 FERROUS METALS

A. Steel Plates, Shapes, and Bars: ASTM A36.

B. Steel W-Shapes: ASTM A992, Grade 50.

C. Stainless Steel Sheet, Strip, Plate, and Flat Bars: ASTM A666, Type 316L.

D. Stainless Steel Bars and Shapes: ASTM A276, Type 316L.

E. Steel Tubing: ASTM A1085.

F. Steel Pipe: ASTM A53, Grade B standard weight (Schedule 40), unless another weight is indicated or required by structural loads.

G. Cast Iron: ASTM A48, Class 30, unless another class is indicated or required by structural loads.

2.03 NONFERROUS METALS

A. Aluminum Plate and Sheet: ASTM B209, Alloy 6061-T6.

B. Aluminum Extrusions: ASTM B221, Alloy 6061-T6.

C. Aluminum Castings: ASTM B26, Alloy 443.0-F.

D. Bronze Plate, Sheet, Strip and Bars: ASTM B36, Alloy UNS No. C28000 (muntz metal, 60 percent copper).

E. Bronze Extrusions: ASTM B455, Alloy UNS No. C38500 (extruded architectural bronze).

F. Bronze Castings: ASTM B584, Alloy UNS No. C83600 (leaded red brass) or No. C84400 (leaded semi-red brass).

G. Nickel Silver Extrusions: ASTM B151, Alloy UNS No. C74500.

H. Nickel Silver Castings: ASTM B584, Alloy UNS No. C97600 (20-percent leaded nickel bronze).

I. All aluminum shall be anodized.

2.04 FASTENERS

A. General: Provide ASTM F593 Type 316 stainless steel, Condition CW1 or CW2, fasteners for exterior use and in wetwells. Provide stainless steel fasteners, Condition CW1 or CW2, for fastening aluminum. Select fasteners for type, grade, and class required.

B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM F3125, Grade A325, Type 1; with ASTM A563 heavy hex nuts, and ASTM F436 hardened carbon steel washers; with hot-dip zinc coating per ASTM A153.

C. Stainless Steel Bolts and Nuts: Regular hexagon-head annealed stainless steel bolts, nuts and flat washers; ASTM F593, Type 316 Condition CW1 or CW2 for bolts and ASTM F594 for nuts. Washers shall be ASTM A 666, Type 304.

D. Provide a passive coating for all stainless steel fasteners and hardware.

E. Anchor Bolts: Stainless Steel, ASTM F 593, Type 304, unless noted otherwise on the Contract Documents.

F. Anchor Bolts: ASTM F1554, Grade 55.

1. Provide hot-dip or mechanically deposited, zinc-coated anchor bolts where item being fastened is indicated to be galvanized.

G. Eyebolts: ASTM A489.

H. Machine Screws: ASME B18.6.3.

I. Lag Bolts: ASME B18.2.1.

J. Wood Screws: Flat head, ASME B18.6.1.

K. Plain Washers: Round, ASME B18.22.1.

L. Lock Washers: Helical, spring type, ASME B18.21.1.

M. Concrete Fasteners and Anchors: Fasteners and anchors shall be of the type and size shown on the Contract Drawings, and as specified as follows:

1. Wedge Anchors: Wedge type, torque-controlled, with impact section to prevent thread damage complete with required nuts and washers. Provide anchors with length identification markings conforming to ICC ES AC01 or ICC ES AC193. Type and size as indicated on Contract Drawings.

    a. Provide stainless steel anchors. Stainless steel anchors shall be AISI Type 304 or 316 stainless steel as required, provided with stainless steel nuts and washers of matching alloy group and minimum proof stress equal to or greater than the specified minimum full-size tensile strength of the externally threaded fastener. Stainless steel nuts shall conform to ASTM F594 unless otherwise specified. Avoid installing stainless steel anchors in contact with galvanically dissimilar metals.

    b. Where anchor manufacturer is not indicated, subject to compliance with requirements and acceptance by the Engineer, provide the following, or approved equal:

        (1) Hilti Kwik Bolt 3, ICC ESR-1385 and ESR-2302

        (2) Hilti Kwik Bolt TZ, ICC ESR-1917

2. Cartridge Injection Adhesive Anchors: Threaded steel rod, inserts or reinforcing dowels, complete with nuts, washers, polymer or hybrid mortar adhesive injection system, and manufacturer's installation instructions. Type and size as indicated on Contract Drawings.

    a. Provide stainless steel anchors. Stainless steel anchors shall be AISI Type 304 or 316 stainless steel as required, provided with stainless steel nuts and washers of matching alloy group and minimum proof stress equal to or greater than the specified minimum full-size tensile strength of the externally threaded fastener. All nuts shall conform to ASTM F594 unless otherwise specified. Avoid installing stainless steel anchors in contact with galvanically dissimilar metals.

b. Reinforcing dowels shall be ASTM A615, Grade 60.

c. Where anchor manufacturer is not indicated, subject to compliance with requirements and acceptance by the Engineer, provide the following, or approved equal.

(1) Hilti HAS threaded rods with HIT-HY 200 Safe Set System using Hilti Hollow Drill Bit and Vacuum System for anchor and rebar anchorage to concrete, ICC ESR-3187.

(2) Hilti HIT-2 anchor rods with HIT-HY 200 Safe Set System for anchorage to concrete, ICC ESR-3187.

(3) Hilti HAS threaded rods with HIT-RE 500 V3 Safe Set System using Hilti Hollow Drill Bit and Vacuum System for anchor and rebar anchorage to concrete, ICC ESR-3814.

3. Capsule Anchors: Threaded steel rod, inserts and reinforcing dowels with 45 degree chisel point, complete with nuts, washers, glass or foil capsule anchor system containing polyvinyl or urethane methacrylate-based resin and accelerator, and manufacturer's installation instructions. Type and size as indicated on Contract Drawings.

a. Provide chisel-pointed stainless steel anchors. Stainless steel anchors shall be AISI Type 304 or 316 stainless steel as required, provided with stainless steel nuts and washers of matching alloy group and minimum proof stress equal to or greater than the specified minimum full-size tensile strength of the externally threaded fastener. All nuts shall conform to ASTM F594 unless otherwise specified. Avoid installing stainless steel anchors in contact with galvanically dissimilar metals.

b. Reinforcing dowels shall be A615 Grade 60, with 45-degree chisel-point at embedded end.

c. Where anchor manufacturer is not indicated, subject to compliance with requirements and acceptance by the Engineer, provide the following, or approved equal.

(1) Hilti HVA Adhesive System with HVU capsules.

4. Substitution of the anchor types shown on the Contract Drawings shall not be permitted without approval of the Engineer.

2.05 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

B. Shop Primers: Provide primers that comply with Section 09900.

C. Zinc-Rich Primer: Complying with SSPC-Paint 20 or SSPC-Paint 29 and compatible with topcoat.

1. Use primer with a VOC content of 3.5 lb/gal or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2. Products shall be Carboline Carbozinc 621, Sherwin-Williams Corothane I GalvaPac Zinc Primer, Tnemec Tneme-Zinc 90-97, or approved equal.

D. Galvanizing Repair Paint: High zinc-dust content paint for regalvanizing welds in steel, complying with SSPC-Paint 20. Cold applied galvanized repair material to be a minimum of 90% zinc.

E. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187.

2.06 FABRICATION, GENERAL

A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

B. Cut, drill and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 0.03125-inch, unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

C. Stainless Steel beams and shapes shall be hot-rolled, extruded or continuously laser fused along their entire length. Stitch welds or intermittent welds are not permitted.

D. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

E. Form exposed work true to line and level with accurate angles and surfaces and straight edges.

F. Weld corners and seams continuously to comply with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.

2. Obtain fusion without undercut or overlap.

3. Remove welding flux immediately.

4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

G. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) screws or bolts, unless otherwise indicated. Locate joints where least conspicuous.

H. Fabricate seams and other connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

I. Cut, reinforce, drill and tap metal fabrications to receive finish hardware, screws and similar items.

J. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.

1. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, ⅛ by 1½-inches, with a minimum 6-inch embedment and 2-inch hook, not less than 8 inches from ends and corners of units and 24 inches o.c., unless otherwise indicated.

2.07 MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Provide steel framing and supports not specified in other Sections as needed to complete the work.

B. Fabricate units from steel shapes, plates, and bars of welded construction, unless otherwise indicated. Fabricate to sizes, shapes and profiles indicated and as necessary to receive adjacent construction retained by framing and supports. Cut, drill, and tap units to receive hardware, hangers, and similar items. Furnish inserts if units are installed after concrete is placed.

C. Galvanize miscellaneous framing and supports.

2.08 LOOSE STEEL LINTELS

A. Fabricate loose steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions. Weld adjoining members together to form a single unit where indicated.

B. Size loose lintels to provide bearing length at each side of openings equal to 0.083 of clear span, but not less than 8 inches, unless otherwise indicated.

C. Galvanize loose steel lintels in accordance with ASTM A123.

2.09 LOOSE BEARING AND LEVELING PLATES

A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts and for grouting.

B. Galvanize plates after fabrication in accordance with ASTM A123.

2.10 STEEL WELD PLATES AND ANGLES

A. Provide steel weld plates and angles not specified in other sections, for items supported from concrete construction as needed to complete the work. Provide each unit with not less than two integrally welded steel strap anchors for embedding in concrete.

2.11 GRATINGS

A. Open grating of a design, material thickness and strength to support all dead loads plus a uniform live load as indicated on the contract drawings, with a maximum of ¼-inch deflection at 100 psf live load. Minimum grating thickness shall be as indicated on the drawings.

B. Grating shall be of the aluminum swage locked type with serrated bars for maximum slip resistance as manufactured by McNichols Co. or approved equal.

C. Anchor angle frames to the supporting construction. Fabricate grating in convenient lengths for handling. Band grating along entire perimeter and at holes or other openings.

2.12 ABRASIVE METAL NOSINGS, TREADS AND THRESHOLDS

A. Cast-Metal Units: Cast gray iron, Class 20, with an integral abrasive finish consisting of aluminum oxide, silicon carbide, or a combination of both. Fabricate units in sizes and configurations indicated and in lengths necessary to accurately fit openings or conditions.

1. Available Manufacturers:

a. American Safety Tread Co., Inc.,

b. Balco Inc.,

c. Barry Pattern & Foundry Co., Inc.,

d. Granite State Casting Co.,

e. Safe-T-Metal Co.,

f. Or Equal.

2. Nosings: Cross-hatched units, 4 inches wide with 1-inch lip, for casting into concrete steps.

3. Nosings: Cross-hatched units, 1½ by 1½ inches, for casting into concrete curbs.

4. Treads: Cross-hatched units, full depth of tread with ¾ by-¾-inch nosing, for application over bent plate treads or existing stairs.

5. Thresholds: Fluted-saddle-type units, 5 inches wide by ½-inch high, with tapered edges.

6. Thresholds: Fluted-interlocking- (hook-strip-) type units, 5 inches wide by ⅝-inch high, with tapered edge.

7. Thresholds: Plain-stepped- (stop-) type units, 5 inches wide by ½-inch high, with ½-inch step.

B. Extruded Units: Aluminum, with abrasive filler consisting of aluminum oxide, silicon carbide, or a combination of both, in an epoxy-resin binder. Fabricate units in sizes and configurations indicated and in lengths necessary to accurately fit openings or conditions.

1. Available Manufacturers:

a. ACL Industries, Inc.,

b. American Safety Tread Co., Inc.,

c. Amstep Products,

d. Armstrong Products, Inc.,

e. Balco Inc.,

f. Or Equal.

2. Provide ribbed units, with abrasive filler strips projecting 0.625-inch above aluminum extrusion.

3. Provide solid-abrasive-type units without ribs.

4. Nosings: Square-back units, 4 inches wide, for casting into concrete steps.

5. Nosings: Beveled-back units, 4 inches wide with 1⅜-inch lip, for surface mounting on existing stairs.

6. Nosings: Two-piece units, 3 inches wide, with subchannel for casting into concrete steps.

7. Treads: Square or Beveled-back units, full depth of tread with 1⅜-inch lip, for application over existing stairs.

C. Provide anchors for embedding units in concrete, either integral or applied to units, as standard with manufacturer.

D. Drill for mechanical anchors and countersink. Locate not more than 4 inches from ends and not more than 12 inches o.c., evenly spaced between ends, unless otherwise indicated. Provide closer spacing if recommended by manufacturer.

1. Provide 2 rows of holes for units more than 5 inches wide, with 2 holes aligned at ends and intermediate holes staggered.

E. Apply bituminous paint to concealed bottoms, sides, and edges of cast-metal units set into concrete.

F. Apply clear lacquer to concealed bottoms, sides, and edges of extruded units set into concrete.

2.13 RAILING

A. Railing:

The pipe handrail shall be constructed with mechanically fastened, flush-fit INTERNA-RAIL aluminum fitting system as regularly manufactured by Hollaender Manufacturing Co. or an approved equal. The fittings shall be internally connected to the pipe by means of an internal double tang, expanded by an austenitic 302 alloy stainless steel, internal, reverse knurl, cup point, hexagon socket set screw. Pop rivets, sheet metal screws and adhesives shall not be acceptable. The fittings shall be machined of austenitic stainless steel bar stock of 302 alloy conforming to ASTM A582, or machined castings of high tensile aluminum-magnesium alloy 535.0 manufactured in compliance with ASTM B26, cast from high-purity ingot 535.2 conforming to ASTM B179. Flanges shall be sand cast from high-tensile aluminum-magnesium alloy 535.0 and fastened directly to the pipe by means of an external, reverse knurl, cup point, hexagon socket set screw.

Aluminum: Handrailing shall be fabricated of standard 6061-T6 alloy, Schedule 40 extruded aluminum structural pipe, in accordance with ASTM B221; pipe shall be nominal 1½-inch, with 1.9" O.D. and 0.145" wall thickness. Pipe posts shall be 1½-inch diameter, 80 gauge.

B. Railing shall be a two rail system designed to meet OSHA standards. Provide additional intermediate rails where indicated on the drawings. Unless otherwise

noted on the drawings, the centerline of top rail shall be 3'-6" above walking surface and the centerline of second rail shall be installed at mid-height. Top railing for stairs shall not be more than 34" and not less than 30" above tread. Provide minimum 3" clearance on single pipe stairway handrails supported on brackets from a wall.

C. Post spacing shall be adequate to meet loading requirements but shall not exceed 6'-0" o.c.

D. The top surface of the top railing shall be smooth and shall not be interrupted by projecting fittings.

E. Provide removable stainless steel chains with snap hooks where indicated.

F. Provide for expansion and contraction in the railing. Expansion joints must align with those in the structure to which the handrail is attached. Post spacing shall be located 1'-0" maximum to the right or left of expansion and contraction joints.

G. Railings shall be capable of withstanding a concentrated load of at least 200 pounds applied in any direction at any point on the rail.

H. Handrail post shall be base flange mounted as noted on the drawings. Stringer connections shall be as detailed on drawings.

I. Removable Setting: Railing shall be set in close-fitting sleeves, bolted to sides of concrete walkways or aluminum walkway support structure.

J. Permanent setting in concrete shall have posts set in sleeves and set in non-shrink grout.

K. Finish

Aluminum: Clear satin anodized, 0.7 mil thickness, AA-M21C22A41. Ship the railing plastic wrapped. Remove plastic wrap after erection.

2.14 METAL STAIRS

A. Metal stairs will be aluminum or steel as indicated on the drawings.

B. Fabricate metal stairways, including stringers, stair treads, handrails, landing decks and fasteners, as indicated on the drawings.

C. Shop fabricated welded or bolted installation; bolted stair treads; field cutting or burning not permitted; bolt holes drilled or punched; draw bolts tight, not protruding more than 1 thread, cut off and file smooth. All bolts and fasteners shall be stainless steel.

D. All grating edges shall be banded.

E. Provide metal riser plate welded to grating tread, unless indicated otherwise. Riser plate material shall match material used for fabrication of stair system.

2.15 TOE BOARDS

A. Provide toe boards a minimum of 4" high at the following locations:

1. At all overhead walking surfaces.

2. Where indicated on the drawings.

B. Toe boards shall be minimum 4" high extruded aluminum and attached to the posts with clamps or brackets which allow for lateral movement due to expansion and contraction between posts. Toe boards shall be set ¼-inch above the walking surface. Notch toe boards as required at post base plates.

C. Where toe board sections terminate, splice toe board sections using a minimum 4" long bracket. The splice connection shall be a snap fit to allow expansion and contraction. Bolt, rivet, etc. type fasteners at the splice shall not be permitted. Provide a gap between the adjoining toe board sections at the splice of the dimension recommended by the manufacturer for the installation temperature.

2.16 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Finish metal fabrications after assembly.

2.17 STEEL AND IRON FINISHES

A. Galvanizing: Hot-dip galvanize items as indicated to comply with applicable standard listed below:

1. ASTM A123, for galvanizing steel and iron products.

2. ASTM A153, for galvanizing steel and iron hardware.

B. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with minimum requirements indicated below for SSPC surface preparation specifications and environmental exposure conditions of installed metal fabrications:

1. Exteriors (SSPC Zone 1B) and Items Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."

2. Interiors (SSPC Zone 1A): SSPC-SP 3, "Power Tool Cleaning."

C. Shop Priming: Apply shop primer to uncoated surfaces of metal fabrications, except those with galvanized finishes and those to be embedded in concrete or masonry, unless otherwise indicated. Comply with SSPC-PA 1, “Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel,” for shop painting. Stripe paint corners, crevices, bolts, welds, and sharp edges.

2.18 STAINLESS STEEL FINISHES

A. Remove tool and die marks and stretch lines or blend into finish.

B. Grind and polish surfaces to produce uniform, directionally textured, polished finish indicated, free of cross scratches. Run grain with long dimension of each piece.

C. Dull Satin Finish: No. 6.

D. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

2.19 ALUMINUM FINISHES

A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

B. Class I, Clear Anodic Finish: AA-M12C22A41 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating (0.018 mm or thicker) complying with AAMA 611.

C. Grind weld joints smooth with adjacent finish surface.

D. Coat aluminum in contact with dissimilar metals, masonry or lime products with one-coat of bituminous paint.

2.20 COPPER-ALLOY FINISHES

A. Finish designations for copper alloys comply with the system established for designating copper-alloy finish systems defined in NAAMM’s “Metal Finishes Manual for Architectural and Metal Products.”

B. Cast Bronze or Nickel Silver Finish: M12 (Mechanical Finish: matte finish, as fabricated).

C. Extruded Bronze or Nickel Silver Finish: M11 (Mechanical Finish: specular, as fabricated).

D. Bronze Plate, Sheet, Strip and Bar Finish: M10 (Mechanical Finish: unspecified, as fabricated).

PART 3 - EXECUTION

3.01 INSTALLATION, GENERAL

A. Cutting, Fitting, and Placement: Perform cutting, drilling and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

C. Field Welding: Comply with the following requirements:

1. Use material and methods that minimize distortion and develop strength and corrosion resistance of base metals.

2. Obtain fusion without undercut or overlap.

3. Remove welding flux immediately.

4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag bolts, wood screws, and other connectors.

E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

F. Corrosion Protection: Coat concealed surfaces of aluminum that will come into contact with grout, concrete, masonry, wood, or dissimilar metals with a heavy coat of bituminous paint.

3.02 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on shop drawings.

3.03 INSTALLING BEARING AND LEVELING PLATES

A. Clean concrete and masonry bearing surfaces of bond-reducing materials and roughen to improve bond to surfaces. Clean bottom surface of plates.

B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with grout.

1. Use non-shrink grout.

2. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.04 INSTALLING NOSINGS, TREADS, AND THRESHOLDS

A. Center nosings on tread widths.

B. For nosings embedded in concrete steps or curbs, align nosings flush with riser faces and level with tread surfaces.

C. Seal thresholds exposed to exterior with elastomeric sealant complying with Section 07900 – Sealants and Caulking to provide a watertight installation.

3.05 RAILING AND WALL BRACKETS

A. Removable Setting: Railings shall be set in close-fitting sleeves; sleeves set in concrete; sleeves shall be 1" less in length than thickness of concrete. Weld 3" flanges to posts at floor level.

B. Bolted Setting: Base plate shall be welded to bottom of posts and bolted to floor with expansion type fasteners.

3.06 ALUMINUM STAIRS

A. Connections

1. Provide welded connections wherever possible.

2. Where bolted or riveted connections are used, draw connections tight; cut off or grind excess smooth.

3. Make all connections tight.

B. Make all joints true and tight.

C. Install metal stair in accordance with the manufacturer's recommendations and approved shop drawings.

D. Install components plumb and level, accurately fitted, free from distortion or defects.

E. Securely bolt or anchor, plates, angles, hangers, and struts required for connecting stairs to structure.

F. Provided welded field joints where specifically indicated or shop drawings. Perform field welding in accordance with the appropriate AWS Specification.

G. Obtain written approval prior to site cutting or creating adjustments not scheduled.

3.07 CONNECTIONS

A. Unless otherwise specified, all shop connections shall be welded or bolted; framing connections made in field shall be made with high strength stainless steel bolts; other connections may be made by any of the above methods (using stainless steel) or with standard strength stainless steel bolts.

B. All connections shall develop strength required for members involved; in no case less than AISC standard.

C. Provide lugs, clips, connections, rivets, bolts, necessary for complete fabrication, erection; bolts remaining in finished, exposed work shall be hexagon head bolts with hexagon nuts; bolts shall be of proper length to permit full thread in nut, but not project more than ¼-inch beyond face of nut. Rivets, both shop and field, power driven; shall provide 100 lbs. per sq. in. at hammer minimum.

D. High Strength Stainless Steel Bolts: Furnish and install in accordance with Research Council or "Riveted and Bolted Structural Joints Using High Tensile Stainless Steel Bolts", latest edition.

3.08 ADJUSTING AND CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

1. Apply by brush or spray to provide a minimum 2-mil dry film thickness.

B. Touchup Painting: Clean and touchup paint field welds, bolted connections, and abraded areas of shop paint in accordance with Section 09900.

C. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780.

3.09 BURNING AND WELDING

A. Burning: Burning of holes in the field shall not be permitted without written approval by the Engineer; if approval is given, burned members shall be finished to an appearance equal to sheared finish; burning shapes to length with standard flame-cutting machine will be permitted.

B. Perform both shop and field welding in accordance with recommendations of American Welding Society. Welds shall be solid and homogeneously a part of metals joined, free from pits or incorporated slag or scale; surfaces of welds shall be smooth and regular, of full area indicated or necessary to develop required strength of joint.

3.10 DRILLED-IN ANCHORS

A. Drill holes with rotary impact hammer drills using carbide-tipped bits, hollow drill bit system, or core drills using diamond core bits. Drill bits shall be of diameters as specified by the anchor manufacturer. Unless otherwise shown on the Contract Drawings, all holes shall be drilled perpendicular to the concrete surface.

1. Cored Holes: Where anchors are permitted to be installed in cored holes, use core bits with matched tolerances as specified by the manufacturer. Properly clean cored holes per manufacturer's instructions.

2. Embedded Items: Contractor shall identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Exercise care in coring or drilling to avoid damaging existing reinforcing or embedded items. Notify the Engineer if reinforcing steel or other embedded items are encountered during drilling.

B. Perform anchor installation in accordance with manufacturer's written instructions.

C. Wedge Anchors: Protect threads from damage during anchor installation. Set anchors to manufacturer's recommended torque, using a torque wrench. Following attainment of 10% of the specified torque, 100% of the specified torque shall be reached within 7 or fewer complete turns of the nut. If the specified torque is not achieved within the required number of turns, the anchor shall be removed and replaced unless otherwise directed by the Engineer.

D. Cartridge Injection Adhesive Anchors: Clean all holes per manufacturer instructions to remove loose material and drilling dust prior to installation of adhesive. Inject adhesive into holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air

pockets in the adhesive. Follow the manufacturer recommendations to ensure proper mixing of adhesive components. Sufficient adhesive shall be injected in the hole to ensure that the annular gap is filled to the surface. Remove excess adhesive from the surface. Shim anchors with suitable device to center the anchor in the hole. Do not disturb or load anchors before manufacturer specified cure time has elapsed.

E. Capsule Anchors: Perform drilling and setting operations in accordance with manufacturer instructions. Clean all holes to remove loose material and drilling dust prior to installation of adhesive. Remove water from drilled holes in such a manner as to achieve a surface dry condition. Capsule anchors shall be installed with equipment conforming to manufacturer recommendations. Do not disturb or load anchors before manufacturer specified cure time has elapsed.

F. Observe manufacturer recommendations with respect to installation temperatures for cartridge injection adhesive anchors and capsule anchors.

END OF SECTION

SECTION 07100

WATERPROOFING AND DAMPPROOFING

PART 1 - GENERAL

1.01 DESCRIPTION

A. This section includes requirements for waterproofing and dampproofing of concrete surfaces that will be in contact with earth below grade.

B. Principal items of work include: Waterproofing the exterior sides of walls below grade and Damproofing as shown on the Drawings.

1.02 SUBMITTALS

A. Manufacturer's descriptive product data and certification of compliance with referenced specifications.

B. Manufacturer's detailed description for handling, recommendation on intended use and installation recommendations.

C. Samples of waterproofing, dampproofing, and composite drainage panel.

D. Complete layout and installation drawings and schedules with clearly indicated dimensions.

E. Detailed drawings showing all anchoring details and construction details at corners, penetrations, flashing, overlaps and terminations.

1.03 STORAGE

A. Waterproofing and dampproofing materials shall be stored in a dry protected place, up off the ground surface, complying in all respects with product manufacturers recommendations.

1.04 JOB CONDITIONS

A. Unless otherwise recommended by the manufacturer, do not apply waterproofing or dampproofing when temperature is below 40 degrees F or when there is ice, frost or dampness visible on surfaces to be waterproofed or dampproofed.

B. Primers and mastics are solvent-based liquids. Prior to the use of any product, consult the manufacturer’s product label for handling, use and storage instructions.

C. Adhere strictly to all manufacturer’s cautions, warnings and product safety and handling instructions.

1.05 QUALITY ASSURANCE

A. Use adequate numbers of skilled workers who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

B. Waterproofing membrane shall be compatible with waterproofing material and installed by methods approved by the membrane manufacturer.

PART 2 - MATERIALS

2.01 WATERPROOFING

A. ACCEPTABLE MANUFACTURERS

Subject to compliance with the Specifications provide products manufactured by one of the following:

1. W. R. Meadows, Inc.

2. Grace Construction Products

3. Polyguard Products

4. BASF

5. Soprema, Colphene® 3000

6. Or Approved Equal

B. WATERPROOFING MEMBRANE

Waterproofing membrane shall be applied to all concrete surfaces exposed to earth as shown on the Contract Drawings.

Self-adhering membrane consisting of a minimum 56 mils of rubberized asphalt laminated to a minimum 4 mils of polyethylene for a minimum of 60 mil membrane. Provide a cold-applied membrane which requires no special adhesives or heating equipment.

The adhesive side of the membrane shall be protected with a special release paper that can be easily removed for installation. The membrane shall conform to the following requirements:

	Test Property	Test Method	Specification Limit
1.	Tensile Strength Membrane	ASTM D412	250 psi. min.
2.	Grab Tensile Strength:	ASTM D5034	70
3.	Pliability, 180-degree bend:	ASTM D146	Unaffected
4.	Elongation	ASTM D412	300% min.
5.	Resistance to Puncture:	ASTM E154	40
6.	Permeance, Permeability:	ASTM E96-B	0.1
7.	Water Absorption	ASTM D570	0.2 max. (% by weight)
8.	Weight, oz/SY, Min.:	ASTM D3776	40
9.	Adhesion to Concrete	ASTM D903	5.0 lbs/in. width max.

10. Primer: As recommended by manufacturer.

11. Mastic: As recommended by manufacturer. Use mastic to seal cut edge terminations.

2.02 COMPOSITE DRAINAGE PANEL

A. Composite drainage panel: Three dimensional, high impact, polystyrene core with a nonwoven filter fabric bonded to the core. Provide a polymeric sheet adhered to the flat side of the polystyrene core. Extend filter fabric beyond the edges to provide total filtering integrity of the drainage system.

B. Physical properties:

Test Property	Test Method	Specified Limit
Compressive Strength (Core)	ASTM D1621	15,000 psf
Apparent Opening Size (Filter Fabric)	ASTM D4751	100 US Sieve
Water Flow Rate (Filter Fabric)	ASTM D4491	150 gpm/ft
Water Flow Rate (Composite System)	ASTM D4716	15 gpm/ft.

C. Composite System Requirements:

1. Provide one inch flange on longitudinal edge.

2. Bond filter fabric to each dimple of polymeric core.

3. Extend filter fabric beyond tow edge of polymeric core to provide total filtering integrity of the drainage system.

4. System shall be approved for use over waterproofing membrane.

2.03 DAMPPROOFING

A. Dampproofing material shall be solvent type asbestos-free asphalt compound that meets the U.S. EPA Architectural Coatings Rule requirements for VOC.

B. Damproofing shall be SEALMASTIC by W.R. Meadows, Inc.; Karnak #220AF by The Karnak Corporation; or Approved Equal.

2.04 OTHER MATERIALS

A. Provide other materials, not specifically described but required for a complete and proper installation, as selected by the Contractor subject to the approval of the Engineer.

PART 3 - EXECUTION

3.01 PREPARATION

A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the work. Do not proceed until unsatisfactory conditions are corrected.

B. Membrane waterproofing shall not be applied until curing has been completed and surfaces are protected against cold. All surfaces shall be dry, smooth and free from projections and holes.

C. Dampproofing shall not be applied until curing has been completed and surfaces are protected against cold. All surfaces shall be dry, clean, smooth and free from projections and holes.

3.02 APPLICATION

A. Materials shall be applied at a temperature above 40 degrees F., unless specifically listed for application below 40 degrees F. Do not apply materials when there is ice, frost, or dampness visible on the surface to be waterproofed or dampproofed.

B. Install material in strict accordance with manufacturer's recommendations and using appropriate and approved equipment. Care shall be taken to prevent coating of parts of the structure that will be exposed to view in the completed structure. Allow each coat of dampproofing to cure 24 hours before applying subsequent coats unless otherwise recommended by the manufacturer. Dampproofing shall not be permitted when the temperature is less than 40 degrees F. Where membrane waterproofing and dampproofing are both indicated for applications, the membrane waterproofing shall be applied first.

C. Protect waterproofing membrane during construction period to prevent damage, soiling or deterioration other than normal wear and weathering up to the time of conditional acceptance by the Owner. No backfilling shall be performed against the installed waterproofing and dampproofing until it is approved by the Owner. Damage to the membrane shall be repaired by the Contractor at no cost to the Owner. Repairs shall extend beyond the outermost damaged portion, and the second ply shall extend at least 3-inches beyond the first ply.

D. Apply dampproofing at the manufacturer’s recommended application rate. If no application rate is provided, apply at a rate of 6 gallons per 100 sf. Prepare and prime all surfaces per the manufacturer’s recommendations.

END OF SECTION

SECTION 07192

UNDER-SLAB VAPOR RETARDER

PART 1 - GENERAL

1.01 DESCRIPTION

A. Includes the installation of an under-slab vapor retarder designed to retard moisture migration through cast-in-place concrete slabs-on-grade.

1.02 SUBMITTALS

A. Submit manufacturer's catalog data of materials and application instructions for review.

1.03 GUARANTEE

A. Contractor to provide a written guarantee as follows:

"Vapor retarder is guaranteed against leaks, defects of workmanship and materials for a period of two years from date of Substantial Completion, and should any leaks occur within this period, repairs to retarder and damage to other portions of the building caused by such leaks will be repaired without cost to the Owner."

PART 2 - MATERIALS

2.01 SHEET VAPOR RETARDERS

A. ASTM E1745, Class A, with a maximum perm rating of 0.02 perms, minimum 45 lb/in tensile strength, 2200 grams puncture resistance. Include manufacturer's recommended adhesive or pressure-sensitive tape for all joints, pipe penetrations, and sealing of vapor retarder. Use only materials, which are resistant to decay when tested in accordance with ASTM E154, as follows: Polyethylene sheet not less than 10 mils thick.

2.02 ACCEPTABLE MANUFACTURERS

A. Moistop Ultra 10 by The Henry Company,

B. Perminator 10 mil by W.R. Meadows, Inc.,

C. VaporBlock VB10 by Raven Industries, Inc.,

D. or approved equal.

PART 3 - EXECUTION

3.01 PREPARATION

A. Base must be leveled and tamped.

3.02 INSTALLATION

A. Place plastic laminated sheet with 12-inch laps. Place top lap in direction of spreading of concrete.

B. Seal laps and seal to walls and pipes with recommended sealant.

C. Turn up on walls a minimum of 4 inches. Stretch and weight edges and laps to maintain their position until concrete is placed.

D. Repair all holes in vapor retarder in accordance with manufacturer's recommendations prior to placing concrete.

E. Provide wood runways for wheeled equipment for transporting concrete. Do not displace vapor retarder during concrete placement.

END OF SECTION

SECTION 07900

SEALANTS AND CAULKING

PART 1 - GENERAL

1.01 DESCRIPTION

A. This Section includes requirements for providing sealant, caulking, and related accessories to weather seal and fill joints.

1.02 SUBMITTALS

A. Submit the following information in accordance with the General Conditions:

1. Manufacturer's descriptive product data and certification of compliance with referenced specification.

2. Manufacturer's detailed description for handling, recommendation on intended use and installation recommendations.

B. Submit samples in accordance with the General Conditions for the following:

1. One cartridge of each type of sealant and caulking compound.

2. One pint of each primer.

3. One linear foot of backup material.

4. One linear foot of compression seal.

5. One cartridge of expansion joint material.

C. Submit full range of manufacturer’s colors of each sealant and caulking compound to be used for selection by the Owner.

1.03 DELIVERY, STORAGE AND HANDLING

A. Deliver materials in manufacturer's original unopened containers with labels intact along with referenced specification number, type and class as applicable.

B. Handle and store product in accordance with manufacturer's recommendations.

C. Maintain sealant and caulking at a temperature of at least 70 degrees F. for a period of not less than 24 hours prior to installation.

1.04 JOB CONDITIONS

A. Environmental Requirements

Unless otherwise recommended by the manufacturer, do not apply sealant and caulking when temperature is below 40 degrees F. and when there is ice, frost or dampness visible on surfaces to be sealed.

B. Safety Requirements

Avoid contact with skin. Wear protective clothing, goggles, gloves and/or barrier creams. Avoid breathing vapors in confined areas.

PART 2 - MATERIALS

Sealant, caulking, primers and accessories shall be the non-staining type and of a color specified or selected by the Owner from the Manufacturer's standard color chart.

2.01 CAULKING

A. Caulking shall be a one-component gun grade butyl-rubber system, such as Butyl-Flex as manufactured by DAP, Inc., Dayton, Ohio or approved equal. Coordinate colors with adjacent work.

2.02 SEALANTS

A. Sealant shall be a two-component base system conforming to ASTM C920, Type M, Grade NS, P or SL, Class 25, Uses NT, I, M, G, A and O. Sealant shall be Thiokol 2235M/2235SL Polysulfide Joint Sealant as manufactured by ITW PolySpec or approved equal.

2.03 PRIMERS AND ACCESSORIES

A. Primers, where applicable, shall be in accordance with caulking/sealant manufacturer's recommendations.

B. Provide backup materials, fillers and joint packing compatible with caulking/sealant and primer.

1. Use back-up material to control caulking/sealant depth as recommended by the caulking/sealant manufacturer.

2. Unless otherwise specified use closed-cell tube or rope shaped stock expanded polyethylene or polyurethane foam.

3. The width or diameter of backup material shall be 1-1/3 to 1-1/2 times the width of the joint.

4. Use semi-rigid vinyl or polyethylene foam, solid neoprene rod or similar approved backing for joints subject to horizontal traffic or puncture.

5. Do not use bituminous or oily product as a backup material.

PART 3 - EXECUTION

3.01 PREPARATION

A. Inspect joint surfaces before starting work. Verify surfaces are dry and meet caulking/sealant manufacturer's requirements.

B. Clean joint surfaces immediately before installation of gaskets and caulking/sealant. Remove dirt, moisture, frost, coatings and other foreign substances that will interfere with performance of compression seal and caulking/sealant.

C. Etch concrete and masonry joint surfaces as recommended by caulking/sealant manufacturer.

D. Prime or seal joints surfaces as recommended by the caulking/sealant manufacturer and as shown.

E. Confine primer or sealer to areas of the compression seal and caulking/sealant bond area.

3.02 APPLICATION

A. General

1. Install material in accordance with manufacturer's recommendations for materials intended use and instructions using appropriate and approved equipment, except where more stringent requirements are shown or specified.

2. Prevent caulking, sealant and compounds from spilling onto adjoining surfaces or to migrate into voids of exposed finishes by using masking tape or other methods. Clean spill on adjoining surfaces immediately.

B. Sealant and Accessories

1. Sealant shall be used on slab and wall control and expansion joints, pipe sleeves through walls and roofs, and on joints and cracks.

2. Install backup material to control caulking depth in accordance with sealant manufacturer's instructions.

3. Place sealant in a manner that will fill the joint without air pockets and form a smooth surface. For exposed surfaces of gun and knife grade sealant that cannot be made smooth during initial application, smooth with tool moistened with either water or sealant solvent.

4. Prepare sealant mixtures in quantities that can be applied within the time period recommended by the manufacturer. Materials mixed and not used within this time period shall be discarded.

5. Finish joint to a smooth concave surface slightly lower than adjoining surfaces except horizontal surfaces shall have joints finished so moisture and debris will not be entrapped. Finished surface shall be free of wrinkles and sags.

3.03 CAULKING

A. Caulking compound shall be used for caulking of interior and exterior doors, windows, louvers, frames, and elsewhere as necessary and shall be applied in accordance with the manufacturer's recommendations.

3.04 CURING AND PROTECTION

A. Cure joint sealers and accessories in accordance with manufacturer's instructions.

B. Protect joint sealers during construction period to prevent damage, soiling or deterioration other than normal wear and weathering up to time of final acceptance. Replace or restore joint sealers damaged, soiled or deteriorated, as directed.

3.05 CLEANUP

A. Clean adjacent surfaces of sealant and soiling resulting from the joint sealer operations. Use cleaning materials and methods recommended by manufacturer for the different surfaces.

END OF SECTION

SECTION 08220

FIBERGLASS REINFORCED PLASTIC (FRP) DOORS

PART 1 - GENERAL

1.01 SUMMARY

A. Work performed under this section includes, but is not limited to, furnishing all labor, tools, materials and services necessary to furnish and install fiberglass reinforced plastic (FRP) doors as shown on the drawings and specified herein.

B. The doors shall be furnished complete with fiberglass resin transfer molded door frames, transoms and removable mullions, as shown.

1.02 SUBMITTALS

A. Shop Drawings: Submit detailed fabrication and installation drawings prior to fabrication. Include door type, frame type, size, handing, accessories and hardware. Include front and rear door elevations showing hardware, bill of materials and dimensional locations of each hardware item and FRP part or product. Provide construction and mounting detail for each frame, transom and mullion type.

B. Product Data: Submit manufacturer's product data for all materials in this specification. Include a statement acknowledging that the products submitted meet the requirements of specifications and referenced standards. Include certificates of compliance, manufacturer's installation instructions, details of core and edge construction, and certification of manufacturer's qualifications.

1.03 QUALITY ASSURANCE

A. Manufacturer Qualifications: Fabrication shall be by a firm experienced in the manufacturing of FRP doors similar to those indicated for this project and with a record of 25-years of documented experience and successful in-service performance.

B. Source Limitations: FRP doors and frames shall be obtained from one source and fabricated by a single manufacturer.

1.04 DELIVERY, STORAGE AND HANDLING

A. Doors and frames shall be crated for protection from damage in the manufacturer's original containers, and clearly marked with the project information. Each crate shall contain all fasteners necessary for installation as well as complete installation instructions.

B. Doors shall be stored on edge in the original container out of inclement weather.

1.05 WARRANTY

A. Warranty FRP doors and frames for a period of 25-years against corrosion. Additionally, warranty FRP doors and frames against defects in materials and workmanship for a period of 10-years, including warp, separation or delamination, and expansion of the core.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Subject to compliance with requirements, manufacturers that may be used include:

1. Chem-Pruf Door Co., Ltd., Brownsville, Texas,

2. Warminster Fiberglass Company, Southampton, Pennsylvania,

3. or approved equal.

2.02 FRP DOORS

A. Door Slabs: Fiberglass reinforced plastic (FRP) construction using resins tailored to a high humidity, corrosive environment and shall have a fiberglass content of 25-percent by weight. The doors shall be flush construction, having no seams or cracks. All mortises shall be molded in at the factory. The doors shall be 1¾ inches thick with a 25-mil color gelcoat and have an R-factor of 12. Secondary painting over pultrusions to achieve color is not acceptable. Adequate reinforcing and compression members shall be used to accommodate hinges, closers, locksets, kickplates, etc.

B. Door Plates: ⅛-inch thick, molded in one continuous piece, starting with a 25-mil gelcoat of the color specified, integrally molded with at least two layers of 1.5-ounce per square foot fiberglass mat and one layer of 16-ounce per square yard unidirectional roving to yield a plate weight of 0.97 lbs per square foot at a ratio of 30/70 glass to resin.

C. Internal Stiles and Rails: The stile and rail shall be molded in one continuous piece to a U-shaped configuration and to the exact dimensions of the door, with no miter joints or disparate materials used. Hollow pultruded shapes shall not be used.

D. Core: 2 psf expanded polyurethane foam, which completely fills all voids between door plates.

E. Internal Reinforcement: shall be firestop of sufficient amount to adequately support required hardware and function of same.

F. Finish: Door and frame shall be gray in color and have identical texture. At time of manufacture, 25-mil of resin-rich gelcoat shall be integrally molded into both door and frame. Secondary painting to achieve color is not acceptable.

2.03 FRP DOOR ACCESSORIES

A. Transoms: Transoms shall be identical to the door slab in construction, materials, thickness and reinforcement, and shall be hinged similar to door. Transom shall include bolts on the interior side to lock each transom panel in the closed position.

B. Transom and Mullion Hardware: Removable mullion shall be connected to the door frame using stainless steel angle beam clips bolted to the interior side of the frame leg and mullion header on each end, such that the mullion will remain completely level. The angles and bolts shall be designed such that the mullion can be removed and reinstalled easily an unlimited number of times without having to make any modifications or repairs to reinstall, and such that the mullion will be completely level in its original location after each re-installation. Each transom shall be held in place with a minimum of four (4) heavy-duty 304 stainless steel surface bolts mounted on the interior side. Each transom shall be provided with two (2) 304 stainless steel pull handles mounted on the interior side for ease of handling transom during installation and removal. Pull plates shall be 4” x 16”, 0.050 inches thick, 8 inches long, with a 2-inch clearance.

C. Cutout: Standard cutout for door and/or transom penetrations shall be bound with a neoprene keeper made from FRP astragal. Neoprene shall be cut in the field to fit exactly around the I-beam with a maximum clearance of ⅛-inch.

D. Threshold: Fiberglass grooved saddle ½-inch threshold, 5-inches wide, color molded in to match doors with stainless steel fasteners, Chem-Pruf FRP Threshold, or approved equal.

E. Weatherstrip: Self-adhesive, high-grade silicone V-strip door gasket/weatherstrip, Pemko, or approved equal.

F. Astragals: Molded fiberglass 2½-inch wide astragal with seal, color molded in to match doors and stainless steel screws, Chem-Pruf FRP Astragal, or approved equal.

G. Door Sweep: Molded fiberglass with neoprene wiper, color molded in to match doors and stainless steel screws, Chem-Pruf FRP Door Sweep w/Neoprene, or approved equal.

2.04 FRAMES

A. Frames: Fiberglass and manufactured using resin transfer method in closed rigid molds to assure uniformity in color and size. Beginning with a minimum 25-mil gelcoat and a minimum of two layers continuous strand fiberglass mat saturated with resin, the frame shall be solid, flat back, of one-piece construction with molded

stop. All frame profiles up to ¾-inch shall be solid fiberglass. All frame profiles greater than ¾-inch shall have a core material of 2 psf polyurethane foam. Metal frames or pultruded fiberglass frames are not acceptable.

B. Finish: Door and frame shall be identical in color and texture. At time of manufacture, 25-mil of resin-rich gelcoat shall be integrally molded into both door and frame. Secondary painting to achieve color is not acceptable.

C. Jamb/Header: Connection shall be CNC machined for a tight mitered fit.

D. Internal Reinforcement: Continuous within the structure to allow for mounting of specified hardware. Material shall be completely non-organic with a minimum hinge screw holding value of 656 lbs. Frame screw holding value to accommodate screw shall be a minimum of 1,000 lbs. per screw.

E. Mortises: For hardware shall be accurately machined by CNC or molded standard duty to facilitate heavy duty hinges at all hinge locations, using spacers when standard weight hinges are used.

2.05 HARDWARE

A. General: All hardware shall be stainless steel unless otherwise noted and furnished and installed by the door and frame manufacturer.

B. Locks:

1. Entrance: Locksets shall be mortise type, suitable for receiving standard Town of Emmitsburg cylinders, and shall be keyed for the Town of Emmitsburg's standard key. Mortise lockset shall be Corbin Russwin ML 2051 LWA, US32D, or approved equal.

a. Contractor shall coordinate locks and keying with the Owner.

b. Provide one (1) key.

2. Privacy: Locksets shall be suitable for bathroom applications and shall contain deadbolt by thumb turn lever inside or by emergency release tool outside. Lockset shall be Corbin Russwin ML 2030 LWA, US32D, or approved equal.

3. Panic Devices:

a. Panic devices for single doors with a maximum opening less than 4 feet by 7 feet shall be a panic mortise exit device suitable for receiving standard Town of Emmitsburg cylinders and shall be keyed for the Town of Emmitsburg's standard key. Panic mortise exit device and mortise lockset shall be Corbin Russwin ED5600 L9M55, US32D, or approved equal.

b. Panic devices for double doors with a maximum active door opening of 4 feet by 10 feet shall be a surface mount vertical rod panic device suitable for receiving standard Town of Emmitsburg cylinders and shall be keyed for the Town of Emmitsburg's standard key. Surface mount vertical rod panic device and lockset shall be Corbin Russwin ED5470 L955, US32D, or approved equal.

c. Contractor shall coordinate locks and keying with the Owner.

d. Provide one (1) key.

C. Hinges: Full mortise, standard weight, ball bearing hinges with non-removable stainless steel pins.

D. Closer: Corrosion resistant aluminum, size as recommended by the door manufacturer, with sweep speed, latch speed, backcheck cushioning, backcheck positioning, and a thumb turn hold open feature, Norton Series 7500CLP-T, or approved equal. For double doors, closers shall be furnished and installed on both active and passive doors.

E. Bolts:

1. Zinc-plated steel surface bolt and strike equipped with a strong hard-drawn wire spring, which throws the bolt automatically when chain is released, Stanley 1055 Chain Bolt, or approved equal, with extra chain as indicated.

2. 304 stainless steel barrel bolt and stop, Chem-Pruf BBS 1, or approved equal.

F. Kickplate: 304 stainless steel, Trimco Model 1034, or approved equal.

G. Door Stops: Where possible, provide wall-mounted type bumpers. Where wall bumper is not practical, provide floor mounted dome stop.

H. Push/Pulls: 304 stainless steel, Trimco Models 1001 and 1017, or approved equal.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install door-opening assemblies in accordance with shop drawings and manufacturer's written installation instructions, using installation methods and materials specified in installation instructions.

B. Field alteration of doors or frames to accommodate field conditions is prohibited.

C. Maintain plumb and level tolerances specified in manufacturer's printed installation instructions.

3.02 ADJUSTING

A. Adjust doors in accordance with door manufacturer's maintenance instructions to swing open and shut without binding and to remain in place at any angle without being moved by gravitational influence.

B. Adjust door hardware to operate correctly in accordance with hardware manufacturer's maintenance instructions.

3.03 FRAME SCHEDULES

A. F-1 Frame is ¾-inch solid fiberglass.

B. F-2 Frame is ¾-inch solid fiberglass with a 2⅝-inch return on one side, which trims the opening to conceal unsightly or rough wall surfaces.

C. F-3 Frame is a 2-inch profile equal rabbet frame to SDI standard dimensions.

D. F-4 Frame is a 2-inch profile single rabbet frame with a maximum width of 9 inches.

3.04 CLEANING

A. Clean surfaces of door opening assemblies and exposed door hardware in accordance with respective manufacturer's maintenance instructions.

END OF SECTION

SECTION 08310

ACCESS HATCHES

PART 1 - GENERAL

1.01 SUMMARY

A. Contractor shall provide all materials, labor, equipment, and services necessary to furnish and install factory-fabricated access hatches as shown on the Contract Drawings and specified herein.

B. Access hatches installed within existing floors shall be furnished with a retrofit angle frame. The retrofit frame shall have side mounting holes to allow the frame to be fastened from within the access opening.

C. Access hatches shall be constructed of aluminum, and shall be non-corrosive, durable and structurally sound.

D. Not all types of access hatches specified herein are necessarily required for this project. Refer to the Access Hatch Schedule on the Contract Drawings for the specific types of hatches and quantity of each to be provided.

1.02 SUBMITTALS

A. Shop Drawings: Submit detailed fabrication and installation drawings prior to fabrication. Show profiles, accessories, locations, and dimensions.

B. Product Data: Submit manufacturer's product data for all materials in this specification.

C. Warranty: Submit manufacturer's written warranty.

1.03 QUALITY ASSURANCE

A. Fabricator Qualifications: Fabrication shall be by a firm experienced in the manufacturing of access hatches similar to the hatches indicated for this project and with a record of successful in-service performance.

B. Design Standards: Comply with ASTM A36-93a, "Standard Specification for Structural Steel".

1.04 DELIVERY, STORAGE AND HANDLING

A. All materials shall be delivered to the job site in manufacturer's original packaging.

B. Store materials in a dry, protected, well-vented area. The Contractor shall thoroughly inspect product upon receipt and report damaged material immediately to delivering carrier and note such damage on the carrier's freight bill of lading.

C. Remove protective wrapping immediately after installation.

1.05 JOB CONDITIONS

A. Mounting surfaces shall be straight and secure; substrates shall be of proper width.

B. Refer to the contract documents, shop drawings, and manufacturer's installation instructions.

C. Observe all applicable OSHA safety guidelines for this work.

1.06 WARRANTY

A. Access hatches shall be free of defects in material and workmanship for a period of ten (10) years. Should a part or material fail to function in normal use within this period, manufacturer shall furnish a new part at no charge.

PART 2 - PRODUCTS

2.01 GENERAL PURPOSE ACCESS HATCH

A. The access hatch shall be pre-assembled from the manufacturer, suitable for installation within new concrete, and installed with the access hatch size and hinge locations as shown on the contract drawings. The access hatch shall be Model APS for single leaf hatches or Model APD for double leaf hatches, as manufactured by U.S.F. Fabrication, Inc., or approved equal.

B. Hatch Panel: The cover of the hatch panel shall be ¼-inch thick aluminum diamond plate, reinforced to withstand 300 p.s.f. live load. The hatch panel shall open to 90 degrees, be equipped with a flush lifting handle that does not protrude above the cover, and a 316 stainless steel hold open arm with a vinyl grip that automatically keeps the panel in its upright open position. The door shall be equipped with a watertight 316 stainless steel slamlock with threaded plug, removable outside key, and fixed inside handle. The slamlock shall latch onto a 316 stainless steel striker plate that is bolted to the frame. When shown, 18-inch square aluminum swaged grating shall be centered in the hatch panel to promote ventilation. Grating shall be comprised of aluminum 1" by $^{3}/_{16}$" bearing bars spaced at $1^{3}/_{16}$" center to center, cross bars spaced 4" center to center, and 1" by $^{3}/_{16}$" banding bars.

C. Frame: The frame shall be extruded aluminum angle frame with an integral anchor flange and door seat on all four sides. A bituminous coating shall be applied to the frame exterior where it will come in contact with concrete. The frame shall be fitted with a vinyl cushion for noise dampening, and an aluminum frame skirt for ease of

installation. The combined depth of the skirt and frame shall equal the thickness of the concrete slab.

D. Hinges: The door shall have 316 stainless steel hinges with 316 stainless steel tamper resistant bolts/locknuts.

E. Lifting Mechanisms: Manufacturer shall provide the required number and size of enclosed spring operators to provide smooth, easy, and controlled cover operation throughout the entire arc of opening and to act as a check in retarding downward motion of the cover when closing. Spring and spring enclosures shall be stainless steel. Operation of cover shall not be affected by temperature.

F. Locking: The access hatch shall be equipped with a recessed staple to accept an Owner supplied padlock.

G. Hardware: All hardware shall be Type 316 stainless steel throughout, unless otherwise noted.

2.02 GENERAL PURPOSE ACCESS HATCH (RETROFIT)

A. The access hatch shall be pre-assembled from the manufacturer, suitable for installation within existing concrete openings, and installed with the access hatch size and hinge locations as shown on the contract drawings. The access hatch shall be Model APS RETROFIT for single leaf hatches or Model APD RETROFIT for double leaf hatches, as manufactured by U.S.F. Fabrication, Inc., or approved equal.

B. Hatch Panel: The cover of the hatch panel shall be ¼-inch thick aluminum diamond plate, reinforced to withstand 300 p.s.f. live load. The hatch panel shall open to 90 degrees, be equipped with a flush lifting handle that does not protrude above the cover, and a 316 stainless steel hold open arm with a vinyl grip that automatically keeps the panel in its upright open position. The door shall be equipped with a watertight 316 stainless steel slamlock with threaded plug, removable outside key, and fixed inside handle. The slamlock shall latch onto a 316 stainless steel striker plate that is bolted to the frame. When shown, 18-inch square aluminum swaged grating shall be centered in the hatch panel to promote ventilation. Grating shall be comprised of aluminum 1" by $^{3}/_{16}$" bearing bars spaced at $1^{3}/_{16}$" center to center, cross bars spaced 4" center to center, and 1" by $^{3}/_{16}$" banding bars.

C. Frame: The extruded aluminum angle frame shall have $^{9}/_{16}$-inch diameter mounting holes on the vertical leg of the frame for bolting to the existing floor, and a horizontal flange with an integral door seat on all four sides. The horizontal leg of the frame will have a beveled edge that slopes to the floor surface. A bituminous coating shall be applied to the frame exterior where it will come in contact with concrete. The frame shall be fitted with a vinyl cushion for noise dampening.

D. Hinges: The door shall have 316 stainless steel hinges with 316 stainless steel tamper resistant bolts/locknuts.

E. Lifting Mechanisms: Manufacturer shall provide the required number and size of enclosed spring operators to provide smooth, easy, and controlled cover operation throughout the entire arc of opening and to act as a check in retarding downward motion of the cover when closing. Spring and spring enclosures shall be stainless steel. Operation of cover shall not be affected by temperature.

F. Locking: The access hatch shall be equipped with a recessed staple to accept an Owner supplied padlock.

G. Hardware: All hardware shall be Type 316 stainless steel throughout, unless otherwise noted.

2.03 WATERTIGHT ACCESS HATCH

A. The access hatch shall be pre-assembled from the manufacturer, suitable for installation within new concrete, and installed with the access hatch size and hinge locations as shown on the contract drawings. The access hatch shall be a singe leaf hatch, Model W-APS as manufactured by U.S.F. Fabrication, Inc., or approved equal.

B. Hatch Panel: The cover of the hatch panel shall be ¼-inch thick aluminum diamond plate, reinforced to withstand 1,560 p.s.f. live load (capable of holding up to 25 feet head of water). The bottom of the cover shall have a continuous groove to securely hold a $^{9}/_{16}$-inch diameter EPDM gasket around its perimeter. The cover shall have 316 stainless steel floodtight cam locks to compress the gasket so that the door will not leak from standing water. The hatch panel shall open to 90 degrees, be equipped with a flush floodtight handle that does not protrude above the cover, and a 316 stainless steel hold open arm with a vinyl grip that automatically keeps the panel in its upright open position.

C. Frame: The frame shall be ⅜-inch thick angle frame with $^{3}/_{16}$" x 1½" strap anchors welded around the frame for casting into concrete. A bituminous coating shall be applied to the frame exterior where it will come in contact with concrete. An aluminum frame skirt shall be provided for ease of installation. The combined depth of the skirt and frame shall equal the thickness of the concrete slab.

D. Hinges: The door shall have 316 stainless steel hinges with 316 stainless steel tamper resistant bolts/locknuts.

E. Lifting Mechanisms: Manufacturer shall provide the required number and size of enclosed spring operators to provide smooth, easy, and controlled cover operation throughout the entire arc of opening and to act as a check in retarding downward motion of the cover when closing. Spring and spring enclosures shall be stainless steel. Operation of cover shall not be affected by temperature.

F. Locking: The access hatch shall be equipped with a staple to accept an Owner supplied padlock. The Manufacturer's watertight hatch cam lock wrench shall also be provided.

G. Hardware: All hardware shall be Type 316 stainless steel throughout, unless otherwise noted.

2.04 WATERTIGHT ACCESS HATCH (RETROFIT)

A. The access hatch shall be the same watertight access hatch as mentioned above, with modifications to the frame to be suitable for installation into existing concrete openings.

B. Frame: The standard extruded aluminum angle anchor straps shall be removed from the frame by the manufacturer. The frame shall be provided to have $^{9}/_{16}$-inch diameter mounting holes on the vertical leg of the frame for bolting to the existing floor, and a horizontal flange with an integral door seat on all four sides. A bituminous coating shall be applied to the frame exterior where it will come in contact with concrete. A continuous EPDM gasket shall be mechanically attached to the aluminum frame to create a floodtight barrier around the entire perimeter of the cover to maintain the floodtight rating of the access hatch.

2.05 H20 ACCESS HATCH

A. The access hatch shall be pre-assembled from the manufacturer, suitable for installation within new concrete, and installed with the access hatch size and hinge locations as shown on the contract drawings. The access hatch shall be Model AHS for single leaf hatches or Model AHD for double leaf hatches, as manufactured by U.S.F. Fabrication, Inc., or approved equal.

B. Hatch Panel: The cover of the hatch panel shall be ¼-inch thick aluminum diamond plate, reinforced to withstand AASHTO H20-44 wheel load. The hatch panel shall open to 90 degrees, be equipped with a flush lifting handle that does not protrude above the cover, and a 316 stainless steel hold open arm with a vinyl grip that automatically keeps the panel in its upright open position. The door shall be equipped with a watertight 316 stainless steel slamlock with threaded plug, removable outside key, and fixed inside handle. The slamlock shall latch onto a 316 stainless steel striker plate that is bolted to the frame.

C. Frame: The frame shall be extruded aluminum angle frame with an integral anchor flange and door seat on all four sides. A bituminous coating shall be applied to the frame exterior where it will come in contact with concrete. An aluminum frame skirt shall be provided for ease of installation. The combined depth of the skirt and frame shall equal the thickness of the concrete slab.

D. Hinges: The door shall have 316 stainless steel hinges with 316 stainless steel tamper resistant bolts/locknuts.

E. Lifting Mechanisms: Manufacturer shall provide the required number and size of enclosed spring operators to provide smooth, easy, and controlled cover operation throughout the entire arc of opening and to act as a check in retarding downward

motion of the cover when closing. Spring and spring enclosures shall be stainless steel. Operation of cover shall not be affected by temperature.

F. Locking: The access hatch shall be equipped with a recessed staple to accept an Owner supplied padlock.

G. Hardware: All hardware shall be Type 316 stainless steel throughout, unless otherwise noted.

2.06 H20 WATERTIGHT ACCESS HATCH

A. The access hatch shall be pre-assembled from the manufacturer, suitable for installation within new concrete, and installed with the access hatch size and hinge locations as shown on the contract drawings. The access hatch shall be a single leaf hatch, Model W-AHS as manufactured by U.S.F. Fabrication, Inc., or approved equal.

B. Hatch Panel: The cover of the hatch panel shall be ¼-inch thick aluminum diamond plate, reinforced to withstand an AASHTO H20-44 wheel load (capable of holding up to 25 feet head of water). The bottom of the cover shall have a continuous groove to securely hold a $^{9}/_{16}$-inch diameter EPDM gasket around its perimeter. The cover shall have 316 stainless steel floodtight cam locks to compress the gasket so that the door will not leak from standing water. The hatch panel shall open to 90 degrees, be equipped with a flush floodtight handle that does not protrude above the cover, and a 316 stainless steel hold open arm with a vinyl grip that automatically keeps the panel in its upright open position.

C. Frame: The frame shall be ⅜-inch thick angle frame with $^{3}/_{16}$" x 1½" strap anchors welded around the frame for casting into concrete. A bituminous coating shall be applied to the frame exterior where it will come in contact with concrete. An aluminum frame skirt shall be provided for ease of installation. The combined depth of the skirt and frame shall equal the thickness of the concrete slab.

D. Hinges: The door shall have 316 stainless steel hinges with 316 stainless steel flat head bolts.

E. Lifting Mechanisms: Manufacturer shall provide the required number and size of enclosed spring operators to provide smooth, easy, and controlled cover operation throughout the entire arc of opening and to act as a check in retarding downward motion of the cover when closing. Spring and spring enclosures shall be stainless steel. Operation of cover shall not be affected by temperature.

F. Locking: The access hatch shall be equipped with a cylinder lock and watertight screw lid. Four (4) keys, keyed to lock/unlock the hatch, shall be provided for each hatch. The Manufacturer's watertight hatch cam lock wrench shall also be provided.

G. Hardware: All hardware shall be Type 316 stainless steel throughout, unless otherwise noted.

PART 3 - EXECUTION

3.01 INSPECTION

A. Verify that the substrate is suitable, dry, clean and free of foreign matter. Correct any defects prior to installation.

3.02 INSTALLATION

A. The Contractor shall field verify dimensions and project conditions and verify the manufacturer's access hatch details for accuracy to fit the application prior to fabrication. The Contractor shall comply with the access hatch manufacturer's installation instructions.

B. The Contractor shall furnish mechanical fasteners, as necessary, in accordance with the access hatch manufacturer's instructions.

C. Access hatches shall be installed so that the hinges are as shown on the contract drawings.

D. Access hatches shall be installed flush with the finished floor.

END OF SECTION

SECTION 09900

PAINTING

PART 1 - GENERAL

1.01 DESCRIPTION

A. Related Work Specified Elsewhere:

1. Sealants and Caulking: Section 07900.

2. Pre-finishing or shop priming requirements as specified in various other Sections of these Specifications.

1.02 QUALITY ASSURANCE

A. Applicator Qualifications: Painting applicator shall show evidence of acceptability as a qualified applicator by the manufacturer of products specified herein. Submit such evidence with Submittals as specified herein.

B. Referenced Standards:

1. Steel Structures Painting Council Surface Preparation Specifications:

a. SSPC-SP1, Solvent Cleaning.

b. SSPC-SP2, Hand Tool Cleaning.

c. SSPC-SP 3, Power Tool Cleaning

d. SSPC-SP6, Commercial Blast Cleaning.

e. SSPC-SP7, Brush-Off Blast Cleaning.

f. SSPC-SP10, Near-White Blast Cleaning.

g. SSPC-SP12, Water Jet Cleaning

h. SSPC-SP13/NACE #6 Surface Preparation of Concrete

i. SSPC-SP16 "Brush-off Blast Cleaning of Coated and Uncoated Galvanized Steel, Stainless Steels, and Non-ferrous Metals"

2. ASTM D6386, Standard Practice for Preparation of Zinc (Hot-Dip Galvanized) Coated Iron and Steel Product and Hardware Surfaces for Painting.

1.03 SUBMITTALS

A. Paint Schedule and Shop Drawings as specified in Section 01000.

B. Samples: Submit sample color chips of standard colors and samples of any intermixes required.

C. Schedule and Product Data: Submit paint schedule in same format as the paint schedule herein and indicate which of the selected manufacturer's products are intended for use. Do not perform painting or coating work without Owner's Representative's approval of submitted paint schedule.

D. Certificates: Paint manufacturer's direct factory representative shall certify in writing to the Owner's Representative painting and coating compliance with the following:

1. Factory representative's initial site inspection of conditions pertinent to painting and coating work with Contractor or his authorized painting representative.

2. Factory representative's second site inspection at completion of painting and coating work to check proper application and actual mil thickness compliance with these Specifications.

3. Certification issued to Owner's Representative only following unacceptable painting and coating work being rectified to Owner Representative's satisfaction.

4. Factory representative shall make his services available to the Owner's Representative for immediate consultation in regard to the painting and coating work and shall make above stated inspections in the Owner Representative's presence.

E. Operation and Maintenance Data: Upon approval of painting schedule, submit five copies of detailed maintenance manuals, including the following information:

1. Name, address and telephone number of manufacturer and local distributor.

2. Product name, number and technical data sheet for each type of paint.

3. Detailed procedures for routine maintenance and cleaning.

4. Detailed procedure for light repairs such as dents, scratches and staining.

F. Maintenance Materials: Turn over to Owner upon completion of the project a full set of pipeline identification stencils.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver paint materials to job site in their original unopened containers with labels intact and legible at time of use.

B. Store approved materials at the job site in a suitable and designated area restricted to storage of paint and coating materials and related equipment.

C. Use all means necessary to ensure safe storage and use of paint and coating materials and the prompt and safe disposal of waste. Store paint and coating products protected from weather when such products may be affected by freezing.

1.05 JOB CONDITIONS

A. Field and Shop Coat Compatibility: To ensure satisfactory paint and coating performance, it is a Contract requirement that products applied in the shop and field be mutually compatible.

1. Contractor shall require fabricators and equipment manufacturers to apply shop coats that are compatible with field coats specified herein.

2. Above requirement does not apply to full factory-finished items, that is, items having both primer and final finish coatings, except as specified in the following paragraphs.

B. Painting Factory-Finished Equipment: Equipment, such as motors, pumps and other such items, which when installed become an integral part of a system and which may be delivered fully factory-finished (that is, having finish coatings in addition to the prime coating) shall not require repainting in the field unless:

1. Factory finish is unacceptable to the Owner's Representative, that is, not having generic type of paint or proper mil thickness to withstand corrosive atmosphere of wastewater facilities; or,

2. Factory finish is damaged.

On factory-finished items requiring repainting, first sand existing paint to a dull finish and then repaint with scheduled finish system for the installed location of such factory-finished items.

C. Painting Caulking Compound: Do not apply paint over caulking compound until integral solvents have been released from the compound; usually two weeks for butyl-rubber based caulking and one day for acrylic latex caulking.

D. Color:

1. As directed by the Owner's Representative.

2. Paint equipment not furnished with a factory finish, or not finished with an acceptable factory finish, and piping and conduits the same color as adjacent surface.

3. Final work shall match Owner's Representative approved samples. Owner's Representative shall select colors where not indicated or specified with no extra compensation allowed the Contractor for such.

E. Placing into Service: Do not place painted items into service until paints and coatings are fully cured (dry-hard).

F. Environmental Requirements:

1. Adhere to manufacturer's data on air and surface temperature limits and relative humidity during application and curing of coatings.

2. Do not spray-apply paint when wind velocity is above 15 mph.

3. Schedule coating work to avoid dust and airborne contaminants.

4. Apply exterior finishes during daylight hours only.

5. When painting must be done in confined spaces, or because of unfavorable ambient conditions, longer drying times will be necessary.

6. Provide supplementary ventilation such as fans and blowers in confined or enclosed areas to carry off solvents during the evaporation stage.

G. Protection:

1. Protect paint materials before, during and after application, and protect other work and materials with drop cloths or other impervious material.

2. Clean up or otherwise remedy without additional cost, damage by paint and coatings to public or private property.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Paint: As specified in the PAINT SCHEDULE included herein.

B. Thinners: Only those thinners recommended for that purpose by the manufacturer of material to be thinned.

2.02 MATERIALS

A. Paint: As specified in the PAINT SCHEDULE included herein.

B. Thinners: Only those thinners recommended for that purpose by the manufacturer of material to be thinned.

PART 3 - EXECUTION

3.01 SURFACE PREPARATION

A. Ferrous Metal:

1. Shop Primed:

a. Immediately before paint application, clean sand, dust, mud, dirt and other foreign matter from shop coat.

b. Touch-up damaged or destroyed shop paint.

c. Surface preparation of surfaces to be touched-up must be as effective as those specified for shop painting.

d. If required by primer or finish coat manufacturer, sand or abrasive clean primer prior to finish coating. Verify maximum recoat time.

2. Not Shop Primed and Submerged or Intermittently Submerged in Liquid:

a. Grind smooth to a rounded contour sharp edges and welds and remove weld splatter.

b. Except for insides of pipes, abrasive blast in accordance with SSPC-SP10.

c. After abrasive blasting, remove dust and spent abrasive from surface by brushing or vacuum cleaning.

d. Apply prime coat before surface starts to rust.

e. Do not allow abrasive blasted surface to stand overnight before coating.

3. Not Shop Primed and Non-Submerged:

a. Grind smooth to a rounded contour sharp edges and welds and remove weld splatter.

b. Abrasive blast in accordance with SSPC-SP6.

c. After abrasive blasting, remove dust and spent sand from surface by brushing or vacuum cleaning.

d. Apply prime coat before surface starts to rust.

e. Do not allow abrasive blasted surface to stand overnight before coating.

B. Galvanized Metal Including Pipes and Conduits:

1. Clean in accordance with the ASTM D6386 and SSPC-SP16.

a. Apply prime coat before surface starts to rust or oxidize.

b. Do not allow cleaned surfaces to stand overnight before coating.

C. Copper Pipe:

1. Solvent clean in accordance with SSPC-SP1.

2. Allow to dry before application of paint.

D. Shop Bituminous Coated Pipe:

1. Non-Submerged: Commercial blast per SSPC-SP6.

2. Submerged: Near White Metal Blast per SSPC-SP10.

E. Polyvinyl Chloride Pipe:

1. Lightly sand off sheen and clean.

F. Existing Concrete:

1. Remove all existing coatings, contaminants, laitance, and weak concrete using impact or power tool methods per ASTM D4259 or SSPC-SP13/NACE #6 Surface Preparation of Concrete. Staining over existing paint will not be permitted.

2. After removal of all existing paint, clean bare concrete surfaces free of dirt, oil, grease, dust, etc. using a cleaner recommended by the new concrete stain manufacturer. Rinse surfaces and allow them to dry thoroughly.

3. Repair all cracked, damaged, and spalled concrete in accordance with the International Concrete Repair Institute (ICRI) Guideline No. 03732.

4. Prepare a surface profile in accordance with the new stain manufacturer's recommendations. Apply new stain only on clean and dry concrete surfaces.

G. New Concrete: Clean in accordance with ASTM D4258 or SSPC-SP13

1. Remove oil, grease, dirt, etc. by steam cleaning or scrubbing with a strong commercial type detergent and flushing with water.

2. Neutralize and flush clean chemical contamination.

3. Fill exposed aggregate or deep pits and air holes with cement grout and trowel to a uniform surface texture.

4. Perform work only on cured, clean and dry concrete surfaces.

H. Pipe Insulation:

1. Clean free of dirt, dust or other foreign matter.

I. Mechanical and Electrical Systems:

1. Clean free of dust, mud, dirt, sand and other foreign matter.

2. Solvent clean or otherwise degrease surfaces; exercise care not to damage surfaces.

3. Do not paint factory painted surfaces of mechanical and electrical components in such systems; does not include galvanized surfaces.

4. Do not paint light fixtures.

J. Wood:

1. For existing painted surfaces, remove loose and peeling paint, de-gloss surface if recommended by the paint manufacturer, sand smooth, and clean.

2. Scrape and clean knots and apply coat of knot sealer before applying primer.

3. Sand surfaces that will be exposed to view, and dust them off.

4. Prime edges, ends, faces, undersides, and backsides of all wood.

5. After priming, fill holes and imperfections in the finished surfaces with putty or plastic wood filler. Sand smooth when dried.

3.02 APPLICATION

A. General:

1. Strictly follow paint manufacturer's label instructions for mixing, thinning, proper spreading rate and drying time. In no case shall film thickness be less than manufacturer's recommendations nor shall area coverage per gallon exceed manufacturer's recommendations.

2. If material has thickened or must be diluted for application, the coating shall be built up to the same film thickness achieved with undiluted material. Do not use thinner to extend coverage of the paint.

3. Regardless of the surface, it shall be the painter's responsibility to achieve a protective and decorative finish either by decreasing the coverage or by applying additional coats of paint.

B. Method of Application:

1. Workmanship: In general, finished surface regardless of method of paint application shall show no evidence of improper application according to accepted trade practice. Do not use paint rollers having nap exceeding ⅜-inch.

2. Multi-coat Application:

a. Succeeding coats of paint shall show visual difference from preceding coats. Each coat shall have a uniform appearance and be tinted to the final coat. The final coat shall present solid hiding with edges of paint adjoining other paint or materials made clean with and sharp without overlap. Wipe or otherwise render undercoats dust free just prior to application of succeeding coatings.

b. Do not apply additional coats of paint until the film to be recoated is sufficiently cured to receive the next coat.

c. If the time limit is exceeded for coatings that have a maximum recoat time, consult paint manufacturer before proceeding with next coat.

C. Painting Exposed/Concealed Surfaces:

1. It is a requirement of this specification that all exposed interior surfaces be painted except as specified herein and elsewhere in the Specifications. Interior surfaces to be covered by ceiling/wall mounted equipment, electrical panels, etc. shall be painted prior to hanging/mounting the equipment. Mounting equipment and painting around it is unacceptable.

2. Exterior surfaces painted only as scheduled.

3. In interior exposed areas of structures, paint mechanical and electrical systems, including pipe, duct and conduit system, except for full factory finished items as defined previously.

4. In interior concealed areas no painting is required including mechanical and electrical systems therein, except that pipe identification is required on piping in concealed but accessible areas.

5. Paint above stated exposed mechanical and electrical systems the same color as adjacent wall and/or ceiling color. Paint materials as scheduled herein.

6. Do not paint exposed aluminum surfaces or rubber components.

D. Pipe Line Identification:

1. After finish painting, mark non-submerged piping with an applicable color band bearing the stenciled name of its contents. Identify piping at valves and fittings, piping on both sides of walls and floors where pipes pass through same and on long pipe runs approximately every 30 feet or closer when directed.

2. Also adjacent to the color band, stencil the pipe size and an arrow indicating direction of flow in the pipe. Color pipe size identification and flow arrow the same as the lettering.

3. Place legend, pipe size and flow arrow in location so that it can be easily read from the floor.

4. Where pipes are adjacent to each other, arrange legends neatly in line.

5. Use block style lettering with letter size and color band width in accordance with the following table:

Pipe Outside Diameter	Color Band Width	Letter Size
¾" to 1¼"	8"	½"
1½" to 2"	8"	¾"
2½" TO 6"	12"	1¼"
8" TO 10"	24"	2½"
Over 10"	32"	3½"

6. Identify pipelines less than ¾" outside diameter with brass or aluminum tags.

7. Schedule for pipeline identification as follows:

Service	Band Color	Lettering Color
Drain	OSHA Safety Black	White
Fuel Oil	OSHA Safety Yellow	Black
Potable Water	Light Blue	White
Wastewater	Light Gray ANSI Z55.1	Black

E. Pump and Motor Identification:

1. Use 3½" block style lettering to paint equipment identification numbers on pumps and motors as applicable or as directed by the Engineer. Lettering color shall be black.

3.03 CLEANING

A. Upon completion of work, remove paint and coating spots, oil and grease stains from floors, walls, fixtures, hardware and equipment, leaving their finishes in a satisfactory condition. Remove materials and debris from the site of work and leave in a clean condition so far as this work is concerned.

B. Keep site free from accumulation of paint containers, solvents, and thinner and used cleaning cloths and legally dispose of same off premises daily.

3.04 INSPECTION & TESTING

A. Upon completion of work, Contractor shall notify the Engineer that the work is ready to be inspected and tested. Engineer will conduct visual examination and dry film thickness (DFT) testing.

B. If Engineer's inspection/testing determines that there are any coating holidays or DFTs less than specified, Contractor shall be required to have the coating manufacturer provide a specific action plan to correct the deficiencies, and the deficient areas shall be abraded, solvent wiped and corrected per the manufacturer's recommendations at no cost to the Owner.

3.05 PAINT SCHEDULE

A. General: The paint systems specified are acceptable options. The following paint systems are intended to include items to be painted at the job site. Any item not specifically named herein but obviously required to be painted, shall be painted in accordance with the system selected by the Owner's Representative, or otherwise painted as directed by the Owner's Representative.

B. Schedule: Refer to Finish Paint Schedule Table following this Section: The entire pumping station and everything therein, whether specifically listed in the Finish Paint Schedule Table or not, shall be painted to match existing colors unless directed otherwise by the Owner's Representative.

FINISH PAINT SCHEDULE TABLE					
Item No.	**Items to Be Painted**	**TNEMEC**	**CARBOLINE**	**SHERWIN-WILLIAMS**	**FINISH COLOR (Remarks)**
1	Misc. Ferrous Metals: vents, drainpipes, structural steel, misc. metal fabrications, roof supports, metal piping, valve handwheels, etc.	Three coats Series V69 Epoxoline II @ 4-6 mils DFT/coat. See Note 4.	One coat Carboguard 635VOC @ 4-6 mils DFT. Two coats Carboguard 690 @ 6-8 mils DFT/coat. See Note 4.	One coat of Macropoxy 646 FC @ 4.0 - 6.0 mils DFT; two coats of Macropoxy 646 FC @ 6.0 - 8.0	Aluminum or Gray (Do not paint ductwork). Valve handwheels, extension stems, and pump shafting shall be OSHA Safety Red.
2	Electrical Conduit (Non-metallic and PVC coated conduit shall not be painted)	One coat Series 1026 Enduratone @ 2.0-2.5 mils DFT. Two coats Series 1029 Enduratone @ 2.0-2.5 mils DFT/coat.	One coat Carbocrylic/ Sanitile 120 @ 2 mils DFT. Two coats Carbocrylic 3359 @ 2-3 mils DFT/coat.	One coat of ProBlock Latex Primer @ 1.5 - 2.0 mils DFT; Two coats of DTM Acrylic @ 2.5 - 3.0 mils dry	Black
3	Water Piping (steel only, copper piping shall not be painted)	One coat Series 94H_2O Hydro-zinc @ 2.5-3.5 mils DFT. Two coats Series V69 Epoxoline II @ 4-6 mils DFT/coat.	One coat Carbozinc 859 @ 3-5 mils DFT. Two coats Carboguard 891VOC @ 4-6 mils DFT/coat.	One coat of Zinc Clad III @ 3.0 - 5.0 mils DFT; Two coats of Macropoxy 5500 @ 4.0 - 6.0 mils DFT	Light Blue
4	Concrete Surfaces: vaults (See Specification Section 13120 for coating walls and ceiling in the Precast Concrete Building).	Two coats Series 617 WB Conformal Stain @ 150-200 ft^2/gal per coat.	See Note 1.	See Note 1	White
	Concrete Surfaces: floors and equipment bases	See Note 2.	See Note 2.	See Note 2	Clear

FINISH PAINT SCHEDULE TABLE					
Item No.	**Items to Be Painted**	**TNEMEC**	**CARBOLINE**	**SHERWIN-WILLIAMS**	**FINISH COLOR (Remarks)**
5	Pump Suction & Discharge Piping, Force Main (Ferrous Metals) (Wetwell Only)	One coat Series 394 Perime-Prime @ 3.0-3.5 mils DFT. One coat Series 435 Perma-Glaze @ 35-45 mils DFT/coat.	One coat Phenoline 311 @ 2-3 mils DFT. One coat Plasite 4500 S @ 45-55 mils DFT.	One coat of Macropoxy 646 FC @ 3.0 - 5.0 mils DFT; One coat of Dura-Plate UHS @ 40.0 - 50.0 mils DFT	Gray
5	Pump Suction & Discharge Piping, Pumps, Motors, Gravity Sewer, Force Main, Ventilation Fans, Heaters, etc. (Ferrous Metals) (All Other Locations)	One coat Series 394 Perime-Prime @ 3.0-3.5 mils DFT. Two coats Series V69 Epoxoline II @ 6-8 mils DFT/coat.	One coat Carboguard 890 @ 4-6 mils DFT. Two coats Carboguard 690 @ 6-8 mils DFT/coat.	One coat of Macropoxy 646 FC @ 3.0 - 5.0 mils DFT; Two Coats of Macropoxy 646 FC @ 6.0 – 8.0 mils DFT/Coat	Aluminum or Gray
6	Galvanized Piping/Steel (Wetwell Only)	One coat Series 27 WB Typoxy @ 2.5-3.5 mils DFT. One coat Series 435 Perma-Glaze @ 35-45 mils DFT/coat.	One coat Phenoline 311 @ 2-3 mils DFT. One coat Plasite 4500 S @ 45-55 mils DFT.	One coat of Macropoxy 646 FC @ 3.0 - 5.0 mils DFT; One coat of Dura-Plate UHS @ 40.0 - 50.0 mils DFT	Gray
	Galvanized Piping/Steel (All Other Locations)	One coat Series 27 WB Typoxy @ 2.5-3.5 mils DFT. Two coats Series V69 Epoxoline II @ 6-8 mils DFT/coat. See Note 4.	One coat Rustbond @ 1-2 mils DFT. Two coats Carboguard 690 @ 6-8 mils DFT/coat. See Note 4.	One coat of Macropoxy 5000 @ 1.0 – 1.5 mils DFT; Two coats of Seaguard 6100 @ 6.0 - 8.0 mils DFT	Aluminum or Gray
7	Wood	One coat Series 151-1051 Elasto-Grip @ 0.7-1.5 mils DFT. Two coats Series 1029 Enduratone @ 2.0-2.5 mils DFT.	One coat Carbocrylic/Sanitile 120 @ 2 mils DFT. Two coats Carbocrylic 3359 @ 2-3 mils DFT.	ProBlock Latex Primer @ 1.5 - 2.0 mils DFT; Two coats of DTM Acrylic @ 2.5 - 4.0 mils dry	White

Notes:

1. Two coats Sherwin Williams H & C Colortop Water-Based Solid Color Concrete Stain @ 150-250 ft^2/gal per coat may be used for this item.

2. Floors and equipment bases to be clear color shall receive two coats Sherwin Williams H & C Clarishield Concrete Sealer Wet Look Water-Based @ 100-200 ft^2/gal per coat. H & C Shark Grip Slip Resistant Additive shall be added to the second coat @ 3.2 ounces/gal.

3. Listed DFT mils per coat applies for spray-on application. Application of paint by roller or brush shall be in accordance with manufacturer's requirements. Additional coats required by the manufacturer to achieve overall listed DFT shall be completed by the Contractor.

4. Paint provided on exterior surfaces to be exposed to UV light shall be provided with UV protection via a final topcoat/dry film thickness as recommended by the Manufacturer.

5. In the event that a coating is no longer available and/or no longer meets the current State VOC emission requirements, the paint manufacturer's representative shall be responsible for recommending and providing a paint system that provides the minimum protection of the coating system specified at no additional cost to the Town.

END OF SECTION

SECTION 09960

CORROSION PROTECTION LINING SYSTEM

PART 1 - GENERAL

1.01 SUMMARY

A. This section covers work, materials and equipment required for protecting the interior surface of a watertight structure by installing a multi-layer lining system to provide corrosion protection and to stop infiltration.

B. This section includes procedures for surface preparation, cleaning, application and testing.

1.02 SUBMITTALS

A. Submit technical data sheets on each product used, including ASTM test results indicating the product conforms to and is suitable for its intended use per these specifications.

B. Material Safety Data Sheets (MSDS) for each product used.

C. Submit technical data sheets and project specific data for repair materials to be top coated with the lining system products including application, cure time and surface preparation.

D. Provide samples of the cured system including stepped samples showing stages of multi-layer applications.

E. Applicator Qualifications:

1. Manufacturer certification that the Applicator has been trained and approved in the handling, mixing and application of the products to be used.

2. Certification that the equipment to be used for applying the products, has been approved by the Manufacturer, and that Applicator's personnel have been trained and certified for proper use of the equipment.

3. Applicator specializing in the performance of work specified in this section with a minimum of three (3) years documented experience and 3,000 vertical feet of application.

4. Five (5) references of municipal sanitary sewer projects successfully performed within the past three years for projects similar in size and scope.

5. Proof of any necessary federal, state or local permits or licenses necessary for this project.

1.03 QUALITY ASSURANCE

A. Contractor and Applicator shall initiate and enforce quality control procedures consistent with all applicable ASTM, NACE and SSPC standards and the corrosion protection lining system manufacturer's recommendations.

B. Lining system materials shall be produced in an ISO 9001 certified facility.

C. Furnish materials of quality required by ASTM standards or other approved standards and specifications.

D. Lining system products shall be capable of being installed and curing properly within the specified environments. Lining system products shall be resistant to all forms of chemical or bacteriological attack found in municipal sanitary sewer systems and capable of adhering to the substrates and repair products.

E. Repair product(s) shall be fully compatible with lining system products including ability to bond effectively to the host substrate and lining system products forming a composite system.

F. Applicator shall utilize equipment for the spray application of the lining system products which have been approved by the lining system Manufacturer; and, Applicator shall have received training on the operation and maintenance of said equipment from the lining system manufacturer.

G. Applicator shall be trained by, or have their training approved and certified by, the Manufacturer for the handling, mixing, application and inspection of the lining system to be used as specified herein.

H. Applicator shall be trained in the use of testing or inspection instrumentation and knowledgeable of the proper use, preparation and installation of the lining system to be used as specified herein.

I. Provide guarantee against defective materials and workmanship in accordance with the requirements of these specifications.

1.04 DELIVERY, STORAGE AND HANDLING

A. Delivery and Handling: Prevent moisture damage and contamination of materials during delivery and handling.

B. Storage: Store materials in undamaged condition with seals and labels intact as packaged by the manufacturer.

1. Liquid products shall be protected from freezing while being stored.

1.05 JOB CONDITIONS

A. Environmental Requirements:

1. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the lining system Manufacturer. Do not apply the products of this Section to frozen surfaces.

2. Do not apply lining system during rain or snow, or when relative humidity is outside the humidity ranges required by the lining system Manufacturer.

B. Protection:

1. Public Safety: If public safety is endangered during the progress of the rehabilitation work, provide adequate protective measures to protect public pedestrian and vehicular traffic on streets and walkways.

a. Signs, signals and barricades used shall conform to requirements of Federal, State and Local laws, rules, regulations, precautions, orders, and decrees.

2. Existing Facilities Protection: Protect existing structures from damage due to operations associated with work of this Section.

3. Personnel Protection: It is the responsibility of the Contractor to provide appropriate protective measures to ensure that chemicals are under the control of the Applicator at all times and are not available to unauthorized personnel or animals.

1.06 WARRANTY

A. Manufacturer and Applicator warrant the liner system against failure for a period of 10 years. "Failure" will be deemed to have occurred if the protective lining fails to prevent the internal deterioration or corrosion of the structure or prevent groundwater infiltration. If any such failure occurs within 10 years of Substantial Completion, the damage will be repaired at no cost to the Owner. The Contractor shall provide a certificate for inclusion in the O&M Manuals documenting the Manufacturer's date of warranty commencement (Contractor's Substantial Completion date) and expiration (ten years hence).

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Subject to compliance with requirements, manufacturers that may be used include:

1. OBIC, LLC.

2. or approved equal.

2.02 REPAIR MATERIALS

A. Subject to compliance with the lining system Manufacturer's requirements, the following products shall be acceptable as compatible repair base coat material:

1. 100% solids, solvent-free epoxy grout specifically compatible with the lining system.

2. Factory blended, rapid setting, high early strength, fiber reinforced, non-shrink repair mortar that can be applied by trowel or pneumatically spray applied, specifically formulated to be suitable with the lining system.

3. A hydraulic cement and/or plug shall be used to stop active infiltration. The hydraulic cement and plug shall be suitable for use with the lining system and shall be approved by the lining system manufacturer.

2.03 LINING SYSTEM MATERIALS

A. Primer Layer:

1. Primer layer shall be a fast curing modified polymer primer and shall be formulated for deep penetration into masonry/concrete surfaces. Primer shall achieve an adhesion to the masonry/concrete surface greater than 400 psi. Primer shall be OBIC Prime 1500 or approved equal.

B. Adhesion Layer:

1. Adhesion layer shall be100% solids, no volatile organic compound (VOC), moisture tolerant, elastomeric polyurea to provide corrosion protection and stop infiltration. Adhesion layer shall be OBIC Armor 1000 or approved equal. Material shall be capable of curing properly given the project site conditions and temperatures, and shall conform to the following minimum physical requirements:

PROPERTY	**VALUE**
Hardness, ASTM D2240	D 52
Tensile strength, ASTM D412	4,000 psi
100% Modulus, ASTM D412	1,460 psi
200% Modulus, ASTM D412	1,960 psi
300% Modulus, ASTM D412	2,650 psi
Tear resistance/DIE-C, ASTM D624	445 pli
Ultimate elongation, ASTM D412	425 %
Taber Abrasion, CS17 Calibrase	23 mg loss

PROPERTY	VALUE
Flexibility, ⅛" Mandrel	Pass
SWAT, ASTM G210	Pass

C. Surface Layer:

1. Surface layer shall be a two-component seamless rigid polyurethane backing material with high closed cell content. Surface layer shall be OBIC Armor 1306 or approved equal. Material shall be capable of curing properly given the project site conditions and temperatures, and shall conform to the following minimum physical requirements:

PROPERTY	VALUE
Density, ASTM D1622	6-8 pcf
Compressive Strength, ASTM D1621	130-180 psi
Closed Cell Content	> 94%
Water Absorption	< 0.03 lbs/sf
Maximum Service Temp	180 deg F
Viscosity (A side) @ 72 deg F	675 cps
Viscosity (B side) @ 72 deg F	200 cps
SWAT, ASTM G210	Pass

D. Armor Layer:

1. The Armor layer shall meet the same requirements as the adhesion layer specified above.

PART 3 - EXECUTION

3.01 ACCEPTABLE APPLICATORS

A. Repair mortar applicators shall be trained to properly apply the cementitious mortar according to the manufacturer's recommendations.

B. Corrosion protection lining system shall be applied by a certified Applicator and in accordance with Manufacturer's requirements.

3.02 EXAMINATION

A. Contractor and Applicator shall take appropriate actions to comply with federal, state and local regulatory and other applicable agencies with regard to environment, health and safety.

B. Sewage flows shall be plugged and diverted so that they shall not be in contact with the lining system until fully cured.

C. Pipe penetrations must be sealed, and no leaks shall be present prior to commencing and during work.

D. Installation of the lining system shall not commence until the concrete substrate has been properly cured and prepared in accordance with this specification.

3.03 SURFACE PREPARATION

A. Standard Portland cement or new concrete must be cured at least 28-days prior to application of the lining system.

B. Conduct surface preparation program to include monitoring of atmosphere for hydrogen sulfide, methane, low oxygen or other gases, approved flow control equipment, and surface preparation equipment.

C. Surface preparation methods may include high pressure water cleaning, hydro blasting, abrasive blasting, grinding, detergent water cleaning and shall be suited to provide a surface compatible for installation of the liner system. Applicator shall maintain strict adherence to applicable NACE and SSPC recommendations with regard to proper surface preparation.

D. Surface preparation method shall produce a cleaned, abraded and sound surface with no evidence of laitance, loose concrete, brick or mortar, contaminants or debris, and shall display a surface profile suitable for application of liner system. Existing coatings which may affect the performance and adhesion of the lining system shall also be removed.

E. After the defects in the structure are identified, repair all leaks with a chemical or hydraulic sealant designed for use in field sealing of ground water. Severe cracks shall be “repaired with a urethane-based chemical” sealant. Product to be utilized shall be as approved by Owner/Engineer prior to installation. Repairs to exposed rebar, defective pipe penetrations or inverts, etc. shall be repaired utilizing non-shrink grout or approved alternative method.

3.04 REPAIR MATERIALS

A. Repair materials shall be used to fill voids, structurally reinforce and/or rebuild surfaces. Repair materials shall be compatible with the lining system and shall be applied in accordance with the manufacturer’s recommendations.

B. Subject to compliance with the lining system Manufacturer’s requirements, the following products shall be acceptable as compatible repair base coat materials for lining system:

1. A hydraulic cement and/or plug shall be used to stop active infiltration. The hydraulic cement and plug shall be suitable for the polyurea top coating and shall be approved by the lining system Manufacturer.

2. Hydrophobic and/or Hydrophilic polyurethane chemical grouts used to stop active infiltration. The chemical grouts shall be suitable for the polyurea top coating and shall be approved by the lining system Manufacturer.

3.05 MATERIAL INSTALLATION

A. Application procedures shall conform to recommendations of the manufacturer, including materials handling, mixing, environmental controls during application, safety and spray equipment.

B. Spray equipment shall be specifically designed to accurately ratio and apply the liner system.

C. Application of multi-layer/component liner system shall be in strict accordance with the lining system Manufacturer's recommendation. Final installation shall be a minimum of ½-inch DFT (500 mils).

1. Primer Layer: 5-10 mils DFT

2. Adhesion Layer: 40-50 mils DFT (not intended to fill small voids)

3. Surface Layer: 400 to 450 mils DFT (intended to fill voids, bug holes)

4. Armor Layer: 50 to 60 mils DFT

3.06 FIELD QUALITY CONTROL

A. Structures shall be tested using a high voltage holiday detection system to determine if any holidays (voids) exist in the lining. The sensitivity control of the holiday tester shall be set to accommodate the thickness of the applied lining, 100-125 volts for each 1 mil thickness. Follow the guidelines of the holiday detection system manufacturer for correct control settings. All detected holidays shall be marked and repaired in accordance with the liner manufacturer's recommendations.

B. Adhesion testing shall be conducted after the lining system has cured per Manufacturer's instruction and in accordance with ASTM D4541(Steel) or ASTM D7234(Concrete). A minimum of one 20 mm dolly shall be affixed to the lined surface of the structure at the upper section, mid-section and at the bottom, unless otherwise directed by the Engineer or Owner. Each testing location shall be identified by the Owner's Inspector. The adhesive used to attach the dollies to the liner shall be rapid setting with tensile strength in excess of the liner material and permitted to cure in accordance with Manufacturer's recommendations. The lining material and dollies shall be adequately prepared to receive the adhesive. Prior to pull test, the Contractor shall utilize a scoring device to cut through the coating until the substrate is reached. Extreme care shall be required while scoring to prevent micro cracking in the coating, since cracks may cause failures at diminished strengths. Failure due to improper dolly adhesive or scoring shall require retesting. The pull tests in each area shall meet or exceed 200 psi. and shall include subbase

adhered to the back of the dolly or no visual signs of coating material in the test hole. Pull tests with results between a minimum 150 psi and 200 psi shall be acceptable if more than 50% of the subsurface is adhered to the back of the dolly. A test result can be discarded, as determined by the Engineer, if there is a valid non-statistical reason for discarding the test results as directed by Sections 8.4 and 8.5 of ASTM D4541 and ASTM D7234. If any test fails, a minimum of three additional locations in the section of the failure shall be tested, as directed by the Engineer or Owner. If any of the retests fail, all loosely adhered or unadhered liner in the failed area, as determined by the Engineer, shall be removed and replaced at the Contractor's expense. Upon acceptance of the testing, all areas shall be repaired to restore the liner to its design conditions.

3.07 INSPECTION

A. Final liner system shall be completely free of pinholes or voids. Liner thickness shall be the minimum value as described herein.

B. Due to the fast gel and set time of the material, thickness of the application can be verified by awl point depth checks into the surface component and physical removal of a small area of the polyurea material. Repair of the test areas to be done immediately after the test.

C. Visual inspection shall be made by the Owner/Engineer. Any deficiencies in the finished liner system shall be marked and repaired according to the procedures set forth by Manufacturer.

D. The structure may be returned to full operational service as soon as the final inspection has taken place.

END OF SECTION

SECTION 10211

TOILET COMPARTMENT

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes painted steel toilet compartment configured as a toilet enclosure.

1.02 SUBMITTALS

A. Product Data: For each type of product.

B. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for toilet compartments.

C. Shop Drawings: For toilet compartments, include plans, elevations, sections, and attachment details. Show locations of cutouts for compartment-mounted toilet accessories. Show locations of reinforcements for compartment-mounted grab bars and locations of blocking for surface-mounted toilet accessories. Show locations of centerlines of toilet fixtures. Show locations of floor drains.

D. Product Schedule: For toilet compartments, prepared by or under the supervision of Supplier, detailing location and selected colors for toilet compartment material.

E. Product Certificates: For each type of toilet compartment.

1.03 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of toilet fixtures, walls, columns, ceilings, and other construction contiguous with toilet compartments by field measurements before fabrication.

PART 2 - PRODUCTS

2.01 PAINTED STEEL TOILET COMPARTMENT

A. Toilet-Enclosure Style: Floor anchored.

B. Door, Panel, and Pilaster Construction: Seamless, metal facing sheets pressure laminated to core material; with continuous, interlocking molding strip or lapped-and-formed edge closures; corners secured by welding or clips and exposed

welds ground smooth. Exposed surfaces shall be free of pitting, seam marks, roller marks, stains, discolorations, telegraphing of core material, or other imperfections.

C. Core Material: Manufacturer's standard sound-deadening honeycomb of resin-impregnated kraft paper in thickness required to provide finished thickness of 1 inch for doors and panels and 1-1/4 inches for pilasters.

D. Grab-Bar Reinforcement: Provide concealed internal reinforcement for grab bars mounted on units of size and material adequate for panel to withstand applied downward load on grab bar of at least 250 lbf, when tested according to ASTM F446, without deformation of panel.

E. Tapping Reinforcement: Provide concealed reinforcement for tapping (threading) at locations where machine screws are used for attaching items to units.

F. Facing Sheets and Closures: Electrolytically coated steel sheet with nominal base-metal (uncoated) thicknesses as follows:

1. Pilasters, Braced at Both Ends: Manufacturer's standard thickness, but not less than 0.036-inch.

2. Pilasters, Unbraced at One End: Manufacturer's standard thickness, but not less than 0.048-inch.

3. Panels: Manufacturer's standard thickness, but not less than 0.030-inch.

4. Doors: Manufacturer's standard thickness, but not less than 0.030-inch.

5. Pilaster Shoes and Sleeves (Caps): Stainless-steel sheet, not less than 0.031-inch nominal thickness and 3 inches high, finished to match hardware.

G. Brackets (Fittings):

1. Stirrup Type: Ear or U-brackets; stainless steel.

2. Full-Height (Continuous) Type: Manufacturer's standard design; stainless steel.

H. Steel Sheet Finish: Immediately after cleaning and pretreating, apply manufacturer's standard baked-on finish, including thermosetting, electrostatically applied, and powder coatings. Comply with coating manufacturer's written instructions for applying and baking. Color: As selected by Owner from manufacturer's full range.

2.02 HARDWARE AND ACCESSORIES

A. Material: Stainless steel.

B. Hardware and Accessories: Manufacturer's heavy-duty operating hardware and accessories.

C. Hinges: Manufacturer's minimum 0.062-inch thick, stainless-steel paired, self-closing type that can be adjusted to hold doors open at any angle up to 90 degrees, allowing emergency access by lifting door. Mount with through-bolts.

D. Latch and Keeper: Manufacturer's heavy-duty, surface-mounted, cast stainless-steel latch unit designed to resist damage due to slamming, with combination rubber-faced door strike and keeper and with provision for emergency access. Provide units that comply with regulatory requirements for accessibility at compartments designated as accessible. Mount with through-bolts.

E. Coat Hook: Manufacturer's heavy-duty, combination cast stainless-steel hook and rubber-tipped bumper, sized to prevent in-swinging door from hitting compartment-mounted accessories. Mount with through-bolts.

F. Door Bumper: Manufacturer's heavy-duty, rubber-tipped, cast stainless-steel bumper at out-swinging doors. Mount with through-bolts.

G. Door Pull: Manufacturer's heavy-duty cast stainless-steel pull at out-swinging doors that complies with regulatory requirements for accessibility. Provide units on both sides of doors at compartments designated as accessible. Mount with through-bolts.

H. Overhead Bracing: Manufacturer's standard continuous, extruded-aluminum head rail with antigrip profile and in manufacturer's standard finish.

I. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel, finished to match the items they are securing, with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use stainless steel, hot-dip galvanized steel, or other rust-resistant, protective-coated steel compatible with related materials.

J. Toilet Paper Dispenser: Stainless steel vertical dual roll toilet paper dispenser compatible with the toilet compartment system.

2.03 MATERIALS

A. Aluminum Castings: ASTM B26.

B. Aluminum Extrusions: ASTM B221.

C. Brass Castings: ASTM B584.

D. Brass Extrusions: ASTM B455.

E. Steel Sheet: Commercial steel sheet for exposed applications; mill phosphatized and selected for smoothness.

F. Electrolytically Zinc Coated: ASTM A879, 01Z.

G. Hot-Dip Galvanized: ASTM A653, either hot-dip galvanized or galvannealed.

H. Stainless-Steel Sheet: ASTM A666, Type 304, stretcher-leveled standard of flatness.

I. Stainless-Steel Castings: ASTM A743.

J. Zamac: ASTM B86, commercial zinc-alloy die castings, chrome plated.

2.04 FABRICATION

A. Fabrication, General: Fabricate toilet compartment components to sizes indicated. Coordinate requirements and provide cutouts for through-partition toilet accessories, and solid blocking within panel where required for attachment of toilet accessories.

B. Overhead-Braced Units: Provide manufacturer's standard corrosion-resistant supports, leveling mechanism, and anchors at pilasters to suit floor conditions. Provide shoes at pilasters to conceal supports and leveling mechanism.

C. Floor-Anchored Units: Provide manufacturer's standard corrosion-resistant anchoring assemblies with leveling adjustment nuts at pilasters for structural connection to floor. Provide shoes at pilasters to conceal anchorage.

D. Ceiling-Hung Units: Provide manufacturer's standard corrosion-resistant anchoring assemblies with leveling adjustment nuts at pilasters for connection to structural support above finished ceiling. Provide assemblies that support pilasters from structure without transmitting load to finished ceiling. Provide sleeves (caps) at tops of pilasters to conceal anchorage.

E. Floor-and-Ceiling-Anchored Units: Provide manufacturer's standard corrosion-resistant anchoring assemblies with leveling adjustment at tops and bottoms of pilasters. Provide shoes and sleeves (caps) at pilasters to conceal anchorage.

F. Door Size and Swing shall be 24-inch wide, in-swinging door for standard toilet compartment and 36-inch wide, out-swinging doors with a minimum 32-inch wide clear opening.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas and conditions, with Installer present, for compliance with requirements for fastening, support, alignment, operating clearances, and other conditions affecting performance of the work.

B. Confirm location and adequacy of blocking and supports required for installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

D. Coordinate layout and installation of supports, inserts, and anchors built into other units of work for toilet compartment anchorage.

3.02 INSTALLATION

A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position indicated with manufacturer's recommended anchoring devices.

B. Maximum Clearances:

1. Pilasters and Panels: 1/2 inch.

2. Panels and Walls: 1 inch.

C. Stirrup Brackets: Secure panels to walls and to pilasters with no fewer than three brackets attached at midpoint and near top and bottom of panel.

D. Locate wall brackets so holes for wall anchors occur in masonry or tile joints.

E. Align brackets at pilasters with brackets at walls.

F. Full-Height (Continuous) Brackets: Secure panels to walls and to pilasters with full-height brackets.

G. Overhead-Braced Units: Secure pilasters to floor and level, plumb, and tighten. Set pilasters with anchors penetrating not less than 1-3/4 inches into structural floor unless otherwise indicated in manufacturer's written instructions. Secure continuous head rail to each pilaster with no fewer than two fasteners. Hang doors to align tops of doors with tops of panels, and adjust so tops of doors are parallel with overhead brace when doors are in closed position.

H. Floor-Anchored Units: Set pilasters with anchors penetrating not less than 2 inches into structural floor unless otherwise indicated in manufacturer's written instructions. Level, plumb, and tighten pilasters. Hang doors and adjust so tops of doors are level with tops of pilasters when doors are in closed position.

I. Ceiling-Hung Units: Secure pilasters to supporting structure and level, plumb, and tighten. Hang doors and adjust so bottoms of doors are level with bottoms of pilasters when doors are in closed position.

J. Floor-and-Ceiling-Anchored Units: Secure pilasters to supporting construction and level, plumb, and tighten. Hang doors and adjust so doors are level and aligned with panels when doors are in closed position.

3.03 ADJUSTING

A. Hardware Adjustment: Adjust and lubricate hardware according to hardware manufacturer's written instructions for proper operation. Set hinges on in-swinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors to return doors to fully closed position.

END OF SECTION

SECTION 10520

FIRE PROTECTION SPECIALTIES

PART 1 - GENERAL

1.01 DESCRIPTION

A. This Section includes all labor, materials, equipment, and incidentals required to provide and install wall-mounted portable fire extinguishers, as specified herein. Contractor shall furnish and install one (1) fire extinguisher in the pump station building.

1.02 SUBMITTALS

A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.01 FIRE EXTINGUISHERS

A. Fire extinguisher shall be wall-mounted, steel cylinder, nitrogen pressurized, dry chemical, multi-purpose type, with 5 lbs. capacity minimum for Class ABC fires; J. L. Industries Cosmic 5E Multi-Purpose Dry Chemical, Amerex Model B402, or approved equal.

B. All fire fighting devices must comply with the provisions of the Occupational Safety and Health Act of 1974 (OSHA), Part 1926. Fire extinguisher shall be UL-approved.

C. Fire extinguisher shall be furnished with an approved type wall mounting bracket, designed to mount fire extinguisher provided.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install fire fighting extinguisher in accordance with manufacturer's written instructions.

B. Install fire extinguisher in accordance with NFPA requirements.

C. Mounting height to top of bracket shall be 4’-8”.

END OF SECTION

SECTION 11310

BASE-MOUNTED PUMPING SYSTEM

PART 1 - GENERAL

1.01 SCOPE

A. Contractor shall furnish and install one factory built base-mounted pumping system consisting of three individual steel bases. The station shall be complete with all equipment specified herein.

B. Principal items of equipment shall include three horizontal, self-priming, centrifugal sewage pumps, V-belt drives, motors, piping, check valves, air release valves, and integral wiring.

C. Electrical power to be furnished to the site shall be 3-phase, 60 hertz, 460-volt, maintained within plus or minus 10 percent. Available fault current at the input to the control panel shall be limited to a maximum of 5 kA rms symmetrical. Voltage tolerance shall be plus or minus 10 percent. Phase to phase unbalance shall not exceed 1% average voltage as set forth in NEMA Standard MG-1. Control voltage shall not exceed 132 volts.

D. The pumping equipment shall be manufactured by The Gorman-Rupp Company, Mansfield, OH as supplied by Envirep, Inc., Camp Hill, PA, or approved equal.

1.02 SUBMITTALS

A. Product Data: Prior to fabrication, submit the following to the Engineer for approval:

1. Shop drawings providing layout of the mechanical equipment and anchor bolt locations and indicating the use of Unified National Standard bolts and fasteners.

2. Catalog cut sheets for major items of equipment, materials of construction, major dimensions, motor and v-belt drive data, pump characteristics curves showing design duty point capacity (GPM), head (FT), net positive suction head required (NPSHr), and hydraulic brake horsepower.

3. Pump Manufacturer’s v-belt drive selection calculation summary sheet showing corrected horsepower (HP) per belt, total HP developed, pitch diameter of sheaves, center distance between driver and driven shafts and combined arc-length correction factor applied to theoretical HP transmission per v-belt, and all calculations to demonstrate a minimum Safety Factor of 1.5.

4. Certified dimensional drawings indicating size, locations and the spherical solids passing capability of the primary recirculation port.

5. Pre-startup checklist to be completed by the Contractor prior to pre-startup inspection.

6. Sample of service agreement and service agreement checklist for the specified equipment.

7. Letter from pump Manufacturer certifying that the pump(s), exclusive of the motor, base, drive, controls, or other associated components are constructed with cast iron, ductile iron, and steel that has been mined, melted, cast, machined, and assembled in the United States.

8. Certified Tests: Prior to shipment of the equipment from the pump manufacturer's facility, submit the following certified tests to the Engineer for approval.

   a. Certified copies of factory run pump performance tests.

      (1) Tests shall be conducted in accordance with Hydraulic Institute Standards 14.6.3.4 Acceptance Grade 1U at the specified head, capacity, rated speed and horsepower.

      (2) The performance tests shall validate the performance of the equipment at the design head, capacity and speed.

   b. Certified reprime performance test data in accordance with procedures herein specified.

   c. Certified copies of air release valve closure performance test.

   d. Tests shall be certified by a registered Professional Engineer.

B. Certification. In addition to the manufacturer’s warranty for the base-mounted pumping system, the Contractor shall obtain and submit to the Engineer and Owner certification from the base-mounted pumping system manufacturer that the system meets the requirements of the intended application and contract specifications. The pumping system manufacturer shall provide a signed certification (such certification signed by a Principal Person (President, Vice-President, etc.) of the equipment manufacturer) attesting that he/she has examined all applicable contract drawings and specifications, and certifies that the equipment he/she proposes to furnish and deliver meets or exceeds the Contract Specifications, is suitable for the intended purposed stated in Specification Section 11310, is suitable for installation as presented in the Contract Drawings and Specifications, and will provide satisfactory performance at the design criteria specified. This certification shall be provided by way of the Equipment Guarantee Certification Form included herewith.

EQUIPMENT GUARANTEE CERTIFICATION FORM

Reference: **New Creamery Road Sewage Pump Station**
Town of Emmitsburg, Maryland

THE UNDERSIGNED HEREBY ATTESTS THAT HE/SHE HAS EXAMINED ALL APPLICABLE CONTRACT DRAWINGS AND SPECIFICATIONS, AND CERTIFIES THAT THE EQUIPMENT THAT HE/SHE PROPOSES TO FURNISH AND DELIVER MEETS OR EXCEEDS CONTRACT SPECIFICATIONS, IS SUITABLE FOR THE INTENDED PURPOSE STATED IN SPECIFICATION SECTION **11310**, IS SUITABLE FOR INSTALLATION AS PRESENTED IN THE CONTRACT DRAWINGS AND SPECIFICATIONS, AND WILL PROVIDE SATISFACTORY PERFORMANCE AT THE DESIGN CRITERIA SPECIFIED. THIS GUARANTEE OF SUITABILITY FOR INTENDED PURPOSE IS IN ADDITION TO AND SHALL NOT BE IN LIEU OF ANY OTHER WARRANTIES, EXPRESSED OR IMPLIED.

EQUIPMENT: **BASE-MOUNTED PUMPING SYSTEM**

MANUFACTURER: _____

Address: _____

_____

By: _____
(Typed Name and Title)

_____/s/_____ (SEAL)
(Signature) (Date)

Equipment Guarantee Certification must be signed by a Principal Person (President, Vice-President, etc.) of the equipment manufacturer. In the event the manufacturer is not the Supplier then a Principal Person of the Supplier must <u>also</u> sign this form.

SUPPLIER: _____

Address: _____

_____

By: _____
(Typed Name and Title)

_____/s/_____ (SEAL)
(Signature) (Date)

C. Operation and Maintenance Manuals:

1. Operation shall be in accordance with written instructions provided by the pump system Manufacturer. Comprehensive instructions supplied at the time of shipment shall enable personnel to properly operate and maintain all equipment supplied. Content and instructions shall assume operating personnel are familiar with pumps, motors, piping and valves, but lack experience on exact equipment supplied.

2. Documentation shall be specific to the pumping equipment supplied and collated in functional sections. Each section shall combine to form a complete system manual covering all aspects of equipment supplied by the Manufacturer. Support data for any equipment supplied by others, even if mounted or included in overall system design, shall be provided by those supplying the equipment. Instructions shall include the following as a minimum.

    a. Functional description of each major component, complete with operating instructions.

    b. Instructions for operating pumps.

    c. Support data for commercially available components not produced by the system Manufacturer, but supplied in accordance with the specifications, shall be supported by literature from the prime Manufacturer and incorporated as appendices.

    d. Mechanical layout drawing of the pumping equipment and components, prepared in accordance with good commercial practice, shall provide installation dimensions and location of all pumps, motors, valves and piping.

3. Operation and maintenance instructions, which rely on vendor cut-sheets and literature, which include general configurations, or require operating personnel to selectively read portions of a manual shall not be acceptable. Operation and maintenance instructions must be specific to equipment supplied in accordance with these specifications.

D. Manufacturer's Field Performance Test Report: The Manufacturer's technical representative shall inspect the completed installation, correct or supervise the correction of any defect or malfunction, and instruct operating personnel in the proper operation and maintenance of the equipment. A written report covering the equipment startup shall be mailed from the Manufacturer's startup technician directly to the Engineer. At a minimum, the report shall include:

1. Nameplate information.

2. Recordings of gauge readings, static discharge head, and total dynamic head for each pump.

3. Recordings of operating speed for each pump, measured with a tachometer.

4. Recordings of wetwell levels during field performance tests.

5. Certification that equipment has been properly installed and lubricated and is in accurate alignment.

6. Certification that the v-belt drive system has been properly aligned using a laser alignment instrument and that v-belts have been tensioned using a belt tensioning instrument.

7. Results of electrical tests including voltage readings and amperage readings of all motors.

8. Certification that the equipment has been operated fully loaded and that it operated satisfactorily.

9. Outline in detail any deficiencies noted and proposed remedial corrections.

10. Include the following photographs in the startup report:

    a. Overall pump station job site

    b. Pumps and motors

    c. Discharge header piping

    d. Pump control panel - closed door

    e. Pump control panel - open door

    f. Wetwell

1.03 QUALITY ASSURANCE

A. Manufacturer’s Qualifications: Upon request from the Engineer, the pumping equipment Manufacturer shall demonstrate the following:

1. Proof of financial stability and ability to produce the pumping equipment within the specified delivery schedules.

2. Evidence of the facilities, equipment, and expertise to demonstrate the Manufacturer's commitment to long-term customer service and project support.

3. Evidence of adequate local and factory spare parts inventory to provide timely delivery of spare parts.

4. Evidence that the pump Manufacturer is an Underwriters Laboratories (UL) panel builder.

5. Evidence that the pumps and pumping equipment are constructed, assembled and tested in the United States by the pump Manufacturer. All pump parts including the casing shall be machined at the pump Manufacturer's facility located within the United States.

6. To ensure compatibility to existing tools and equipment, all pump internal and external nuts, bolts, and hardware, shall be Unified Thread Standard (UNC coarse series) per ASME/ANSI standards.

7. Consideration shall be given only to pump Manufacturers meeting the following qualifications:

    a. Twenty-five years minimum experience successfully producing pumping equipment of the type specified herein.

    b. A minimum of twenty-five installations of pumping equipment of the type specified herein in successful operation for a minimum of ten years.

8. Pump Manufacturer must be ISO 9001:2000 certified, with scope of registration including design control and after sales activities.

B. Manufacturer's Representative Qualifications: Upon request from the Engineer, the equipment Manufacturer's local representative shall demonstrate the following:

1. Evidence of adequate local spare parts inventory to provide timely delivery of spare parts.

2. Evidence of established locally based factory-trained service personnel.

3. Evidence that representative offers comprehensive equipment service agreements for the equipment specified.

4. List of at least ten local municipalities with installations like the specified equipment.

5. Evidence that the representative offers full-day operator training seminars on Centrifugal Pump Maintenance and Troubleshooting.

6. Evidence that the representative offers technical design assistance and hydraulic recommendations for pump station design.

7. Certification from Manufacturer that the service technician has been factory-trained and is authorized for such duties by the Manufacturer.

C. Pump Performance:

1. Design and construct the pumps in accordance with standards of the Hydraulic Institute. The efficiency of the pumps, when operating under conditions of the specified capacities and heads shall be as near peak efficiency as practicable.

2. Design the pumps designated as self-priming centrifugal to pump raw sewage containing solids up to ten percent and stringy materials with a minimum of clogging.

3. Pump motors shall be capable of operating with reduced voltage solid state (RVSS) motor starters and variable frequency drives (VFDs) as specified in Division 17 to ensure a fully functional system.

D. Source Quality Control:

1. Obtain pumping equipment, motors, and appurtenances from the pump Manufacturer whose responsibility it is to ensure that the pumping equipment is properly furnished, coordinated, and tested in accordance with these specifications.

2. The Manufacturer of the pumping equipment shall provide a listing of similar self-priming sewage pumping systems located in the Delaware-Maryland-New Jersey-Pennsylvania area, for review by the Engineer. This listing shall include locations and contract names. Project references provided should include similar size self-priming pumps utilized with the controls specified.

1.04 MANUFACTURER'S WARRANTY

A. All components of the pumping equipment shall be manufactured, assembled and tested as a unit by the pump Manufacturer. The pumping equipment must be a standard catalog item with the Manufacturer. The pump Manufacturer shall assume system responsibility, i.e. the pumping equipment must be warranted by the Manufacturer as described herein. Individual component warranties are desirable; however, individual warranties honored solely by the manufacturers of each component will not be acceptable.

B. The pump Manufacturer shall warrant all equipment to be of quality construction, free of defects in material and workmanship. A written warranty shall include specific details described below:

1. The pumps shall be warranted for a period of five (5) years, with no hour limitation, non-prorated. The warranty shall become effective on the date of acceptance by the purchaser or the purchaser's authorized agent, or sixty (60) days after installation, or ninety (90) days after shipment from the factory, whichever occurs first.

2. All equipment, apparatus, and parts furnished shall be warranted for two (2) years, excepting only those items that are normally consumed in service, such as oils, grease, packing, gaskets, O-rings, etc. The pump Manufacturer shall be solely responsible for warranty of the pumping equipment components when installation and operation and maintenance is performed in accordance with the Manufacturer's recommendation.

3. Components failing to perform as specified by the Engineer, or as represented by the Manufacturer, or as proven defective in service during the warranty period, shall be replaced, repaired, or satisfactorily modified by the Manufacturer without cost of parts or labor to the Owner.

PART 2 - PRODUCTS

2.01 PUMPS

A. Pump Description:

1. Pumps shall be Gorman-Rupp Model T10A3S-B horizontal, self-priming, centrifugal pumps, specifically designed for pumping raw, unscreened, domestic sanitary sewage or approved equal. Three (3) pumps shall be installed.

2. All openings, internal passages, and internal recirculation ports shall be large enough to permit the passage of the specified spherical solids passing capacity, and any trash or stringy material which may pass through the average wastewater collection system. Screens or any internal devices that create a maintenance nuisance or interfere with priming and performance of the pump are not permitted.

3. The pumps shall have the following characteristics:

a.	Suction connection, flanged, in	10
b.	Discharge connection, flanged, in	10
c.	Minimum shutoff head, each pump, ft	128
d.	Pump speed, rpm	1325
e.	Maximum NPSH required at design point, ft	6.0
f.	Minimum reprime lift capability, ft	22
g.	Spherical solids passing capability, in. diameter	3.0
h.	Motor horsepower	75
i.	Motor speed, rpm	1750
j.	Impeller diameter, in	14.75

B. Pump Performance:

1. Each pump must have the necessary characteristics and be properly selected to perform under these operating conditions:

a.	Capacity, GPM	1,650
b.	Total dynamic head, ft	98

2. Consideration shall be given to the sanitary sewage service anticipated, in which occasionally debris will lodge between the pump suction check valve and seat, resulting not only in loss of the suction leg, but also in the siphoning of liquid from the pump casing to the approximate center line of the impeller. Such occurrence shall be considered normal with proper installation of air release line to atmosphere.

3. In consideration of such occurrence and of the unattended operation anticipated, each pump shall be so designed as to retain adequate liquid in the pump casing to ensure unattended automatic repriming while operating at its rated speed in a completely open system without suction check valves and with a dry suction leg.

4. Pumps shall be capable of operating at a reduced speed such that they can pump 700 GPM continuously without cavitation, clogging, vibration, or other operational problems. Minimum reduced speed setpoint shall be such that they pump 960 GPM continuously to maintain a velocity of 2 feet per second in the force main.

C. NPSH available:

1. 13.5 feet @ 1,650 GPM

2. 12.2 feet @ 2,600 GPM

D. Reprime Performance:

1. Each pump must be capable of the specified reprime lift while operating at the selected speed and impeller diameter. Reprime lift is defined as the static height of pump suction centerline above liquid that the pump will prime; and delivery within five minutes on liquid remaining in the pump casing after a delivering pump is shut down with the suction check valve removed. Systems requiring ancillary vacuum generating devices are not acceptable. Additional standards under which reprime tests shall be run are:

    a. Piping shall incorporate a discharge check valve downstream from the pump. Check valve size shall be equal (or greater than) the pump discharge diameter.

    b. A 10-foot length of 1-inch pipe shall be installed between pump and discharge check valve. This line shall be open to atmosphere to duplicate the air displacement rate of a typical pump system fitted with an air release valve.

    c. No restrictions shall be present in pump or suction piping that could serve to restrict the rate of siphon drop of the suction leg. Suction pipe configuration for reprime test shall incorporate a minimum horizontal run of 2 feet and one 90-degree elbow.

    d. The pipe size used for the reprime performance test shall be the same size as the pump suction diameter.

    e. Impeller shall be set at the clearances recommended by the Manufacturer in the pump service manual.

    f. Reprime lift repeatability shall be demonstrated by five sequential reprime cycles.

    g. Liquid to be used for reprime test shall be water.

E. Serviceability:

1. The pump Manufacturer shall demonstrate to the Engineer's satisfaction that due consideration has been given to reducing maintenance costs by incorporating the following features:

    a. No special tools shall be required for replacement of any components within the pump. Threaded fasteners shall be of the Unified National Standard type.

b. The mechanical seal shall be a one-piece cartridge type to allow for easy replacement. Mechanical seals requiring assembly of individual components are not acceptable.

c. The pump must be equipped with a removable cover plate, allowing access for service and repair without removing suction or discharge piping.

d. The pump shall be fitted with a replaceable wear plate. Replacement of the wear plate, impeller, seal, and suction check valve shall be accomplished through the removable cover plate without removing suction or discharge piping.

e. The entire rotating assembly, which includes bearings, shaft, seal, and impeller, shall be removable as a unit without removing the pump volute or piping.

f. Each pump shall incorporate a suction flap valve that can be removed or installed through the removable cover plate opening, without disturbing the suction piping. Sole function of the suction flap valve shall be to eliminate re-priming with each cycle. Pumps requiring suction flap valves to prime or reprime are not acceptable.

g. Atmospheric isolation: The shaft bearings shall be isolated from the seal cavity with an air gap to provide positive protection of the bearings in the event of a seal leak and to provide for external monitoring of the seal integrity.

h. Adjustment of the impeller face clearance (distance between impeller and wear plate) shall be accomplished by external means. The adjusting mechanism shall provide a means to make discrete calibrated movements in increments of 0.005 inches. No special tools, measuring devices, feeler gauges, or other tools shall be required to make these impeller-to-wear plate clearance adjustments.

i. Clearances between the impeller and wear plate shall be maintained by a 4-point external shim-less cover plate adjustment system with four, collar and adjusting screws. Provide 4-point incremental clearance adjustment. Each of the four points shall be lockable to prevent inadvertent clearance increases or decreases due to equipment vibration. The 4-point system shall provide equal clearance gaps at all points between the impeller and wear plate. Systems that require realignment of belts, couplings, sheaves, etc., each time a clearance adjustment is performed are not acceptable. Cover plate shall be capable of being removed and reinstalled without disturbing the clearance settings.

Clearance adjustment systems that utilize less than a 4-point system will not be considered.

j. There shall be provisions for additional clearance adjustment in the event adjustment tolerances are depleted from the cover plate side of the pump. The removal of stainless steel shims from the rotating assembly side of the pump shall allow for further adjustment as described above.

k. Clearance adjustment which requires movement of the shaft only, thereby adversely affecting seal working length or impeller back clearance, are not acceptable.

F. Construction:

1. The pump, excluding the base frame and motor, shall be manufactured of iron that is melted and cast in the United States.

2. Pump design: Pumps shall be the original design of the pump Manufacturer.

3. Hardware: All hardware, nuts and bolts, shall be Unified Thread Standard (UNC coarse series) per ASME/ANSI standards.

4. Pump casing: Made of Gray Iron 30, shall be foot supported, and shall have a horizontal centerline suction and vertical discharge.

a. The casing shall have a top mounted $3^1/_2$-inch priming fill port with a safety lock bar cover. In consideration for safety, hand nut threads must provide slow release of pressure, and the clamp bar shall be retained by detent lugs. A Teflon gasket shall prevent adhesion of the fill port cover to the casing.

b. Casing shall have no openings of smaller diameter than the specified sphere size.

c. Casing shall be designed to retain sufficient liquid to ensure automatic repriming and unattended operation.

d. A minimum 1¼-inch diameter drain hole shall be provided for attachment of the pump drain kit and to ensure complete and rapid draining.

e. Bolts and other threaded fasteners shall have Unified National Standard threads.

f. Suction flap valve: Molded neoprene with integral steel and nylon reinforcement. A blow-out center shall protect the pump casing from

hydraulic shock or excessive pressure. Removal or installation of the check valve must be accomplished through the cover plate opening without disturbing the suction piping. Sole function of the suction flap valve shall be to save energy by eliminating need to reprime after each pumping cycle. Pumps requiring a suction check valve to assist reprime are not acceptable.

g. Pump shall be provided with a separate capped threaded port for use of an optional casing heater.

5. Cover plate: Cover plate shall be Gray Iron 30.

a. Retained by four (4) hand nuts for complete access to pump interior. Cover plate removal must provide ample clearance for removal of stoppages, and allow removal or service of the impeller, seal, wear plate or suction flap valve.

b. Replaceable wear plate: A replaceable front wear plate secured to the pump casing. The wear plate shall be ductile iron. The wear plate shall be of sufficient width to maintain the manufacturer's recommended clearance between the entire edge of each impeller vane and the wear plate. The wear plate shall be clamped between a machined shoulder in the pump casing and the suction head flange. The wear plate shall be provided with integral pusher bolt capability for easy removal.

c. In consideration for safety, a pressure relief valve shall be supplied in the cover plate. Relief valve shall open at 75 psi.

d. Easy-grip handle shall be mounted to face of cover plate.

6. Rotating assembly:

a. Impeller: Two-vane, semi-open, non-clog, cast in Ductile Iron 65-45-12 with integral pump out vanes on the back shroud. Impeller shall thread onto the pump shaft and be secured with a lockscrew.

b. Shaft: Shaft shall be constructed of Alloy Steel No. 4150 and shall employ an Alloy Steel No. 4130 shaft sleeve.

c. Mechanical seal: A mechanical cartridge seal shall seal the pump shaft against leakage. The stationary sealing member and the mated rotating face shall be tungsten titanium carbide. Each of the mated surfaces shall be lapped to a flatness of three light bands (35 millionths of an inch), as measured by an optical flat under monochromatic light. The stationary seal seat shall be double floating so that faces will not lose alignment during periods of shock loads that will cause deflection, vibration, and axial movement of the

pump shaft. The seal shall be warranted for five (5) years from date of shipment.

d. Lubrication: Separate oil filled cavities, vented to atmosphere, shall be provided for shaft seal and bearings. Oil cavities must be cooled by the liquid pumped. Three lip seals will prevent leakage of oil.

(1) The bearing cavity shall have an oil level sight gauge and fill plug with check valve. The clear sight gauge shall provide easy monitoring of the bearing cavity oil level and condition of oil without removal of the fill plug. The check valve shall vent the cavity but prevent introduction of moist air to the bearings.

(2) The seal cavity shall have an oil level sight gauge and fill plug with vent. The clear sight gauge shall provide easy monitoring of the seal cavity oil level and condition of oil without removal of the vented fill plug.

(3) Double lip seal shall provide an atmospheric path providing positive protection of bearings, with capability for external drainage monitoring.

e. Atmospheric isolation: The shaft bearings shall be isolated from the seal cavity with an air gap to provide positive protection of the bearings in the event of a seal leak and to provide for external monitoring of the seal integrity.

f. Seal plate: Replaceable seal plate shall be constructed of Gray Iron and shall be bolted to the bearing housing.

g. Back wear plate: Replaceable back wear plate shall be constructed of carbon steel, and shall be secured to the seal plate by four welded studs and nuts.

h. Shaft bearings: Shall be anti-friction ball bearings, of ample size and proper design to withstand all radial and thrust loads which can reasonably be expected during normal operation. Pump designs in which the same oil lubricates both the shaft bearings and the shaft seal are not acceptable.

i. Pusher bolt capability to assist in removal of rotating assembly. Pusher bolt threaded holes shall be sized to accept same capscrews as used for retaining rotating assembly.

7. Discharge spools: Each pump shall be equipped with one-piece, cast iron spool, flanged on each end. Each spool shall have one $1^{1}/_{4}$-inch NPT and one $^{1}/_{4}$-inch NPT tapped hole with pipe plugs for mounting of gauges or other instrumentation.

2.02 PUMP ACCESSORIES

A. Spare Parts: Furnish the following spare parts:

1. Three (3) Spare Parts Kits each including one (1) mechanical cartridge seal, one (1) set of rotating assembly adjustment shims, one (1) cover plate O-ring, one (1) rotating assembly O-ring;

2. One (1) complete rotating assembly;

3. One (1) impeller;

4. One (1) front wear plate;

5. One (1) impeller shaft;

6. One (1) impeller socket head capscrew;

7. One (1) impeller washer;

8. Three (3) suction flap valve assemblies;

9. One (1) belt tensioning gauge(s) - spring loaded;

10. Two (2) quart(s) of seal lubricant;

11. Two (2) air release valve diaphragms;

12. Two (2) air release valve springs;

13. One (1) ARV spring compression tool;

14. One (1) gallon touch-up paint, white; and

15. One (1) quart touch-up paint, safety orange

B. Pump Drain Kit:

1. A pump drain kit shall be provided, including the following:

a. One set of drain fittings for each pump. Each set of drain fittings includes a pipe nipple, bushing, bronze ball valve and aluminum quick connect male Kamlock fitting.

b. One drain hose for common use among all pumps. Drain hose shall consist of plastic hose with an aluminum quick connect female Kamlock fitting on one end. Routing of drain hose shall be so as to not interfere with any equipment or be a tripping hazard. Drain hose length shall be sufficient to drain to the sump pit based upon the routing above.

2. All fittings shall be supplied as stainless steel, unless specified otherwise above.

C. High Pump Temperature Sensor:

1. Each pump shall have a Normally-Open high pump temperature sensor, which shall close upon pump temperature reaching 140°F. The sensor shall be wired to the pump control panel.

2.03 VALVES AND PIPING

A. Check Valves, 10-inch x 12-inch:

1. Each pump shall be equipped with a full flow type check valve, each capable of passing a 3" spherical solid, with flanged ends and be fitted with an external lever and spring. The valve seat shall be constructed of stainless steel and shall be replaceable. The valve body shall be cast iron. The valve shall be equipped with a removable cover plate to permit entry for complete removal and replacement of internal components without removing the valve from the line. Valve clapper shall have a molded neoprene seating surface incorporating low pressure sealing rings. Valve hinge pin and internal hinge arm shall be stainless steel supported on each end in brass bushings, sealing bushing shall have double o-rings. O-rings shall be easily replaceable without requiring access to interior of valve body. Valve shall be rated at 175 psi water working pressure, 350 psi hydrostatic test pressure. Valves other than full flow type or valves mounted in such a manner that prevents the passage of a 3" spherical solid are not acceptable.

2. Each check valve shall be provided with a ¼-inch threaded tap with plug on the downstream side of the valve for installation of a pressure gauge.

B. Air Release Valves (Diaphragm Type):

1. Each pump shall be equipped with one pressure actuated automatic air release valve, designed to permit the escape of air to the atmosphere during initial priming or unattended repriming cycles. Upon completion of the priming or repriming cycle, the valve shall close to prevent recirculation. Valves shall provide visible indication of valve closure and shall operate solely on discharge pressure. Level/float actuated air release valves are not acceptable.

2. All valve parts exposed to sewage shall be constructed of cast iron, stainless steel, or similar corrosion resistant materials. Diaphragms shall be fabric-reinforced neoprene or similar inert material.

3. A cleanout port, 3 inches or larger in diameter, shall be provided for ease of inspection, cleanout, and service.

4. Valves shall be field adjustable for varying discharge heads.
5. Air release valves shall be connected to pump station piping using stainless steel pipe fittings.

6. Each air release valve shall be provided with an isolation ball valve.

7. Air release valve piping must discharge directly into wetwell. Air release valve piping shall not discharge to a sump.

8. Each air release valve shall have a separate air release discharge pipe back to the wetwell. Discharge pipe shall be minimum 1½-inch diameter.

C. Supports and Thrust Blocks:

1. Contractor must ensure all pipes connected to the pumping system are supported to prevent piping loads from being transmitted to pumps or system piping.

2. Pump station discharge force main piping shall be anchored with thrust blocks by the Contractor where shown on the drawings.

D. Gauge Connection Assembly:

1. The header piping shall be equipped with a gauge connection assembly located between the discharge check valve and force main isolation gate valve allowing the Operator to easily attach a discharge gauge on any pump for troubleshooting.

2. The gauge assembly shall consist of a ¼-inch brass pipe nipple, ¼-inch brass full port ball valve and a quick connect fitting.

3. The gauge connection assembly shall be installed in the discharge header piping such that the static and dynamic pressure in the force main can be read unless the force main isolation gate valve is closed for that pump.

2.04 FABRICATED STEEL BASE

A. One fabricated steel base shall be provided for each pump and motor assembly. The base shall comprise a base plate, perimeter flange, and reinforcements. Base plate shall be fabricated of steel not less than ¼" thick, and shall incorporate openings for access to all internal cavities to permit complete grouting of unit base after installation. Perimeter flange and reinforcements shall be designed to prevent flexing or warping under operating conditions. Base plate and/or flange shall be drilled for hardware used to secure unit base to concrete pad as shown on the Contract Drawings. Unit base shall contain provisions for lifting the complete pump unit during shipping and installation.

2.05 DRIVE UNIT

A. Motors:

1. Provide motors as specified herein.

2. The pump motors shall be horizontal, totally enclosed fan cooled, explosion-proof, induction type, with normal starting torque and low starting current characteristics.

3. Motors shall be approved for use in areas classified by NEC as Class I, Div, 1, Group C & D Hazardous Locations, as defined and approved by UL and/or FM.

4. The specified maximum motor horsepower shall be adequate so that the pump is non-overloading throughout the entire non-truncated pump performance curve from shut-off through run-out. Motor overloads resulting from pump performance that exceed the design point within acceptable HI Standards will not be accepted.

5. Motors shall be suitable for use with RVSS starters and VFDs.

6. Motors shall be tested in accordance with provisions of ANSI/IEEE Std. 112.

7. Each motor shall be in current NEMA Design B cast iron frame with copper windings.

8. Motors shall be NEMA Premium Efficient, per NEMA MG-1, Table 12-12.

9. Motors shall be supplied with winding thermostat switches, one per phase.

B. Drive Transmission:

1. Power shall be transmitted from motors to pumps by means of v-belt drive assemblies. The drive assemblies shall be selected to establish proper pump speed to meet the specified operating conditions.

2. Each drive assembly shall have a minimum of two v-belts. In no case will a single belt drive be acceptable. Each v-belt drive assembly shall be selected on the basis that adequate power will be transmitted from driver to pump. Drive systems with a Safety Factor of less than 1.5 will not be considered sufficient for the service intended. Computation of the Safety Factor shall be based on performance data published by the drive manufacturer.

3. V-belts shall be the banded type.

C. Belt Guards:

1. Pump drive transmissions shall be enclosed on all sides in a guard constructed of any one or combination of materials consisting of expanded, perforated, or solid sheet metal, except that maximum perforated or expanded openings shall not exceed ½-inch.

2. Guards shall be manufactured to permit complete removal from the pump unit without interference with any unit component and shall be securely fastened to the unit base.

3. All metal shall be free of burrs and sharp edges. Structural joints shall be continuously welded. Panels may be riveted to frames with not more than 5-inch spacing. Tack welds shall not exceed 4-inch spacing.

4. The guard shall be finished with one coat of gray water reducible (W.R.) non-lift primer and one coat of orange acrylic alkyd W.R. enamel in accordance with Section 3, Color Definitions of ANSI 253.1; Safety Color Code for Marking Physical Hazards.

2.06 FINISH

A. Surface Preparation and Painting:

1. Pumps, piping, and exposed steel framework shall be cleaned prior to coating, using an approved solvent wipe or phosphatizing cleaner. The part must be thoroughly dry before paint application. Open joints shall be caulked with an approved polyurethane sealant.

2. Exposed surfaces shall be coated with one coat of Tnemec Series 69 Polymide Epoxy Primer and one finish coat of Tnemec Series 73 Aliphatic

Acrylic Polyurethane for a total dry film thickness of 4-6 mils. Finish coat shall be semi-gloss white for optimum illumination and enhancement.

3. The finish coat shall be corrosion, moisture, oil, and solvent resistant when completely dry.

4. The factory finish shall allow for over-coating and touch up for 6 months after coating. Thereafter, sanding may be required to accept a topcoat or touch-up coating.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Contractor shall off-load equipment at installation site using equipment of sufficient size and design to prevent injury or damage. Pumping equipment Manufacturer shall provide written instructions for proper handling. Immediately after off-loading, Contractor shall inspect pumping equipment and appurtenances for shipping damage or missing parts.

B. Any damage or discrepancy shall be noted in written claim with shipper prior to accepting delivery. Validate all serial numbers and parts lists with shipping documentation. Notify Manufacturer's representative of any unacceptable conditions noted with shipper.

3.02 INSTALLATION

A. Install, level, and align pump station as indicated on drawings or as directed by the Engineer. Installation must be in accordance with written instructions supplied by the Manufacturer.

B. Suction pipe connections must be vacuum tight. Fasteners at all pipe connections must be tight. Install pipe with supports and thrust blocks to prevent strain and vibration on pump system piping. Install and secure all service lines (level control, air release valve and pump drain lines), as required, in wetwell.

C. Provide adequate clearance for removal of pump rotating assembly and cover plate.

D. Each air release valve shall have a separate air release discharge pipe back to the wetwell. Discharge pipe shall be minimum 1½-inch diameter, and installed with constant downward slope towards the wetwell. Pipe shall be routed so as not to interfere with any equipment or be a tripping hazard.

E. Check motor and control data plates for compatibility to site voltage. Install and test the electrical ground prior to connecting line voltage to pump control panel.

F. Prior to applying electrical power to motors or control equipment, check all wiring for tight connection. Verify that fuses and circuit breakers conform to project requirements. Manually operate circuit breakers and switches to ensure operation without binding. Open all circuit breakers and disconnects before connecting utility power. Verify line voltage, phase sequence and ground before actual startup.

G. After all anchor bolts and piping connections are installed, seal all openings between wetwell and pump station building.

H. If determined by the Engineer and/or Manufacturer at startup, that grouting the pump/motor base is needed, the Contractor shall be responsible to install grout to the pump/motor base. If grout is installed, the Contractor shall ensure that the grout does not interfere with the pump/motor/belt guard adjustment or mounting hardware.

3.03 PROTECTION

A. The pumping equipment shall be placed into service soon after delivery of the equipment. If installation is delayed, the pumping equipment and motor control center shall be stored indoors, free of excessive dust, in a low humidity, heated environment.

B. During installation and after the pumping equipment is placed into operation the motor control center shall operate in an environment free of excessive dust, in a low humidity, heated environment.

3.04 FIELD QUALITY CONTROL

A. Prior to acceptance by the Owner, an operational test of the pump station, including the pumps, drives, control systems and all ancillary equipment and systems, shall be conducted to determine if the installed equipment meets the purpose and intent of the specifications. Tests shall demonstrate that all equipment is electrically, mechanically, structurally, and otherwise acceptable; is safe and in optimum working condition; and conforms to the specified operating characteristics.

B. Prior to startup, Contractor shall clean wetwell by removing construction debris and foreign material.

3.05 MANUFACTURER’S PRE-STARTUP INSPECTION

A. Contractor shall coordinate system pre-startup with Manufacturer’s factory-trained service technician. The factory-trained service technician shall inspect the installation and answer any installation questions by the Contractor, Engineer, or Owner.

B. Manufacturer's representative shall provide pre-startup checklist to be completed by the Contractor prior to pre-startup inspection.

C. Verify that Operation & Maintenance Manual is on site and installation instructions contained in the manual have been followed.

D. Verify that all pumping equipment, piping, level control system, alarms and ancillary equipment have been properly installed and all wiring is complete.

E. Verify that spare parts for the pumping equipment are on site.

F. Pre-startup inspection shall be a separate trip and shall not be less than two weeks prior to the startup of the equipment.

3.06 MANUFACTURER'S STARTUP AND FIELD PERFORMANCE TESTING

A. Coordinate system startup with Manufacturer's factory-trained service technician. The factory-trained service technician will inspect the completed installation, calibrate and adjust instrumentation, and correct or supervise correction of defects or malfunctions. Startup shall be performed in the presence of the Owner.

B. Contractor shall supply clear water of adequate volume to operate the system including the force main through several pumping cycles.

C. Contractor shall have an electrician present at startup to resolve any wiring issues.

D. Observe and record operation of pumps, suction and discharge pressure gage readings, voltage readings, ampere draw, pump controls, and liquid level controls. Check calibration of all instrumentation equipment. Test manual and automatic control systems. Test all alarms. Report and remedy any undue noise, vibration or other operational problems.

E. Startup shall be a separate trip.

3.07 MANUFACTURER'S OPERATION AND MAINTENANCE TRAINING

A. The Manufacturer shall furnish the services of a qualified, factory-trained operations and maintenance serviceman to instruct and train Owner's personnel in the proper care, operation and maintenance of the equipment. The training shall include, but not be limited to, the following:

1. Theory of operation.

2. Actual operation.

3. Mechanical maintenance.

4. Hydraulic troubleshooting.

5. Safe operating and working practices and operation of safety devices.

B. One (1) training session is required. Training shall be completed after startup services have been performed. Training shall be a separate trip and shall not be less than two weeks after the startup of the equipment. Time, location, and duration of all training sessions shall be coordinated with Owner's personnel.

C. Hands-on training and demonstrations shall use the installed equipment.

D. Supplier shall provide all materials for training and shall provide training manuals to all personnel being trained.

3.08 MANUFACTURER'S EQUIPMENT RE-CERTIFICATION

A. Manufacturer's factory-trained service technician shall return to the site six (6) months after initial startup of the equipment to perform a final re-certification of the equipment.

B. The re-certification shall consist of demonstrating and certifying that the equipment is meeting the performance requirements of the specifications. Equipment service technician shall perform field-testing of the equipment in the presence of the Owner. Results of all field-testing shall be submitted to the Engineer and the Owner.

3.09 MANUFACTURER CALL-BACKS

A. In addition to the services specified above, the Contractor shall cover the cost in his bid for two (2) on-site call-backs to be provided to the Owner by the manufacturer's factory-trained service technician.

B. Call-backs may be used anytime, up to one (1) year from the date of startup. Each call-back shall be a separate trip, consisting of up to eight (8) hours on-site.

C. Use of manufacturer's call-backs shall be at the sole discretion of the Owner. Call-backs may be used for equipment repair, warranty evaluation, routine maintenance, operator training, etc.

3.10 CLEANING AND HOUSEKEEPING

A. Prior to acceptance, inspect interior and exterior of pump station for dirt, splashed material or damaged paint. Clean or repair accordingly. Use touch-up paint to repair any painted surfaces damaged during installation or startup. Remove from the job site all tools, surplus materials, scrap and debris.

END OF SECTION

SECTION 11330

INFLUENT SEWAGE GRINDER

PART 1 - GENERAL

1.01 SUMMARY

A. This section describes the influent sewage grinder and motor controller. The equipment shall be installed as shown on the plans, as recommended by the manufacturer, and in compliance with all OSHA, MOSHA, and local, state and federal codes and regulations. Grinder frame shall be designed to support the grinder, as shown on the plans. Grinder frames shall also be designed to accommodate an influent sluice gate, when shown in combination on the plans.

B. Contractor shall provide all equipment, material, labor, tools and services necessary to furnish and install one (1) sewage grinder, complete with explosion-proof immersible motor, stainless steel guiderails, and all other appurtenances and accessories for a complete installation.

C. The intended purpose of the grinder is to grind up the solids typically found in raw, unscreened sewage into small particles with a maximum theoretical size of 0.5” x 1.5” x 1.5” under the conditions and installation described in the Contract Documents.

1.02 SUBMITTALS

A. Shop Drawings: Equipment descriptions, specifications, dimensional and assembly drawings, parts lists, and job specific drawings, including wiring diagrams. Include complete electric submersible motor data.

B. Operation and Maintenance Manuals: The manuals shall include equipment descriptions, operating instructions, drawings, troubleshooting techniques, a recommended maintenance schedule, recommended lubricants, and complete overhaul information for all components of the system.

C. Manufacturer’s Warranty: Shall be for a period of two (2) years, with no hour limitation, non-prorated, from the date Contractor achieves Substantial Completion for the project. The warranty shall cover grinder and motor against defects in materials and workmanship, including all parts and factory or authorized service facility labor. The Contractor shall provide a certificate for inclusion in the O&M Manuals documenting the Manufacturer’s date of warranty commencement (Contractor’s Substantial Completion date) and expiration (two years hence).

D. Equipment Guarantee Certification Form

In addition to the manufacturer's warranty for the grinder equipment, the Contractor shall obtain and submit to the Engineer and Owner certification from the grinder manufacturer that the grinder meets the requirements of the intended application and contract drawings and specifications. This certification shall be provided by way of the Equipment Guarantee Certification Form included herewith.

EQUIPMENT GUARANTEE CERTIFICATION FORM

Reference: **New Creamery Road Sewage Pump Station**
Town of Emmitsburg, Maryland

THE UNDERSIGNED HEREBY ATTESTS THAT HE/SHE HAS EXAMINED ALL APPLICABLE CONTRACT DRAWINGS AND SPECIFICATIONS, AND CERTIFIES THAT THE EQUIPMENT THAT HE/SHE PROPOSES TO FURNISH AND DELIVER MEETS OR EXCEEDS CONTRACT SPECIFICATIONS, IS SUITABLE FOR THE INTENDED PURPOSE STATED IN SPECIFICATION SECTION **11330**, IS SUITABLE FOR INSTALLATION AS PRESENTED IN THE CONTRACT DRAWINGS AND SPECIFICATIONS, AND WILL PROVIDE SATISFACTORY PERFORMANCE AT THE DESIGN CRITERIA SPECIFIED. THIS GUARANTEE OF SUITABILITY FOR INTENDED PURPOSE IS IN ADDITION TO AND SHALL NOT BE IN LIEU OF ANY OTHER WARRANTIES, EXPRESSED OR IMPLIED.

EQUIPMENT: **INFLUENT SEWAGE GRINDER**

MANUFACTURER: _____

Address: _____

_____

By: _____
(Typed Name and Title)

_____/s/_____ (SEAL)
(Signature) (Date)

Equipment Guarantee Certification must be signed by a Principal Person (President, Vice-President, etc.) of the equipment manufacturer. In the event the manufacturer is not the Supplier then a Principal Person of the Supplier must <u>also</u> sign this form.

SUPPLIER: _____

Address: _____

_____

By: _____
(Typed Name and Title)

_____/s/_____ (SEAL)
(Signature) (Date)

1.03 QUALITY ASSURANCE

A. Qualifications: Qualified manufacturers shall have a minimum 5 years experience at manufacturing two-shafted grinding equipment and motor controls with a minimum of 25 installations with similar equipment. Contractor shall provide a list of names and dates of installations for verification by the Engineer or Owner's Representative.

B. Regulatory Requirements: Motor controllers shall, as applicable, meet the requirements of the following Regulatory Agencies:

1. National Electrical Manufacturer's Association (NEMA) Standards.

2. National Electrical Code (NEC).

3. Underwriters Laboratory (UL).

1.04 DELIVERY, STORAGE AND HANDLING

A. The equipment shall be packaged in containers constructed to protect all equipment from damage.

B. Contractor shall comply with grinder manufacturer's written instructions for storage and handling.

1.05 IDENTIFICATION

A. Each unit of equipment shall be identified with a stainless steel nameplate, securely affixed in a conspicuous place. Nameplate information shall include equipment model number, serial number, supplier's name, and location.

1.06 SPARE PARTS

A. Contractor shall furnish the following spare parts for each grinder:

1. Fuses (quantity of 3) of each size/type installed.

2. Complete set of gaskets.

3. Any special tools required for assembly or disassembly.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Grinders, immersible motors, motor controllers, support systems, frames, guide plates, guiderails, and all appurtenances and accessories shall be in compliance with these specifications and contract documents, and shall be JWC Environmental

Channel Monster Grinder Model CMD3210-XDS2.0 Wipes Ready, or Vogelsang Model XRG100-800QD HCS. Maximum Design Flow Capacity: 3,819 GPM (5.5 MGD)

B. The manufacturer must certify that the unit can be returned for maintenance to the factory or a local repair facility. The certification shall include a statement that there will be no charge for repair labor.

2.02 SUPPORT SYSTEM

A. GENERAL

1. Provide channel frame of suitable dimension and strength to support grinder in place and direct flows from cutters to the wetwell. Channel frames shall also be designed to accommodate an influent sluice gate, when shown in combination on the plans. The channel frame shall be Type 316 stainless steel construction and firmly anchored to the wetwell wall.

2. An overflow bar rack for each grinder shall be provided to ensure screening upon failure of grinder. Overflow bar rack shall be integral to the channel frame.

3. A guiderail system for each grinder shall be provided to permit easy removal of grinder for maintenance. The manufacturer shall supply a 316 stainless steel lifting bail, such that there shall be no need for personnel to enter the wetwell.

4. Each installed grinder shall be furnished with a ¼-inch diameter 304 stainless steel wire rope as supplied by the Portable Equipment Hoist Manufacturer, a 316 stainless steel shackle, and a 316 stainless steel cable saddle for removing/installing the grinder. Each wire rope shall be of adequate length to cover the required anchor wraps, boom length, and distance between the boom end and pick point, while not exceeding the winch drum capacity. The saddle and shackle shall be of sufficient size to connect to the grinder, and of sufficient strength to not derate the Portable Equipment Hoist maximum lifting Capacity. The upper end of the cables shall be neatly hung and cable tied from a 316 stainless steel hook located within the access hatch opening.

5. An aluminum basket strainer for each grinder shall be provided for installation in the channel frame to ensure continued screening when the grinder is removed for maintenance or inspection.

2.03 GRINDER

A. GENERAL

1. Each grinder shall include cutters, spacers, shafts, bearings and seals, side

rails, end housings, covers, reducer and motor. One-piece monolithic rotors may be used instead of individual cutters and spacers.

2. The grinder shall be of two-shaft design and be capable of continuous operation, processing wet or dry. Bar screens or single-shaft devices utilizing a single rotating cutter bar with stationary cutters shall not be acceptable.

3. Two-shaft design shall consist of two parallel shafts alternately stacked with individual intermeshing cutters and spacers positioned on the shaft to form a helical pattern or equipped with monolithic cutter assemblies positioned on the shaft to form a helical pattern. The two shafts shall counter-rotate with the driven shaft operating at approximately two-thirds (2/3) the speed of the drive shaft. Cutter diameters on the drive shall be of equal diameter to ensure proper clean-out of the spacers.

B. COMPONENTS

1. Cutter Assembly shall be either,

a. Multi-Zone-Staggered and Helical Stack Configuration:

i. Cutters and spacers stacked with two defined zones, each with its own unique cutter and spacer type, thickness, stacking configuration, and material throughout zone. Zone 1 cutters for high abrasion resistance and Zone 2 cutter for shearing and particle size control.

ii. Zone 1-Grit Zone. Material Zone 1: Alloy Steel.

(1). Cutters: Through hardened to 45-52 HRC
(2). Spacers: Through hardened to 34-52 HRC.

iii. Cutters-Zone 1 (3-inch Grit Zone)-Staggered Stack

(1). 7-tooth Cam style, .438-inch effective thickness, 4.710-inch diameter. Designed specifically for waste streams containing heavy volumes of solids.
(2). Precision ground individual cutter elements with a thickness tolerance of +.000/ -.001.
(3). Keyed to shaft with hexagon opening.

iv. Spacers-Zone 1 (3-inch Grit Zone)

(1). Smooth O.D. .446-inch thick, Alloy Steel.
(2). Precision ground individual spacer elements with a thickness tolerance of +.001/ -.000.
(3). Keyed to shaft with hexagon opening.

v. Configuration-Zone 1 (Grit Zone)

(1). Cutters and spacers form 3-inch nominal stack height
(2). Cutters stacked staggered with every other cutter's teeth aligned to minimize absorbed torque requirement and maximize cutter tooth force.

vi. Zone 2-Working Zone. Material Zone 2: Alloy Steel.

(1). Cutters: Through hardened to 45-52 HRC
(2). Spacers: Through hardened to 34-52 HRC.

vii. Cutters-Zone 2 (Working Zone)-Helical Stack

(1). 11-tooth Cam style, .310-inch thick, 4.710-inch diameter. Designed specifically for waste streams containing municipal waste and moderate volumes of solids.
(2). Precision ground individual cutter elements with a thickness tolerance of +.000/ -.001.
(3). Keyed to shaft with hexagon opening.

viii. Spacers-Zone 2(Working Zone)

(1). Smooth O.D. .319-inch thick.
(2). Precision ground individual spacer elements with a thickness tolerance of +.001/ -.000.
(3). Keyed to shaft with hexagon opening.

b. Or, Manufactured from a monolithic assembly

i. Cutting stack shall be a nominal height of 31.49 inches (800mm)

ii. Monolithic assembly constructed from a solid block of alloy steel surface ground to a blade thickness of .37-inches +.000/-.001 (9.5 mm +.000/-.003).

iii. Cutters shall be heat treated to produce a hardness of 60-65 Rockwell C.

iv. Cutters shall be nitrated for high corrosion resistance.

v. Cutters shall have eight cam shaped teeth.

vi. Cutter tooth height shall not be greater than ½-inch (13 mm) above the root diameter of the cutter.

vii. Cutter assembly OD shall be 4.72-inches (120 mm) minimum. Spacer shall be cut into the monolithic cutter, and shall have a smooth outside diameter with no tooth profiles. Designs with multiple cutters and spacers shall not be acceptable.

2. Shafts

a. Shafts shall be AISI 4140 alloy steel with a tensile strength rating of not less than 149,000 psi.

b. Shafts shall measure a nominal 2 inches across flats of hex. Shafts shall have a minimum hardness of 38-42 Rockwell C.

3. Intermediate Shaft Support

a. Intermediate shaft supports shall be 304 stainless steel, AISI 17-4 stainless steel and SAE 660 bearing bronze. Shaft supports shall be lubricated with high temperature marine grade grease at the factory.

b. Grease fittings on the shaft supports shall be provided for periodic additions of grease.

c. Intermediate shaft supports shall provide additional support to the shafts during severe grinding demands.

d. Intermediate shaft yokes shall provide radial support to the shafts during severe grinding demands.

e. Intermediate shaft yokes shall be constructed of 304 stainless steel, 660 bronze, and 17 4PH Stainless steel.

f. Intermediate shaft yokes shall be factory lubricated with high temperature marine grade grease.

g. Grease fittings shall be provided on intermediate shaft yokes for periodic maintenance.

4. Perforated Screen Drums

a. Perforated Screen Drums

i. Screens cylindrically formed with ½ inch diameter holes (Orifices) with a nominal 50% open area across the surface of the screen.
ii. Maximum area of each orifice: 0.2 square-inches.
iii. Center of screen drum void of any shaft or obstruction.
iv. Screens deburred AISI 304 stainless steel.

v. Trunnions top and bottom of screen drums ASTM A564 Grade 630 condition H1150 (17-4) stainless steel.

5. Shaft Bearings and Seals

a. Mechanical Seal and Bearing Cartridges-Severe Duty

i. Seals and bearing incorporated into a cartridge style design requiring no external seal flush or lubricants to operate wet or dry.
ii. Rated for maximum operating depth: 346 feet (150 psi).
iii. Secondary lip seal with grease barrier.
iv. Dynamic and Static seal faces to be Tungsten carbide with 6% nickel binder.
v. Cartridge bushing and housing are AISI 304 stainless steel.
vi. O-rings to be Viton (Fluorocarbon).

b. The bearings shall be housed in a replaceable cartridge that supports and aligns the bearings and seals, as well as protects the shafts and end housings. The seal elements shall be independent of the stack height therefore cutter stack tightness shall not affect seal performance. The seal elements shall maintain their factory set preload independent of the cutter stack tightness.

c. Seals shall meet required pressure rating regardless of cutter stack fit. The seal cartridge shall provide seal protection against axial loading on shafts and bearings during shaft deflection.

d. Each seal element shall be positively locked to its corresponding rotating or static cartridge element. This positive lock on the seal elements is critical.

6. Side Rails

a. The screen drum side rail shall create a baffle around part of the screen drum and support the mounting of a brush to seal the interface and clean solids from surface of screen drum.

b. Clearance between the cutter side rail and adjacent cutters shall not exceed 0.100 inch.

c. Cutter side rail shall have evenly-spaced Delta-P horizontal fingers to maximize flow and maximize capture of solids by cutter stack.

d. The side rails shall be cast of A536-84 ductile iron.

7. End Housings and Covers

a. End housings and top cover shall be ASTM A536-84 ductile iron or 1018 carbon steel housing segments. End housings shall have integral bushing deflector to guide solids from seal cartridges.

b. Bottom cover shall be ASTM A36 rolled steel.

8. Reducer

a. Reducer shall be internal planetary mechanism with cycloidal curved tooth profile. The speed reducer shall be grease-filled planetary-type of reducer with a 500% shock load capacity. The reduction ratio shall be 29:1. The input shaft of the reducer shall be directly coupled to the motor using a three-piece coupling, and the output shaft of the reducer shall be directly coupled with the grinder using a two-piece coupling.

b. Or, the grinder gearbox shall be a low speed, high-torque parallel shaft gearbox manufactured by Nord Gear. Maximum motor speed shall not exceed 1800 rpm, and should provide a minimum of 10% reserve hp as evidenced by specific requirements at maximum design.

9. Motor

a. The motor shall be a 5 hp immersible motor, capable of continuous submergence underwater without loss of watertight integrity to a depth of 40 feet for 40 days and continuous unsubmerged operation in air without overheating, rated for the electrical service shown on the electrical drawings. TECO-Westinghouse motors are not acceptable.

b. Motor service factor shall be 1.15, the efficiency factor not less than 91% at full load and the power factor not less than 74% at full load. Motor shall be U.L. rated NEMA 6P. Motor shall not utilize fan cooling at any time during operation. Motor shall use ceramic shaft seal requiring no oil lubrication.

10. Required Running Torque per Horsepower:

a. At Momentary Load Peaks: 3,995 in-lbs/hp

2.04 MOTOR CONTROLLER

A. GENERAL

1. The controller shall provide independent control of the grinder.

2. Controller shall be the supplier's standard UL listed Model PC2220 or UL listed XRG panel.

3. The controller shall be rated for the electrical service as shown on the electrical drawings and shall include a rotary panel disconnect/circuit breaker.

4. Controller shall have a minimum 10KAIC rating.

B. OPERATION

1. The controller shall be equipped with a GRINDER ON-OFF/RESET two (2) position selector switch.

   a. In the OFF/RESET mode the grinder shall not run. In the ON mode the grinder will run.

   b. The grinder shall only be reset by switching the GRINDER ON-OFF/RESET switch to the OFF/RESET position.

C. SAFETY FEATURES

1. When a grinder jam condition occurs in the grinder ON mode, the controller shall stop the grinder, and then reverse the grinder rotation to clear the obstruction. If the jam is cleared, the controller shall return the grinder to normal operation. Up to two (2) additional reversing cycles (3 times total) may occur within 30 seconds before the controller de-energizes the grinder motor and activates the grinder fail indicator and relay.

2. If a power failure occurs, an on-delay timer shall delay grinder restarting when power is restored. Timer shall have an operating range of 0.05 seconds to three hundred hours.

3. If a power failure occurs while a grinder is running, operation shall resume when power is restored.

4. If a power failure occurs while a grinder is in a fail condition the fail indicator shall reactivate when power is restored.

5. The controller shall provide overload protection for the motor through an overload relay mounted directly on the grinder starter.

6. Contractor shall install properly sized circuit breaker for short-circuit protection.

7. Controller reset shall be from the local panel controls only.

8. Disconnects for the grinder (where shown) shall provide contacts to indicate the status of the switches. The contacts shall open when the switches are opened (off). These signals shall be connected in series with the grinder fail signals and connected to the Pump Control Panel. The grinder fail alarm contacts shall be fail-safe by using a normally closed contact to open on a failed condition. In addition to the normal conditions that constitute a grinder fail condition, the grinder control programming shall be configured to generate a failed condition any time power is removed from the grinder controls, or any time the grinder is not running for any reason.

D. COMPONENTS

1. Enclosure

a. Enclosure shall be NEMA 4X, fabricated of FRP, and shall be suitable for wall mounting. Doors shall have corrosion-resistant hinges and latches.

b. Enclosure shall house the control devices, relays, terminal blocks and reversing motor starters.

2. Control Devices

a. Pilot devices shall be mounted on the enclosure front panel door.

b. The controller shall have indicator lights for POWER ON, RUN and each FAIL condition. The FAIL indicators shall be GRINDER JAM, MOTOR OVERLOAD, and MOTOR OVERTEMP.

c. Indicator lights are LED pilot lights. Lamps and the selector switches shall be heavy duty NEMA 4X type.

d. Control transformer shall be protected by two primary fuses and one secondary fuse. The 120-volt secondary shall have one leg grounded.

e. Relay contacts shall be included for GRINDER RUN and FAIL signal outputs. The contacts shall be rated 2-amp, 240 VAC, resistive load.

3. Motor Starter

a. Starter shall be NEMA 1 full-voltage reversing with 120-volt operating coils.

b. Forward and reverse contactors on the starter shall have both mechanical and electrical interlocks.

c. Overload relays (OL) shall be adjustable so that the range selected includes the FLA (full load amperes) rating and service factor.

2.05 SOURCE QUALITY CONTROL

A. The grinder and controller shall be factory tested to ensure satisfactory operation.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Grinder and motor controller shall be installed in accordance with the supplier's installation instructions, and in compliance with all OSHA, MOSHA, and local, state and federal codes and regulations.

B. The Contractor shall install the influent sewage grinder system and appurtenances in strict accordance with the manufacturer's recommendations and as approved by the Owner. The Contractor and Pump Control System Supplier under Division 17 shall be responsible for supervising the installation, cabling, startup, and for implementing all functions of the influent sewage grinder systems required for the Pump Control System.

3.02 MANUFACTURER'S SERVICES

A. The manufacturer shall furnish the services of a qualified, factory-trained service representative who shall inspect the complete equipment installation under the supervision of the Contractor and Pump Control System Supplier to ensure that it is installed in accordance with the manufacturer's recommendations, make all adjustments necessary to place the system in trouble-free operation and instruct the operating personnel in the proper maintenance and operation of the equipment furnished. A minimum of two (2) days start-up assistance shall be provided.

B. The Owner reserves the right to videotape and archive all startup instruction provided by the influent sewage grinder manufacturer or authorized representative.

END OF SECTION

SECTION 11350

SUMP PUMP

PART 1 - GENERAL

1.01 DESCRIPTION

A. Work performed under this section includes, but is not limited to, furnishing and installing one sump pump with level sensing switch as specified herein.

B. The physical size of the pump furnished must be capable of fitting within the sump pump pit, as shown on the drawings, with no adverse hydraulic effects.

1.02 SUBMITTALS

A. Submit the following:

1. Layout drawings showing pump, and all discharge piping, valves, fittings and supports.

2. Wiring diagrams and electrical schematic indicating pump operation, control, and power supply.

3. Catalog data on the sump pump, level sensing switch, and all appurtenances.

4. Manufacturer's installation instructions.

5. Operation and maintenance manuals for the sump pump, level sensing switch, and accessories.

1.03 WARRANTY

A. The Contractor shall submit to the Owner a written manufacturer's warranty covering equipment defects and workmanship and shall be responsible for repairing or replacing at his own expense, including labor and shipping, all parts defective in material or workmanship for a period of two years from the date of Substantial Completion. The Contractor shall provide a certificate for inclusion in the O&M Manuals documenting the Manufacturer's date of warranty commencement (Contractor's Substantial Completion date) and expiration (two years hence).

PART 2 - PRODUCTS

2.01 SUMP PUMP

A. Sump pump shall be a non-clog, submersible type and shall be rated for intermittent operation at 67 gpm at 17 feet of total dynamic head and handle a 1½-inch solid. The curves submitted for approval shall state, in addition to head and capacity performance, solid handling capability, amp rating, and design impeller diameter. Sump pump shall be Myers Pump Model MSP50 Series, Barnes Series SE511VF, or approved equal.

B. Sump pump shall be provided with 2" NPT outlet. Piping shall be as specified in Section 15100. Provide an isolation gate valve and double check valves on the discharge side of pump as specified in Section 15110.

C. Pump Construction:

1. Motor Housing - Cast Iron ASTM A48, Class 30

2. Pump Housing - Cast Iron ASTM A48, Class 30

3. Impeller - Cast Iron, Non-Clog

4. Pump Shaft - Stainless Steel or nickel plated steel

5. External Fasteners - Stainless Steel

6. O-rings - Buna N

7. Mechanical Seals - Carbon/Ceramic

8. Bearings - Heavy Duty, Single Row Ball Bearings

9. Power Cord - Water Resistant, UL or CSA approved, double insulation.

D. Motor:

1. Refer to the requirements set forth in Division 16. Motor shall be 0.5- horsepower (HP) with voltage, phase and service as indicated on the Electrical Drawings. Motor shall be sized not to exceed nameplate current over the complete range of the head-capacity curve. Motor shall have a service factor of 1.0 and shall have thermal overload with automatic reset.

2. The stator, rotor and bearings shall be mounted in a sealed submersible housing. Single phase motors shall be split phase or capacitor start with centrifugal switch. Full load and locked rotor amps, as well as start and run winding resistance shall be tabulated for each pump.

E. Bearings, Shaft and Mechanical Seal:

1. An upper radial and lower thrust bearing are required. The upper and lower bearings shall be heavy duty, single row ball bearings. The bearings shall be permanently and continuously lubricated and cooled by dielectric oil which fills the motor housing.

2. The motor shaft shall be stainless steel or nickel plated steel and sealed from the pumped liquid with a carbon ceramic mechanical seal.

F. Impeller:

1. The impeller shall be high capacity, non-clog design with pump out vanes on the back side to wash out grit and stringy material.

G. Automatic Control:

1. Pump shall operate automatically based on level. Pump shall be furnished with either a pressure diaphragm switch or vertical float switch that features a piggy-back plug for automatic operation. The piggy-back plug shall be capable of being disconnected to allow the pump to be operated manually without removal of the pump from the sump.

PART 3 - EXECUTION

3.01 INSTALLATION

A. The sump pump shall be installed in accordance with the manufacturer's recommendations.

3.02 PAINTING

A. Sump pump shall be painted with water reducible alkyd enamel, air-dried, applied in one coat with a minimum thickness of 3 to 4 mils.

3.03 TESTING

A. Field testing shall include:

1. Test manual operation with water.

2. Test automatic operation with water. Operate pump by adding water to sump to ensure pump comes on. Remove water to ensure pump turns off.

3. Observe for proper operation of check valves (no reverse flow).

4. Verify motor amperage does not exceed nameplate rating.

END OF SECTION

SECTION 13120

PRECAST CONCRETE BUILDING

PART 1 - GENERAL

1.01 SUMMARY

A. This section describes the furnishing of a precast concrete transportable building and installation on prepared foundation in accordance with manufacturer's recommendations. Building shall be provided by the manufacturer with all necessary openings required by the Contract Documents in conformance with manufacturer's structural requirements.

1.02 QUALITY ASSURANCE

A. ACI-318-02, "Building Code Requirements for Reinforced Concrete"

B. American Society for Testing and Materials

1. ASTM A185; Standard Specification for Steel Welded Wire Reinforcement, Plain for Concrete

2. ASTM A615; Specification for Deformed and Plain Billet Steel Bars for Concrete Reinforcement

C. ANSI/ASCE-7-2 "Building Code Requirements for Minimum Design Loads in Buildings and Other Structures", most recent version.

D. International Building Code (IBC), most recent version.

E. International Energy Conservation Code (IECC), most recent version.

F. UL-752 test method level 4 for bullet resistance certified by an independent structural engineer.

G. Fabricator must be producer member of National Precast Concrete Association (NPCA) and participate in its Plant Certification Program.

H. Concrete Reinforcing Institute, "Manual of Standard Practice", most recent version.

1.03 DESIGN REQUIREMENTS.

A. Provide a building designed in accordance with ACI-318 and local prevailing codes for reinforced concrete and manufactured under Precast Concrete Institute (PCI) standards and Quality Control Manual MNL-116. Building shall be Easi-Span Model 2427.

B. Dimensions:

1. Exterior: 23'-4" x 27'-0"

2. Interior: 22'-0" x 25'-8" x 10'-2" ceiling

C. Design Loads:

1. Seismic load performance category 'C', Exposure Group III

2. Standard Live Roof Load - 60 PSF

3. Wind Loading - 130 MPH

D. Roof and Walls:

1. Roof panel shall have a peak and roof slope as shown on the Contract Drawings. The roof shall extend a minimum of 3 inches beyond the wall panel on each side and have a turndown design which extends ½-inch below the top edge of the wall panels to prevent water migration into the building along top of wall panels.

2. Roof panel(s) shall support design loads imposed upon them. The roof panels shall achieve an R39 insulation factor by means of "sandwiching" a Thermomass Insulation System between two concrete panels. The wall panels shall achieve an R13 insulation factor by means of "sandwiching" a Thermomass Insulation System between two concrete panels.

3. Roof and wall panels must each be produced as single component monolithic panels. No roof or vertical wall joints will be allowed, except at corners.

1.04 SUBMITTALS

A. Shop drawings shall include complete details, pertinent calculations, design loads, materials, strengths, sizes and thicknesses, locations of monorail beam, door, louver, and plumbing drain vent openings, and joint and construction design and details.

B. Contractor shall submit a complete list of all materials proposed to be furnished as part of this complete building, including all appurtenant equipment and component parts.

C. Contractor shall provide the Owner with complete design certification signed and sealed by a Professional Engineer registered in the State of Maryland.

D. A written acknowledgment from the Professional Engineer licensed in the State of Maryland and responsible for the design stating that seismic provisions pursuant to 7 CFR 1972, Subpart C were used in the design of the structure. Model Code/Standard and Date: International Building Code 2018 and ASCE 7-16; Seismic Use Group: Seismic Design Category – B; Seismic Factor: Seismic Risk Category – III. Contractor shall submit the written acknowledgment from the licensed Professional Engineer, as well as complete applicable USDA certification forms as part of the submittal package.

E. Verification from the supplier via written acknowledgment of location of existing overhead power lines and method of building installation in accordance with all applicable requirements.

1.05 DELIVERY, STORAGE AND HANDLING

A. Precast concrete building shall be considered suitable for handling for transport to the construction site after the concrete has cured to a minimum strength of 80 percent of the final design strength.

B. Delivery of precast concrete building shall be coordinated with installation.

C. Prefabricated building shall be unloaded with proper equipment of adequate capacity and equipped with appropriate slings and lifting devices to protect the material from damage. If damage occurs and is deemed repairable, it shall be repaired as directed by the Owner in accordance with the manufacturer's recommendations at no additional cost to the Owner. If damage is not repairable in the opinion of the Owner, such items of material will be rejected and shall be removed and replaced at the Contractor's expense.

1.06 WARRANTY

A. Contractor shall submit to the Owner a written manufacturer's warranty covering material defects and workmanship, including labor and shipping, for a period of two years from the date of Substantial Completion.

1.07 ACCEPTABLE MANUFACTURER(S)

A. Building shall be manufactured by M&W PRECAST, LLC, Ottsville, PA, or Smith-Midland, Midland, VA or approved equal. Products from Oldcastle Infrastructure are not acceptable and will not be approved.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Concrete: Steel-reinforced, 5,000-PSI minimum 28-day compressive strength, air-entrained (ASTM C260).

B. Reinforcing Steel: ASTM A615, Grade 60, unless otherwise indicated.

C. Post-tensioning Strand: 41K Polystrand CP50, .50, 270 KSI, 7-wire strand, enclosed within a greased plastic sheath (ASTM A416). Roof and floor each to be post-tensioned by a single, continuous tendon. Said tendon shall form a substantially rectangular configuration having gently curving corners wherein the positioning of the cable member results in a pattern of one or more loops and a bisecting of the loop(s). The cable member starts from one corner of the concrete building panel, forms a gentle perimeter loop(s) returning to a point where the cable member entered the concrete building panel. The tendon then turns 90 degrees and follows the cable member(s) to a point midway along the "Y" axis of the concrete building panel and then turns 90 degrees along the "X" axis of the concrete building panel. This bisects the concrete building panel and crosses the opposite parallel portion of the cable member and exits from an adjacent side of the concrete building panel.

1. If post-tensioning is not used in the roof panel, the following guidelines must be followed to ensure a watertight roof design.

a. The entire precast concrete roof panel surface must be cleaned and primed with a material that prepares the concrete surface for proper adherence to the coating material.

b. The entire precast concrete roof panel surface shall be sealed with a 0.045 EPDM continuous membrane cemented to the concrete with a compound designed for this purpose.

D. Caulking: All joints between panels shall be caulked on the exterior and interior surface of the joints. Caulking for exterior joints shall be SIKAFLEX-1A elastic sealant, or approved equal. Caulking for interior joints shall be SIKAFLEX-15LM elastic sealant, or approved equal.

E. Panel Connections: All panels shall be securely fastened together with $^{3}/_{8}$-inch thick powder-coated steel brackets. Steel is to be of structural quality, hot-rolled carbon complying with ASTM A283, Grade C and powder coated after fabrication. All fasteners to be ½-inch diameter bolts complying with ASTM A307 for low-carbon steel bolts. Cast-in anchors used for panel connections to be Meadow-Burke #FX-19, or approved equal. All inserts for corner connections must be fastened directly to form before casting panels. No floating-in of connection inserts shall be allowed.

2.02 ACCESSORIES

A. Doors and Frames

1. Doors and frames shall comply with Specification Section 08220 FIBERGLASS REINFORCED PLASTIC (FRP) DOORS.

B. HVAC

1. HVAC components shall comply with Specification Section 15500 HVAC and Specification Section 15700 Mini-Split Heat Pump Air Conditioning System. Contractor shall be responsible to coordinate all HVAC components and their installation with the Precast Concrete Building Supplier.

C. Monorail Crane System

1. Monorail crane system shall comply with Specification Section 14100 MONORAIL CRANE SYSTEM. Contractor shall be responsible to coordinate all monorail crane and hoist system components and their installation with the Precast Concrete Building Supplier.

2.03 INSULATION

A. Thermomass Building System, as supplied by Thermomass, PO Box 950, Boone, Iowa 50010 (800-232-1748), or approved equal, consisting of both:

1. Wall Insulation: 2" Thick R-13 extruded polystyrene board insulation complying with ASTM C578, Type IV; with regularly spaced holes identifying connector placement locations.

2. Roof Insulation: 5" Thick R-39 extruded polystyrene board insulation complying with ASTM C578, Type IV; with regularly spaced holes identifying connector placement locations.

3. Structurally non-composite wythe connectors: Non-conductive, non-corrosive, fiber-composite connectors, having a tensile strength of 120,000 psi, minimum glass content of 76 percent by weight, and a coefficient of thermal expansion of 5x10-6in/in/°F, nominal.

2.04 GUTTERS

A. Subject to compliance with requirements, gutters shall be manufactured by Merchant and Evans, Inc., Southern Aluminum Finishing Company, or approved equal.

B. Gutter Section: 0.063-inch formed aluminum, 6-inches deep. Provide slotted anchorage holes.

C. Spacers: 0.063-inch formed aluminum, 1-inch wide, spaced at 30-inches on centers unless indicated otherwise, alternate with gutter brackets.

D. Brackets: 0.25-inch formed aluminum, 1-inch wide, spaced at 30-inches on centers unless indicated otherwise, alternate with gutter spacers.

E. Joint Splice: 0.063-inch formed aluminum, 5-inches wide, spaced at 10-feet on centers maximum. Splice contour shall match gutter section.

F. Expansion Joints: 0.063-inch formed aluminum, 6-inch wide top cover, bottom cover and caps. Provide concealed 2-inch expansion space between end caps. Expansion joint shall match profile of gutter section.

G. Finish: KYNAR 500 PVDF resin. Color shall be selected by the Owner or Engineer from the manufacturer's standard range of colors.

2.05 DOWNSPOUTS

A. Subject to compliance with requirements, downspouts shall be manufactured by Merchant and Evans, Inc., Southern Aluminum Finishing Company, or approved equal.

B. Starters: 0.032-inch formed aluminum.

C. Downspouts: 0.032-inch formed aluminum, 3-inches by 4-inches unless indicated otherwise.

D. Offset Brackets: 0.125-inch formed aluminum, 2-inches wide, fasteners shall be stainless steel screws with washers set into lead shields. Anchor holes shall be drilled into masonry walls.

E. Elbows and Transitions: 0.032-inch formed aluminum, all welded joints, fabricate to match approved shop drawings, custom assemble to match field conditions.

F. Finish: KYNAR 500 PVDF resin. Color shall be selected by the Owner or Engineer from the manufacturer's standard range of colors.

G. Provide precast concrete splash block at base of all downspouts.

2.06 MISCELLANEOUS

A. Corners: Provide mitered and welded corners to match custom gutter and fascia sections. Corner legs to be approximately 4-feet long.

B. Anchorage Holes: Provide slotted anchorage holes for connection of gutter and fascia sections to wood nailers. Align anchorage holes of gutter and fascia sections so that gutter is installed only through slotted anchorage holes in the fascia sections.

2.07 FINISHES

A. Interior of Building

1. The walls and ceilings shall be prepared in accordance with ASTM: D4258-05 Standard Practice for Surface Cleaning Concrete for Coating. Apply two coats of Macropoxy 646 FC @ 3.0 - 5.0 mils DFT for a total DFT of 6.0 - 10.0 mils. Coordinate color per the Owner's selection from manufacturer's standard color chart.

B. Exterior of Building

1. Exterior finish combination of architectural/brick finish. Finish must be imprinted in top face of panel while in form using an impression form liner as manufactured by Architectural Polymers, Inc. Finished brick size shall be 2-3/8" x 7-5/8". Joints between each brick must be 3/8" wide x 3/8" deep. Back of joint shall be concave to simulate a hand-tooled joint. Each brick face shall be coated with H & C Concrete Stain by Sherwin & Williams. Stain shall be applied per manufacturer's recommendation. Grout joints shall be kept substantially free of stain to maintain a natural gray concrete color. Coordinate brick color with the Town. Provide manufacturer's standard color charts to the Owner in sufficient time to not impact fabrication and delivery and for selection by the Town.

PART 3 - EXECUTION

3.01 ACCESS

A. Contractor must provide level unobstructed area large enough for crane and tractor-trailer to park adjacent to pad. Crane must be able to place outriggers within 3'-0" of edge of pad and truck and crane must be able to get side-by-side under their own power. Firm roadbed with turns that allow 65-foot lowbed tractor and trailer must be provided directly to site. Building shall not be placed closer than 2'-0" to an existing structure. Contractor shall be responsible to coordinate installation with the Precast Concrete Building Manufacturer and any overhead lines to install the building in panel sections, as may be required. Installation of insulation blankets and/or sheets shall be used as required to cover energized electrical conductors.

3.02 SITE PREPARATION

A. Building shall bear fully on a cast-in-place concrete foundation as shown on the Contract Drawings. The foundation slab shall be level within $^{1}/_{8}$-inch in both directions.

B. Floor panel must have a ½" step-down around the entire perimeter to prevent water migration into the building along the bottom of wall panels.

C. Precast concrete building shall be provided by one single manufacturer. Building shall be installed on the foundation in the orientation shown on the drawings.

3.03 INSTALLATION OF GUTTERS AND DOWNSPOUTS

A. Install gutters and downspouts in accordance with the manufacturer's recommendations, approved shop drawings and the SMACNA "Architectural Sheet Metal Manual".

B. Install gutters and downspouts straight, level and plumb.

C. Align slotted anchorage holes in gutter and fascia. Fasten linear components through slotted anchorage holes in a manner to allow normal expansion/ contraction to occur without distortion of the materials.

D. Install in a secure, watertight manner with anchorage which allows adequate expansion and contraction movements of all aluminum fascia and gutter sections so that no "oil canning" or other distortions of the metal work occurs.

E. Remove and replace any sections which are warped, twisted, crimped, scraped, dented, or otherwise distorted in any manner.

END OF SECTION

SECTION 14100

MONORAIL CRANE SYSTEM

PART 1 - GENERAL

1.01 DESCRIPTION

A. Work performed under this section includes, but is not limited to, furnishing all labor, tools, materials and services necessary to design, fabricate and install a monorail crane system, as specified herein and as indicated on the Contract Drawings.

B. Installation must be provided by an authorized dealer of the monorail crane system manufacturer.

C. OSHA 1926.406 shall be used to determine when a disconnect switch shall be incorporated into a project. When required, the Contractor shall furnish, mount and wire a floor operated, individual fusible electrical disconnect switch including wiring from disconnect to a junction box within two (2) feet of the conductor bar or festoon system.

D. The intended purpose is to remove/install equipment from/to the recessed floor containing the sewage pumps and through the double door entrance, and to/from the exterior of the pump station.

1.02 QUALITY ASSURANCE

A. Equipment furnished under this section shall comply with the applicable requirements of the following:

1. Occupational Safety and Health Act (OSHA)

2. NAPA-70 National Electric Code (N.E.C.)

3. ANSI B30.11 “Safety Standard of Monorails and Underhung Cranes” and ANSI MH27.1 “Specifications for Underhung Cranes and Monorail Systems”

4. ANSI B30.16 “Safety Standard for Overhead Hoist, HMI Standard” and ANSI/ASME HST-4M “Performance Standards for Overhead Electric Wire Rope Hoists”

5. Specifications for Design, Fabrication and Erection of Steel for Buildings of the American Institute of Steel Construction (AISC)

6. American Welding Society (AWS) D14.1 “Specifications for Welding Industrial and Mill Cranes” and D1.1 “Code for Welding in Building Construction”

1.03 SUBMITTALS

A. Shop drawings showing design, fabrication, assembly and installation. Drawings shall include layout showing plan, elevation and sectional views.

B. Catalog data for all crane system components and accessories.

C. Wiring diagrams and electrical schematics indicating trolley and hoist motor operation, controls and power supply.

D. Design computations.

E. Equipment Guarantee Certification Form

In addition to the manufacturer's warranty for the monorail crane system equipment, the Contractor shall obtain and submit to the Engineer and Owner certification from the authorized dealer that the monorail crane system meets the requirements of the intended application and contract drawings and specifications. This certification shall be provided by way of the Equipment Guarantee Certification Form included herewith.

EQUIPMENT GUARANTEE CERTIFICATION FORM

Reference: **New Creamery Road Sewage Pump Station**
Town of Emmitsburg, Maryland

THE UNDERSIGNED HEREBY ATTESTS THAT HE/SHE HAS EXAMINED ALL APPLICABLE CONTRACT DRAWINGS AND SPECIFICATIONS, AND CERTIFIES THAT THE EQUIPMENT THAT HE/SHE PROPOSES TO FURNISH AND DELIVER MEETS OR EXCEEDS CONTRACT SPECIFICATIONS, IS SUITABLE FOR THE INTENDED PURPOSE STATED IN SPECIFICATION SECTION **14100**, IS SUITABLE FOR INSTALLATION AS PRESENTED IN THE CONTRACT DRAWINGS AND SPECIFICATIONS, AND WILL PROVIDE SATISFACTORY PERFORMANCE AT THE DESIGN CRITERIA SPECIFIED. THIS GUARANTEE OF SUITABILITY FOR INTENDED PURPOSE IS IN ADDITION TO AND SHALL NOT BE IN LIEU OF ANY OTHER WARRANTIES, EXPRESSED OR IMPLIED.

EQUIPMENT: **MONORAIL CRANE SYSTEM**

AUTHORIZED DEALER: _____

Address: _____

_____

By: _____
(Typed Name and Title)

_____/s/_____ (SEAL)
(Signature) (Date)

Equipment Guarantee and Certification must be signed by a Principal Person (President, Vice-President, etc.) of the equipment manufacturer. The manufacturer hereby guarantees and certifies that the equipment that he/she proposes to furnish and deliver meet or exceed contract specifications, are suitable for the intended purpose and installation, and will provide satisfactory performance at the design criteria specified.

MANUFACTURER: _____

Address: _____

_____

By: _____
(Typed Name and Title)

_____/s/_____ (SEAL)
(Signature) (Date)

F. Mill Test Reports: Signed by manufacturer certifying that the following products comply with requirements:

1. Monorail beam including chemical and physical properties.

1.04 DESIGN REQUIREMENTS

A. All equipment shall be designed for minimum ASME Class H4 as defined by the Hoist Manufacturers Institute (HMI) and as specified in the ANSI MH27.1 specifications, and operation in normal ambient temperatures 32- to 104-degrees F and normal indoor conditions, free from excessive dust, moisture and corrosive fumes.

B. An impact allowance shall be included in design calculations for crane and monorail tracks. The impact allowance shall be ½-percent of the rated load for each foot per minute of hoisting speed with a minimum allowance of 15% and a maximum of 50%.

C. Hook height, hook lift, support spacing, etc., shall be as shown on the contract drawings. Hoist and monorail must be capable of traveling through the new double door and outside of the pumping station building.

D. Capacity: 1-Ton.

E. Hoist Speed: 39 and 6.5 FPM.

F. Trolley Speed: 65 FPM – Variable.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Store monorail beam to permit easy access for inspection and identification. Keep monorail beam off ground and protect it from erosion and deterioration.

1.06 WARRANTY

A. Manufacturer's authorized dealer shall provide a 2-year warranty starting on the date Contractor achieves Substantial Completion for the project. The warranty shall cover against defects of materials and workmanship.

PART 2 - MATERIALS

2.01 GENERAL

A. The monorail crane shall have an electrically operated low headroom hoist.

2.02 MONORAIL

A. Monorail beam shall be a W-shape steel beam in accordance with ASTM A992, Grade 50.

B. Bottom flange shall have a minimum ultimate tensile strength of 65,000 psi. Girder shall be straight, with factory prepared ends. No rough-cut ends will be permitted. Holes shall be factory punched or drilled. All welds shall be full penetration. Girder shall be coated with a minimum of one coat of factory primer enamel and be free of corrosion.

C. The girder size shall be computed based on the load positioned on the bridge system to produce the most severe conditions of stress and deflection.

D. The total girder deflection shall not exceed 1/600 of the span or 1¼", whichever is least.

E. Monorail end stops shall be of the bolted type and shall be capable of withstanding the impact of a fully loaded crane or carrier traveling at 50% of the full load speed.

F. Monorail sections shall be installed with bolted or welded type splice plates to provide flush and level connections at the operating tread of the track. The maximum gap between the adjacent ends at load carrying flange shall not exceed $^{1}/_{16}$-inch.

2.03 TRACK ELECTRIFICATION

A. Conductor bar shall be roll formed electro-galvanized steel sections, rated 100 amps continuous. Insulation cover shall be high-visibility orange color, with an operating temperature of 160º F (71º C). Conductor bar shall be bottom entry type.

B. Conductors are to be complete with mounting brackets, insulators, couplings, end caps and current taps.

C. Current collectors shall be the sliding shoe type, spring loaded and so designed that sparking and loss of contact will be minimized.

D. Separate conductors shall be provided for each phase. More than one conductor in a single enclosure will not be permitted.

2.04 HOIST

A. General

1. Hoist design shall maximize hook vertical travel and clear hook height.

2. Hoist shall be a low-headroom electric wire rope hoist, R&M Materials Handling, Inc.'s Spacemaster SX, or approved equal.

3. All hoists shall be supplied with two-speed hoisting contactor controls to minimize load swing and ensure accurate load positioning.

B. Mechanical

1. Reeving: Unless otherwise specified, hoists shall be single-reeved. Lateral hook drift shall not exceed ⅛-inch per foot of vertical travel.

2. Hoist Drums: The drum to rope diameter ratio shall be a minimum of 30:1 to minimize rope flex and extend rope life. Drum shall be made from steel and supported on heavy-duty anti-friction bearings; groove depth shall be at least 35% of rope diameter. The rope drum shall be equipped with a rope guide and spring loaded roller to keep the rope aligned in the grooves of the drum.

3. Hoisting Gearing: Gear reducers shall be integral components of standard hoists of manufacturers regularly engaged in the design and manufacturing of hoists for Class H4 hoists. The gear reduction units shall be fully enclosed in oil-tight housing. Operation shall be smooth and quiet. Hoisting gears shall be hardened and ground. Gears and pinions shall be spur, helical, or herringbone type only, and shall be hardened steel; open-type gearing is not acceptable. Gears and pinions shall be manufactured to AGMA 2001-B Quality Class 11 or better precision. Gear reducer shall not incorporate a mechanical load brake; the gear reducer shall not require regular internal maintenance or frequent lubricant changes due to friction material contamination and high running temperatures.

4. Load-Limit System: Each hoist shall be equipped with an electronic load-limiting device that shall prevent lifting more than 110% of the rated load.

5. Main Hoist Load Blocks/Hook Assembly: Hooks shall be made of forged alloy steel (34CrMo4 Class T). Hooks shall be fitted with spring loaded safety latches designed to preclude inadvertent displacement of slings from the hook saddle and have 360-degree rotation on anti-friction bearings. Hook shall be secured to the bottom block with a removable fastener, and shall not be welded. Hooks shall be designed and commercially rated with safety factors in accordance with ASME. Bottom block shall be totally enclosed in a steel housing. Rope sheaves shall be supported on heavy-duty anti-friction bearings. Load blocks shall be of steel construction. Load blocks shall be provided with hot-rolled or forged steel fixed crosshead separate from the sheave pin with swivel mounting for forged steel hook.

6. Sheaves: Sheaves shall be of steel or ductile iron (240 to 302 BHN hardness). Sheave grooves shall be accurately machined, smoothly finished and free of surface defects. The sheave to rope diameter ratio shall be a minimum of 20:1 to minimize rope flex and extend rope life.

7. Hoisting Ropes: Wire rope shall be constructed from galvanized steel having a steel core and a minimum safety factor of 5. Hoisting ropes shall be the

rated capacity load plus the load block weight divided by the number of rope parts, and shall not exceed 20-percent of the certified breaking strength of rope. Ropes shall be suited to meet the service requirements. Rope anchor connections shall be equal to or greater than the rope strength. Hoisting ropes shall be secured to hoist drum so that no less than 2 wraps of rope remain at each anchorage of hoist drum at the extreme low position (limit switch stop).

8. Paint: Steel load bearing parts shall have a primer coat of epoxy primer of 60 µm thick and a finish coat of epoxy paint 60 µm thick; total epoxy primer/paint thickness 120 µm. Steel and aluminum covers shall have epoxy finishing paint 80 µm thick. Prior to painting, all surfaces shall be washed, degreased and shot blasted.

C. Electrical/Control Requirements

1. General: The hoist shall be CSA approved and/or UL approved to NEMA 3R protection. Pendant control enclosure shall be rated NEMA 4.

2. Hoist Motor(s): Hoisting motors shall be two-speed/two winding squirrel cage type with a speed ratio of 6:1. Hoisting motors effective duty shall be 60% ED (30 minute rated) or higher with minimum Class F insulation. One thermal sensitive device embedded in hoist motor winding shall be provided. Thermal-sensitive device and associated circuits shall be self-restoring (automatic reset). Motors shall be designed specifically for hoist duty.

3. Hoist Controls: Hoist controls shall be full magnetic type, specially selected for hoisting service.

4. Hoist Limit Switches: Hoist shall be equipped with a geared adjustable upper and lower limit switch to limit extreme upper and lower travel of the bottom block assembly. Geared limit switch shall have four positions with the following functions: lower limit, upper slowdown, upper limit, and phase reversal supervision. The upper most limit shall be wired to the down circuit in such a manner to prevent hoisting in the event of a phase reversal. Block limit switch is not required.

5. Disconnect switch shall be provided where shown on the drawings or required by the NEC, fused or unfused as required, and shall be Square D class 3110 Heavy Duty, or equal. Any switch installed outdoors or installed in a room with base slab below grade level in the pump station shall be rated NEMA 4X, and shall be 316 stainless steel. Provide option to allow locking in open or closed position. Disconnect shall be furnished with auxiliary contacts for remote monitoring of switch position. Contacts shall be configured to be closed when the switch is closed (on) and open when the switch is opened (off).

2.05 ELECTRIFICATION

A. One of the following types of electrical power systems shall be employed as a means of supplying power and control for hoist and trolley travel motions. Applicable electrical power system is to be selected on the basis of the “Design Requirements” and specific job application.

1. Rigid enclosed conductor bar system may be mounted off the web in a down-turned position. Power and control circuits must have individual conductor bars.

2. Festooned or rigid enclosed conductor bar systems may be factory mounted or mounted in the field.

2.06 CONTROLS

A. Controls shall be housed in a NEMA 12 or IP55 enclosure for protection against dust and moisture.

B. A magnetic mainline contactor is to be provided and operated from the pushbutton station.

C. All motor starters shall be adequately sized for hoist duty consistent with horsepower requirements.

D. Each motor shall be provided with thermal overload protection.

E. Fusing shall be provided on the secondary side of the control circuit transformer.

F. Means for controlling trolley acceleration must be provided. Trolley speed shall be variable.

G. The complete control panel is to be factory mounted and wired. All wires within the panel are to be marked and terminated on numbered terminal strips.

PART 3 - EXECUTION

3.01 INSTALLATION

A. The monorail crane system shall be installed by an authorized dealer of the crane system manufacturer, who shall adjust and test all components and furnish a manufacturer’s certification statement.

B. Stops and adjustable bumpers shall be installed on the monorail beam, and shall meet the requirements of the governing standards.

C. Electrical power shall be connected to the hoist.

3.02 PAINTING

A. Painting shall be as specified in Section 09900.

3.03 FIELD TESTING

A. The monorail crane shall be tested in accordance with the following:

1. Visually inspect all equipment and supports before attempting the load test.

2. Operate the equipment with no load to verify correct motions and speeds of the equipment.

3. Measure distance from floor to center of monorail span to check for track deflection before loading.

4. Measure hook at the throat opening before loading.

5. Load hook with 100 percent of rated load for five minutes to check for any change in hook throat opening. Lift the test load a maximum of six inches above the floor.

6. Measure distance from floor to center of monorail to check track deflection with 100% of rated load on hook to verify deflection does not exceed the maximum allowable deflection of 1/600 of largest span for the monorail. Ensure hook is at the center of the monorail.

7. Move the hoist down the monorail so that the maximum load is applied to the support points.

8. Repeat testing at all support points.

9. Test all hoist limit switches.

10. Check voltage and amperage values under load for the hoist.

11. Test the endstops with 50% of the rated capacity on the hoist hook.

12. Contractor shall maneuver test load from drywell floor, through the Operating Room access hatch, and through the double door to outside of the pumping station.

13. Provide a written report of the test results and monorail crane system manufacturer’s certificate of approval to the Engineer.

END OF SECTION

SECTION 14110

DAVIT ARM PERSONNEL MAST

PART 1 - GENERAL

1.01 DESCRIPTION

A. The Contractor shall furnish and install a davit arm personnel mast consisting of one (1) davit arm retrieval system, one (1) winch and associated bracket, one (1) permanent mount sleeve and sleeve cap, and all appurtenances specified herein complete with all bolts, pins and hardware for a complete assembly.

1.02 SUBMITTALS

A. The Contractor shall furnish detailed shop drawings showing outline and dimensions of all equipment specified herein and details for installation of the mount sleeves into the concrete slabs.

B. The Contractor shall submit catalog data for all components of the davit arm personnel mast assembly and a complete list of all materials and equipment to be furnished, giving the manufacturer's name, catalog number and catalog cut for each item, where applicable.

C. Operations and Maintenance Manuals for the davit arm personnel mast and winch.

D. Submit certificates of compliance certifying that all equipment and materials comprising the complete davit arm personnel mast system comply with specified performance characteristics and criteria.

1.03 PRODUCT HANDLING

A. The Contractor shall protect all the equipment and materials before, during and after installation and protect the installed work and materials of all other trades.

B. In the event of damage to equipment, Contractor shall make all repairs and replacements necessary to restore the equipment to its approved condition, at no additional cost to the Owner.

PART 2 - PRODUCTS

2.01 DAVIT ARM RETRIEVAL SYSTEM

A. The davit arm retrieval system shall consist of one (1) offset mast, one (1) elbow section, and one (1) center post with winch mounting assembly. All davit arm components shall be made from aluminum and steel.

B. Davit arm assemblies shall be capable of achieving multiple offset reaches and shall be man rated to 350 pounds.

C. Offset mast shall be capable of accepting both winches and/or self-retracting lifelines.

D. The davit arm shall be Model No. DK3036 as manufactured by the T.A. Pelsue Company or approved equal.

2.02 WINCH AND BRACKET

A. The winch shall be man rated to 310 pounds with a 10:1 safety factor, 5.1:1 gear ratio single speed drive and retrieval rate of 23 feet per minute.

B. The winch shall have a continuous braking drive to prevent free wheeling and double pawls on the friction brake to provide back-up safety.

C. The winch shall have low wear, high temperature brake pads to eliminate brake maintenance for the life of the winch and anti-friction drive bearings to assure trouble free life in continuous use.

D. The winch shall have level wind springs that prevent loosening of cable lays and a slip clutch drive that prevents back winding of cable drum.

E. All metal parts of the winch shall have a galvanic zinc coating to prevent corrosion in harsh environments.

F. The winch shall be supplied with 70 feet of stainless steel cable and a double action locking swivel snap hook rated for the loads specified herein.

G. The winch shall be Model No. PH07C as manufactured by the T.A. Pelsue Company or approved equal. The bracket shall be Model No. MB-PF1 as manufactured by the T.A. Pelsue Company or approved equal.

2.03 SLEEVES AND SLEEVE CAPS

A. The sleeves shall be flush mounted, and installed into the concrete slabs, as shown on the contract drawings, and in accordance with the manufacturer's recommendations. The flush mount sleeves shall be suitable for use with the davit arm mast furnished.

B. The sleeves shall be made of stainless steel, allow the davit arm mast to pivot 360 degrees, and include a drain hole to eliminate water buildup.

C. The sleeves shall have a CPVC plastic liner with PVC slip plates.

D. A stainless steel sleeve cap shall be included with each mount sleeve to seal the sleeve and prevent entrance of water and debris when not in use. The top of the cap shall be flush with the top of the mount sleeve, so as to not create a tripping hazard.

E. The flush mount sleeves shall be Model No. DSS-C1 for stainless steel flush floor mount set in new concrete, or DSS-F3 for stainless steel flush floor mount bolted on existing concrete as manufactured by the T.A. Pelsue Company or approved equal.

F. The flush mount sleeve caps shall be Model No. DSC-S1 as manufactured by the T.A. Pelsue Company or approved equal.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Contractor shall install the complete davit arm personnel mast system in strict accordance with the manufacturer's recommendations.

3.02 TESTING

A. After erection and prior to final inspection, the davit arm personnel mast shall be given a full load test. Full load test shall consist of loading the unit to its rated capacities at each boom position and raising and lowering the hook the full limit of its travel.

B. The above test shall be performed to the satisfaction of the Owner. In the event the equipment does not satisfactorily meet the specifications, such changes as may be required shall be made and the tests repeated until complete satisfaction is obtained.

C. Weights to perform the above test shall be provided by the Contractor.

END OF SECTION

SECTION 14600

PORTABLE EQUIPMENT HOIST

PART 1 - GENERAL

1.01 DESCRIPTION

A. The Contractor shall furnish and install a portable equipment hoist assembly consisting of one (1) galvanized finished davit crane, one (1) winch, ¼-inch diameter 304 stainless steel wire rope, and all appurtenances specified herein complete with all bolts, pins and hardware for a complete assembly. Quantity and style of bases shall be as shown on the Contract Drawings.

B. The portable equipment hoist will be used to lower and raise equipment as shown on the Contract Drawings. Contractor shall coordinate with the equipment manufacturer to ensure that the portable equipment hoist assembly is manufactured and installed in a manner that will permit the raising and lowering of the equipment in accordance with the equipment manufacturer's instructions for handling.

1.02 SUBMITTALS

A. The Contractor shall furnish detailed shop drawings showing outline and dimensions of all equipment specified herein and details for installation of the base specified.

B. The Contractor shall submit catalog data for all components of the crane assembly and a complete list of all materials and equipment to be furnished, giving the manufacturer's name, catalog number and catalog cut for each item, where applicable.

C. Operations and Maintenance Manuals for the hoist and winch.

D. Submit certificates of compliance certifying that all equipment and materials comprising the complete portable equipment hoist system comply with specified performance characteristics and criteria.

1.03 PRODUCT HANDLING

A. The Contractor shall protect all the equipment and materials before, during and after installation and protect the installed work and materials of all other trades.

B. In the event of damage to equipment, Contractor shall make all repairs and replacements necessary to restore the equipment to its approved condition, at no additional cost to the Owner.

1.04 WARRANTY

A. The Contractor shall submit to the Owner a written manufacturer's warranty covering equipment defects and workmanship for a period of 2-years from the date Contractor achieves Substantial Completion for the project.

PART 2 - PRODUCTS

2.01 DAVIT CRANE

A. The davit crane shall have a lifting capacity of 2,000 pounds and an adjustable boom length up to 82 inches. Hook height shall be dependent on base furnished, with a hook height up to 97 inches for a pedestal base, up to 83 inches up for a flush or wall mount base, and up to 104 inches for a wheel base. The adjustable boom shall be capable of telescoping to four (4) different lengths and adjusting in height while under load with a ratchet style screw-jack.

B. The davit crane shall be able to rotate 360 degrees on a stainless-steel roller/ball bearing at top of base, and shall include a stainless steel lock assembly to keep crane in position during winch operation and when crane is not in use. Roller/ball bearing shall be Model No. 5PT20BRG-S, or approved equal.

C. The davit crane shall be capable of being disassembled for storage and transporting, and shall include a quick-mount winch bracket and clevis pins.

D. The davit crane shall be Model No. 5PT20G with a galvanized finish as manufactured by Thern, Inc., or approved equal.

2.02 WINCHES

A. Manual Winch

1. The winch shall be a machine cut spur gear with an automatic brake that provides positive load control for lifting and lowering operations. The winch shall be constructed of stainless steel, electro-polished for added corrosion resistance.

2. The winch shall have a lifting capacity of 2,000 pounds with a double gear ratio of 14.7:1 so that a maximum force of 17 pounds on the crank handle is required to lift 1,000 pounds.

3. The winch shall have bronze and radial ball bearings that provide smooth and efficient operation, a large diameter drum with a minimum diameter of 2½ inches to minimize wear on the wire rope, and gear covers to protect the gears and prevent injuries.

4. The winch shall be Model No. M4312PBSS-K as manufactured by Thern, Inc., or approved equal.

2.03 BASES

A. General Requirements:

1. A heavy duty base cap with lanyard shall be included with each pedestal, wall, and flush mount base, and shall fit inside the mast hole to prevent water and debris from collecting in the sockets. The top of the cover for wall and flush mount bases shall be flush with the top of the base, so as to not create a tripping hazard.

2. A 15-inch base extension shall be furnished with each wall and flush mount base, and shall be Model No. 5BE20-15G, or approved equal.

3. Base anchors for each pedestal, wall, and flush mount base shall be 316 stainless steel, shall comply with manufacturer's crane reaction loads and sizes, and shall be installed in such a manner that they do not create a tripping hazard.

B. Pedestal Bases:

1. Pedestal bases shall be fastened to the concrete floor slab in accordance with the manufacturer's recommendations, and shall be suitable for use with the davit crane furnished.

2. Pedestal bases shall be made of 316 stainless steel, allow the davit crane to pivot 360 degrees, and include a drain hole to eliminate water buildup.

3. Pedestal bases shall be Model No. 5BP20S316 as manufactured by Thern, Inc., or approved equal.

C. Flush Bases:

1. Flush bases shall be flush mounted, and installed in the concrete slab in accordance with the manufacturer's recommendations. The flush mounted bases shall be suitable for use with the davit crane furnished.

2. Flush bases shall be made of 316 stainless steel and shall allow the davit crane to pivot 360 degrees.

3. Flush bases shall be Model No. 5BF20S316 as manufactured by Thern, Inc., or approved equal.

2.04 WIRE ROPE ASSEMBLIES

A. The wire rope shall be ¼-inch diameter and constructed of 304 stainless steel. The wire rope shall include a swivel hook suitable for lifting the intended equipment. The Contractor shall ensure the wire rope length adequately covers the required anchor wraps, boom length, and distance between the boom end and pick point, while not exceeding the winch drum capacity.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Contractor shall install the complete portable equipment hoist in strict accordance with the manufacturer's recommendations.

3.02 TESTING

A. After erection and prior to final inspection, the portable equipment hoist shall be given a full load test. Full load test shall consist of loading the unit to its respective rated capacities at each boom position and raising and lowering the hook the full limit of its travel.

B. The portable equipment hoist shall then be used to raise and lower the intended equipment through two complete cycles to ensure satisfactory performance of the intended application.

C. The above tests shall be performed to the satisfaction of the Owner. In the event the equipment does not satisfactorily meet the specifications and performance criteria, such changes as may be required shall be made and the tests repeated until complete satisfaction is obtained.

D. Weights to perform the above test shall be provided by the Contractor.

END OF SECTION

SECTION 15050

BASIC MECHANICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.01 DESCRIPTION

A. This Section includes requirements for basic mechanical materials and methods. It applies to all sections of Division 15 and to other sections that include mechanical equipment requirements except when, in these individual sections, requirements are otherwise specified. Mechanical systems shall be complete including all miscellaneous materials, and ready for operation as indicated in accordance with the Contract Documents.

1.02 QUALITY ASSURANCE

A. Unless otherwise indicated, provide materials and equipment which are the standard products of manufacturers regularly engaged in the production of such materials and equipment. Provide the manufacturer's latest standard design that conforms to these Specifications. When two or more units of the same class of equipment are required, these units shall be the products of the same manufacturer.

B. Where materials and equipment are specified to meet requirements of standards or organizations such as Underwriters Laboratories (UL), American Society for Mechanical Engineers (ASME), American Gear Manufacturer's Association (AGMA), American Gas Association (AGA), Air Refrigeration Institute (ARI), etc., that use a label or listing as a method of indicating compliance, such label or listing shall be attached to the material or equipment when delivered to the job site.

C. Each major component of equipment shall have the manufacturer's name, address and model number on a metal nameplate attached to the item of equipment.

D. Comply with requirements of the National Fire Protection Association, Air Moving and Conditioning Association, Underwriter’s Laboratories, American Society of Heating, Refrigeration, and Air Conditioning Engineers, American National Standards Institute, and Sheet Metal and Air Conditioning Contractors National Association as directly related to material and workmanship.

E. Welding shall be performed by certified welders in accordance with AWS D1.1 for the types of welding required on the work.

F. Except where otherwise specified, structural and miscellaneous fabricated steel used in equipment shall conform to AISC standards and structural members shall be designed for appropriate shock and vibratory loads. Unless otherwise specified, steel which will be all or partially submerged during operation of equipment shall be at least ¼-inch thick.

1.03 SUBMITTALS

A. Equipment data and information, including descriptive and published details concerning performance, capacity and noise ratings for each piece of equipment. For electrical motor driven equipment, include schematic drawings showing coordination with electrical system and provide rated horsepower, full load current requirements, and for electric motors ¾ horsepower and larger, provide temperature rating, locked rotor current, power factor at full and ¾ load, efficiency at full load and rated operation condition, type of bearings, lubrication requirements and net weight.

B. Catalog data for materials, other than equipment, that are manufacturer's standard products.

C. Shop drawings, including scaled mechanical layout drawings showing dimensioned plan views and elevations of mechanical equipment, equipment mounting and foundations including space requirements, coordination with building features, and other work.

D. Submit manufacturer's instructions and recommendations for installation, handling and storage, and cleaning and maintenance of equipment and materials prior to initial energizing.

E. Complete drawings showing identification of wire, wire numbers, terminal numbers and equipment termination for all instrumentation and electrical equipment in accordance with the control wiring identification requirements in Division 16. These control numbers shall be used in all instrumentation and electrical equipment and shall be so indicated on the shop drawings.

1.04 DELIVERY, STORAGE AND HANDLING

A. Materials and equipment shall be boxed, crated or otherwise completely enclosed and protected during shipment, handling, and storage. Such boxes, crates or protection shall be clearly labeled with manufacturer's name, brand or model designation, type or grade, and color. Complete packing lists and bills of materials shall be included with each shipment. Each item of equipment shall be tagged or marked with the same identification number or mark as shown on the packing lists and bills of materials.

B. Protect materials and equipment from exposure to the elements and keep dry at all times. Handle and store to prevent damage and in accordance with manufacturer's recommendations.

C. Pumps, motors and other equipment with antifriction or sleeve bearings shall be stored in weather-tight areas maintained at a temperature above 60 degrees F.

D. Material and equipment damaged by handling and storage shall be repaired or replaced by the Contractor as directed by the Engineer.

1.05 JOB CONDITIONS

A. The drawings indicate the extent and general arrangement of equipment, piping and ductwork. Equipment shall fit into the space allotted and shall allow adequate clearance for entry, installation, replacement, servicing and maintenance. Actual and final arrangement, location, grade and elevations of equipment, appurtenances, piping and ducts shall be verified by the Contractor before ordering material and equipment. If adjustments and modifications are deemed necessary by the Contractor, details of such adjustments and modifications and the reasons therefore shall be submitted to the Engineer for approval as soon as practicable but not later than with the submittal of the scaled mechanical layout drawings. No adjustments or modifications shall be made without the Engineer's written approval.

B. Coordinate the work so equipment may be moved in place without altering building components, other equipment or installations. Drops, rises or offsets not shown on the drawings but required for proper installation of the work shall be provided.

1.06 SAFETY REQUIREMENTS

A. Enclose or provide guards for belts, pulleys, chains, gears and other rotating parts to protect operating personnel.

B. Guard or cover high temperature equipment and piping with insulation to protect personnel and prevent a fire hazard.

C. Provide items such as catwalks, ladders and guardrails, where required, for safe operation and maintenance of equipment.

1.07 SEQUENCING AND SCHEDULING

A. Sequencing and scheduling of mechanical work shall be coordinated with other parts of the work including verification that all structures, piping, wiring, conduits and equipment components are compatible.

1.08 MAINTENANCE MATERIALS

A. Spare parts listed to be furnished shall be packed in wooden boxes, labeled with the manufacturer's name, address and telephone number; local representative's name, address and telephone number; name of equipment the parts are for and list of parts contained therein, including the quantity of each part.

B. Extra material shall be packed in strong cartons, labeled with manufacturer's name, material name, type, color and location where material was installed.

C. Store maintenance materials in a location directed by the Owner.

1.09 MANUFACTURER'S SERVICES

A. Manufacturers of furnished equipment shall provide qualified field representatives to provide services as required during installation, start-up, inspections/tests, and to instruct City personnel on operation and maintenance of the equipment. Field representatives shall be available to observe, instruct, guide and direct the Contractor's handling, installation, start-up and adjustment procedures of the equipment. Manufacturer's services shall be provided as follows:

1. Equipment shall be installed in accordance with the manufacturer's instructions but shall not be energized or operated until a field representative of the manufacturer has inspected the installation and is available on the site to supervise the equipment start-up.

2. Prior to and during the required inspections/tests, a field representative shall be available to operate and adjust the equipment to perform in accordance with the Contract Documents.

3. When required in the specification sections for the equipment, provide competent factory-trained service personnel to instruct City personnel in the operation and maintenance of the equipment. Instruction sessions shall be conducted at times and locations suitable to the Owner.

PART 2 - MATERIAL

2.01 GENERAL

A. In the design and supply of equipment, provide for interchangeability of parts and items for equipment, piping, ductwork, motors and other appurtenances.

B. Factory assemble, coat and paint mechanical equipment as much as is permissible for shipping and handling but never less than a factory applied prime coat.

2.02 EQUIPMENT BASES

A. Unless otherwise indicated, floor mounted equipment shall be provided with concrete bases a minimum of four inches high, and not less than 4 inches larger in both directions than supported unit, and outside, ground mounted equipment shall be provided with concrete bases with top elevation 6 inches above grade and bottom elevation 12 inches below the frost line, and not less than 6 inches larger in both directions than supported unit.

B. Cast iron or welded steel baseplates shall be provided. Each unit and its drive assembly shall be supported on a single baseplate.

2.03 ANCHOR BOLTS

A. Anchor bolts, nuts and washers shall be stainless steel. Unless otherwise indicated, size anchor bolts to the largest diameter that will pass through the bolt holes of the equipment base. Length of the bolts shall be long enough to permit a minimum of one inch of grout beneath the base plate and a minimum of six inches anchorage into the structural concrete.

B. Provide anchor bolts, nuts and washers, together with template or setting drawing, sufficiently in advance to permit anchor bolts to be set either prior to or during structural concrete placement.

2.04 MECHANICAL SLEEVE SEALS

A. Sleeve seals shall be modular sealing element units, designed for field assembly, to fill annular space between pipe and sleeve as manufactured by Pipeline Seal and Insulator, Inc., or approved equal.

B. Sealing elements shall be EPDM or NBR, as recommended by the seal manufacturer for the specific application, interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.

C. Pressure plates shall be a composite material. Include two for each sealing element.

D. Connecting bolts and nuts shall be stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.05 SUPPORTS AND BRACES

A. Provide supports and braces fabricated to meet requirements of the manufacturers and/or as indicated on the drawings.

2.06 DRIVE UNITS

A. The nominal input horsepower rating of each gear or speed reducer shall be at least equal to the nameplate horsepower of the drive motor. Drive units shall be designed for 24 hour continuous service.

B. Motor and drive gears shall be rated AGMA Class II and shall bear an AGMA nameplate.

C. Gear reducers shall be totally enclosed, oil lubricated, with antifriction bearings throughout. Worm gear reducers shall have a service factor of at least 1.20. Shaft mounted gear reducers shall be rated AGMA Class II. Other helical, spiral bevel combination bevel-helical gear reducers shall have a service factor of at least 1.50. Each gear reducer shall bear an AGMA nameplate.

D. Variable speed drives shall have a service factor of at least 1.75 at maximum speed, unless otherwise specified.

E. V-belt drive shall include a sliding base or other suitable tension adjustment mechanism. V-belt drives shall have a service factor of at least 1.60 at maximum speed.

2.07 SAFETY GUARDS

A. Belt and chain drives, fan blades, couplings, shafts and other moving and rotating parts shall be covered on all sides by a safety guard. Safety guards shall be fabricated from 16 or heavier gauge galvanized or aluminum-clad sheet steel or ½-inch mesh galvanized expanded metal. Each guard shall be designed for easy installation and removal. Necessary supports and accessories, including bolts, shall be provided for each guard. Supports and accessories, including bolts, shall be galvanized or painted in accordance with Section 09900 as required. Safety guards in outdoor locations shall be designed to prevent entrance of rain and dripping water. Safety guards shall meet OSHA requirements.

2.08 LUBRICATION

A. Equipment shall be lubricated by systems that require attention no more frequent than weekly during continuous operation. Lubrication facilities, oil drains and fill opening shall be accessible from normal operating area or platform. Drain ports shall allow for collection of waste oil in containers from operating area or platform without removing the unit from its installed position.

B. Pressure grease fittings shall be Zerk Hydraulic or Alemite type. Locations of grease fittings shall be accessible for lubricating with a grease gun.

2.09 SHOP PAINTING

A. Surface prepare and shop coat equipment, supports, piping, duct work and appurtenances as specified in Section 09900 or as shown on the drawings except connecting ends and where it would hinder installation. These points shall be shop primed and field painted after installation. Shop primer shall be compatible with field coat.

2.10 ELECTRICAL SERVICE

A. All mechanical equipment requiring electrical power to operate shall be rated for electrical service as shown on the electrical drawings and shall have sufficient length of cable and all other appurtenances necessary to provide an operational and fully functional unit. If the electrical service is not shown on the electrical drawings, the Contractor shall provide the service as required by the equipment manufacturer at no additional cost to the Owner.

2.11 THERMAL INSULATION

A. Provide thermal insulation jacket for generator exhaust silencers and piping. All generator silencers and exhaust piping shall be wrapped with high temperature-flexible insulation which conforms to Military Specification MIL-I-16411-E, Type II. Insulation shall be Type E Fiberglass Insulation designed for use in insulating high temperature equipment as manufactured by Advanced Thermal Products, Inc. or approved equal. Insulation shall be flexible, lightweight and shall not compact under vibration. Insulation shall be manufactured from chopped glass fibers and shall be free from resinous binders.

2.12 SPECIAL TOOLS AND ACCESSORIES

A. Provide special tools, instruments and accessories required to adjust, maintain or repair equipment. Equipment requiring special devices for lifting and handling shall be furnished complete with these devices.

PART 3 - EXECUTION

3.01 MECHANICAL DEMOLITION

A. Disconnect, demolish, and remove mechanical systems, equipment, and components indicated to be removed.

1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible material.

2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible material.

3. Ducts to Be Removed: Remove portions of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.

4. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material.

5. Equipment to Be Removed: Disconnect and cap services and remove equipment.

6. Equipment to Be Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.

B. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.02 PREPARATION

A. Inspect areas and surfaces to receive mechanical equipment, piping, duct work and appurtenances and verify that areas are ready for installation. Before installation, repair any defects or damaged areas, and adjust surfaces and areas so they are ready for proper installation.

B. Field measure areas to be occupied by mechanical equipment and appurtenances and verify space is adequate and in accordance with approved shop drawings. If adjustment is required obtain approval of Engineer and adjust as approved.

3.03 INSTALLATION

A. Equipment and appurtenances shall be installed in accordance with manufacturer's instructions. Provide complete final connections to equipment, including pipe, duct, electric and controls.

B. Whether shown or not, isolation valves and accessory fittings shall be provided on each side of equipment to allow the equipment to be removed and isolated for servicing. High points in piping shall be provided with manual vents and low points in fluid piping provided with drain valves fitted for hose adapters. Rises and drops as required by field conditions, whether shown or not, shall be provided. The above required items shall be provided by the Contractor at no additional cost to the Owner.

3.04 FOUNDATIONS, BASES AND SUPPORTS

A. All equipment, ductwork, electrical conduits and piping shall be supported by providing compatible frames, braces, hangers and anchors.

B. Unless otherwise shown on the drawings, floor mounted equipment shall be set on reinforced concrete pads a minimum of four inches high, doweled to the floor, and outside ground mounted equipment shall be set on reinforced concrete pads on 6 inches of stone bedding. Provide baseplate, anchor bolts and vibratory absorption pad construction as shown on the drawings or as recommended by the equipment manufacturer. Baseplate shall be anchored to the concrete base with anchor bolts, leveled using shims or wedges and the space beneath filled with quick setting non-shrink grout. After grout has hardened, anchor bolts shall be finally tightened and cut off not more than one inch or less than ½-inch above top of the nut.

C. Non-vibratory equipment suspended from building walls or ceilings shall be braced and supported to provide a rigid installation. Supports and hangers shall be attached to bearing walls, roof and floor supports or framing members. Cross bracing shall be provided, as required, to develop a rigid installation.

D. Vibratory equipment suspended shall be braced, supported and provided with cushioning and anti-vibratory material as shown on the drawings or as recommended by the equipment manufacturer.

3.05 ACCESS PANELS

A. Provide access panels and openings where it will be necessary for maintenance and servicing of concealed equipment, piping and ductwork.

3.06 LUBRICATION

A. Equipment shall be lubricated in accordance with manufacturer's instructions after installation and prior to initial operation. Following testing and prior to final acceptance, re-lubricate as necessary.

3.07 ADJUSTMENT AND INITIAL OPERATION OF EQUIPMENT

A. Before systems and equipment are initially started, piping, ductwork and equipment shall be cleaned. Moving parts shall be checked for freedom of movement, alignment and adjustment. Air-handling units shall have temporary filters in place to protect permanent filters.

B. Provide manufacturer's services as required herein before equipment is energized and operated. Make adjustments as required and recommended by the manufacturer's representative.

3.08 SURFACE TOUCH-UP/FIELD PAINTING

A. Touch-up where shop coats have been damaged using paint, coatings and film thickness identical to original shop coats.

B. Clean field installed bolts, nuts, washers and support systems.

C. Field paint as specified in Section 09900 or as shown on drawings.

3.09 PROTECT AND CLEAN

A. Protect equipment during and after installation from construction dust and debris. Provide temporary protection as required until final acceptance of the project.

B. Clean equipment, surrounding areas, piping and ductwork inside and out. Replace filters on air-handling equipment.

3.10 FIELD QUALITY CONTROL

A. Demonstrate and inspect/test the operation of the various systems and equipment in the presence of the Engineer as specified in the specific sections for the equipment.

END OF SECTION

SECTION 15060

HANGERS AND SUPPORTS

PART 1 - GENERAL

1.01 DESCRIPTION

A. This section includes requirements for providing pipe hangers, brackets, supports, and spacing of expansion joints in piping systems as indicated in accordance with the Contract Documents. Pipe supports shall be furnished complete with all necessary inserts, bolts, nuts, rods, washers, and other accessories.

1.02 JOB CONDITIONS

A. In certain locations, pipe supports, and anchors are shown on the drawings, but no attempt has been made to indicate every pipe support and anchor. It shall be the Contractor's responsibility to provide complete system of pipe supports and to anchor all piping in accordance with this section.

B. Concrete and fabricated steel supports shall be as indicated on the drawings, as specified in other sections, or, in the absence of such requirements, as permitted by the Engineer.

C. All piping shall be rigidly supported and anchored so that there is no movement or visible sagging between supports.

D. Pipe supports, and expansion joints are not required in buried piping, but concrete blocking or other suitable anchorage shall be provided as indicated on the drawings or specified in other sections.

E. Any additional pipe supports or modifications to pipe supports that may be required, in the opinion of the Engineer, to eliminate or reduce vibration of pumps or other equipment, shall be provided by the Contractor at no additional cost.

1.03 SUBMITTALS

A. Shop drawings in conjunction with Specification Sections for piping, valves and pumps, showing the location of all pipe supports for pipes two-inches and larger. Shop drawings shall show fabrication and installation details, and shall include calculations, for all hangers and supports.

B. Catalog data for all hangers, supports and associated components to be used.

C. Manufacturer's installation instructions.

PART 2 - PRODUCTS

2.01 GENERAL

A. Pipe supports shall comply with ANSI/MSS SP-58 and Federal Specification WW-H-171E. Load carrying, and coating tests will not be required.

B. Pipe supports specified are identified by manufacturer's name and catalog number.

C. Pipe supports shall be manufactured for the size and type of pipe to which they are applied. Straphangers will not be acceptable. Threaded rods shall have threading to permit the maximum adjustment available in the support item.

D. Pipe supports shall be furnished complete with all necessary inserts, bolts, nuts, rods, washers, and other accessories.

E. Contact between dissimilar metals, including contact between stainless steel and carbon steel, shall be prevented. Supports for brass or copper pipe or tubing shall be copper plated. Portions of pipe supports which contact other dissimilar metals shall be rubber or vinyl coated.

F. All pipe supports located in the pump station wetwell shall be AISI Type 316 stainless steel. Stainless steel supports fabricated by welding shall be AISI Type 316L material.

2.02 DESCRIPTION

Pipe support types and application shall comply with the following.

	Description or Size	**MSS SP-58**	**Manufacturer and Model**
A.	Hangers		
	2-½-inch and smaller pipe,		
	adjustable J	5	B-Line Fig. B3690, Grinnell Fig. 104, or equal.
	clevis	1	Grinnell Fig. 65, B-Line Fig. B3104, or equal.
	3-inch through 10-inch pipe		
	clevis	1	Grinnell Fig. 260, B-Line Fig. B3104, or equal.
	12 inch and larger pipe		
	clevis	1	Grinnell Fig. 260, B-Line Fig. B3102, or equal

	Description or Size	MSS SP-58	Manufacturer and Model
B.	Standard weight and extra strong steel pipe and stainless steel pipe (all sizes)		
	uninsulated, steel pipe clamp	4	Elcen “1”, Fee & Mason “236", ITT Grinnell “212", or equal
C.	Concrete Rod Attachment Plate, 6-inch and smaller pipe	19	Grinnell Fig. 52, or equal.
D.	Turnbuckles, Steel	13	Elcen 81, Fee & Mason 2382, Grinnell Fig. 230, or equal
E.	Hanger Rods, Carbon Steel, threaded both ends, ½-inch minimum size	--	Elcen 72, Fee & Mason 267, Grinnell Fig. 140, or equal.
F.	Wall Mounted Pipe Supports and Frames, steel 12 inch and smaller pipe		
	brackets	33,34	Grinnell Fig. 195 & 199; B-Line Fig. B3066 & B3067, or equal.
	prefabricated channels, galvanized	--	12 gauge, 1⅝" x 1⅝" with suitable brackets and pipe clamps.
	offset pipe clamp, 1½-inch and smaller pipe, galvanized	--	1¼" x $^{3}/_{16}$" steel, with ⅜" bolts.
	offset pipe clamp, 2-inch to 3½-inch pipe, galvanized	--	1¼" x $^{3}/_{16}$" steel, with ⅜" bolts.
G.	Pipe Riser Clamps		
	cold piping system	–	Pipe Shields, Inc., “E1000", or equal
	copper tubing	–	CT-121 or CT-121C
	other piping systems	–	Grinnell “261", or equal
H.	Floor Mounted Pipe Supports, steel, cast or ductile iron, 2 inch through 24 inch pipe		

Description or Size	MSS SP-58	Manufacturer and Model
Flange Support	–	Standon Model S89 with galvanized extension pipe, or equal
Saddle Support	–	Standon Model S92 with neoprene liner and galvanized extension pipe, or equal
Flange Cradle Support	–	Standon Model S96 with galvanized extension pipe, or equal

PART 3 - EXECUTION

3.01 LOCATION AND SPACING

A. Piping shall be supported approximately 1½ inches out from the face of walls and at least 3 inches below ceilings or beams. The maximum spacing for pipe supports and expansion joints shall be:

Type of Pipe	Pipe Support Maximum Spacing, Feet	Maximum Run without Expansion Joint, Loop or Bend, Feet (See Note 1)	Expansion Joint Maximum Spacing, Feet (See Note 2)	Type of Expansion Joint
Ductile Iron	15	80	80	Mechanical Couplings
Steel:				
1¼-inch and smaller	7	30	100	Note 3
1½ to 4- inch	10	30	100	Note 3
Copper:				
1-inch and smaller	5	--	--	None required
Over 1-inch	7	50	100	Note 3
PVC:				
⅛- and ¼-inch	Continuous Support	20	60	None required

Type of Pipe	Pipe Support Maximum Spacing, Feet	Maximum Run without Expansion Joint, Loop or Bend, Feet (See Note 1)	Expansion Joint Maximum Spacing, Feet (See Note 2)	Type of Expansion Joint
½- to 2-inch	4	20	60	None required
Over 2-inch	6	20	60	None required
Cast Iron Soil Pipe:	10	–	–	None required

Notes:

1. Unless otherwise permitted, an expansion joint shall be provided in each straight run of pipe having an overall length between loops or bends exceeding the maximum run specified herein.

2. Unless otherwise permitted, the spacing between expansion joints in any straight pipe run shall not exceed the maximum spacing specified herein.

3. Expansion joint fittings as specified in the miscellaneous piping section.

4. At least two properly padded supports for each pipe section.

5. At least one support for each pipe section.

3.02 INSTALLATION

A. Concrete inserts or L-shaped anchor bolts shall be used to support piping from new cast-in-place concrete. Expansion anchors shall be used to fasten supports to masonry.

B. Design loads for inserts, brackets, clamps, and other support items shall not exceed the manufacturer's recommended loads.

C. Anchorage shall be provided to resist thrust due to temperature changes, changes in diameter or direction, or dead ending. Anchors shall be located as required to force expansion and contraction movement to occur at expansion joints, loops or elbows, and as required to prevent excessive bending stresses and opening of mechanical couplings. Anchorage for temperature changes shall be centered between elbows used as expansion joints.

D. Provide dielectric isolation. Do not allow copper and other metals to make contact with each other.

E. All pipe supports located in sewage wetwells shall be stainless steel.

F. All piping shall be supported and anchored so that there is no movement or visible sagging between supports.

G. Pipe supports shall be manufactured for the size and type of pipe to which they are applied. Straphangers will not be acceptable. Threaded rods shall have sufficient threading to permit the maximum adjustment available in the support item.

H. Vertical Piping:

1. Secure at sufficiently close intervals to keep pipe in alignment and to support weight of pipe and its contents.

2. Support vertical iron and steel pipe on maximum 5'-0" centers with steel pipe riser clamps.

3. Support vertical copper tubing at no more than 10'-0" spacing, using plastic coated steel pipe riser clamps or pipe clamp hangers at end of runs and at intermediate points as installation dictates.

4. Support vertical plastic pipe at 4'-0" centers, using plastic coated pipe riser clamps or pipe clamp hangers at end of runs and at intermediate points as installation dictates.

I. Horizontal Piping:

1. Support at sufficiently close intervals to prevent sagging, thrust restraint, and vibration.

2. Install hangers or supports at ends of runs or branches and at each change of direction or alignment.

3. Install steel clevis-type pipe hangers for horizontal iron and steel pipe on maximum 10'-0" centers.

4. Install steel clevis-type pipe hangers for copper tubing on 6'-0" centers for 1¼" size and smaller, and on 10'-0" centers for copper tubing larger than 1¼" size.

5. Install plastic coated ring-type pipe hangers for horizontal plastic pipe on maximum 4'-0" centers, close to every joint, at ends of each branch, and at each change in direction of elevation; hangers shall not compress, distort, cut or abrade plastic piping and shall permit free movement of the pipe.

J. The Contractor is responsible for properly bracing piping against lateral movement or sway. The Engineer shall review with the Contractor and approve method of bracing of piping at each location prior to Contractor proceeding with the installation

of the bracing. Bracing shall be installed at all locations where sway is anticipated and as directed by the Engineer.

K. Rubber hose and flexible tubing shall be provided with continuous angle or channel support.

END OF SECTION

SECTION 15100

PIPING

PART 1 - GENERAL

1.01 DESCRIPTION

A. This section includes requirements for providing pump piping, drain piping, and other miscellaneous piping as indicated in accordance with the Contract Documents.

1.02 SUBMITTALS

A. Layout drawings for all piping, including sizes, types, and locations. The drawings shall also indicate location of all fittings, wall and floor penetrations, valves, and pipe supports. Layout drawings for the piping shall be coordinated with shop drawings for the base-mounted lift station specified in Section 11300 and valves specified in Section 15110.

B. Catalog data for all pipe, fittings and appurtenances.

C. Grooved joint couplings and fittings, when used, shall be shown on layout drawings and product submittals and shall be specifically identified with the applicable Victaulic style or series designation.

D. Manufacturer's instructions for installation and assembly of joints and accessories, including the manufacturer's recommended maximum deflection per joint.

E. Submit certificates of compliance for all pipe, fittings and appurtenances in this section.

F. Submit details of joint bonding, field welded joint restraint calculations, calculations for pipe design and fittings reinforcement and/or test data.

PART 2 - MATERIALS

2.01 PIPING

Piping shall be furnished and installed complete with all fittings, jointing materials, hangers and supports, anchors, and other necessary appurtenances. Unless otherwise stated, the latest edition for any commercial standards and all manufacturing tolerances referenced therein shall apply.

A. Ductile Iron Pipe – Exposed/Interior:

1.	Pipe	Flanged, ANSI A21.51 Class 54. Grooved, ANSI/AWWA C606 Class 54.
2.	Lining	Ceramic Epoxy, Induron Protecto 401, or approved equal.
3.	Flanges	ANSI A21.15/ASME B16.1, Class 125.
4.	Nuts and Bolts	ASTM A307, Grade B. ANSI B18.2.1 and B18.2.2. Provide ASTM F593 Type 316 stainless steel, Condition CW1 or CW2, fasteners (in wetwells).
5.	Fittings	ANSI A21.10 or A21.53; with factory installed flanges in accordance with ANSI A21.15/ASME B16.1, Class 125.
6.	Grooved Couplings	Victaulic Style 31. ASTM A536, Grade 65-45-12.
7.	Grooved Fittings	Victaulic ANSI A21.10/AWWA C-110.
8.	Pipe Couplings	Dresser Style 38, Rockwell Type 411, Victaulic Depend-O-Lok®; harnessed.
9.	Flange Adapters	Victaulic Style 341, EBAA Iron Megaflange 2100, or approved equal.
10.	Dismantling Joints	Smith Blair Model 975 or Romac Style DJ400; AWWA C219, fusion bonded epoxy coating.
11.	Gaskets	Ductile iron pipe flanged joints shall conform to ANSI/AWWA C115/A21.15. Gaskets for ductile iron flanged joints shall be full face type SBR elastomer per ANSI/AWWA C111/A21.11 and shall be 1/8" thickness. Flanged gaskets shall be high-performance type satisfying the special requirements of ANSI/AWWA C111/A21.11 Appendix C, Sec. C.2 and have at least (3) bulb type rings molded into both faces of the gasket. Flanged gaskets shall be U.S. Pipe FULL FACE FLANGE-TYTE Gasket or approved equal.

B. Ductile Iron Pipe – Buried:

1.	Pipe	Push-On Joint, Fastite, Tyton, ANSI A21.51 Class 54. Grooved, ANSI/AWWA C606 Class 54.

2.	Lining	Ceramic Epoxy, Induron Protecto 401, or approved equal.
3.	Push-On Joints	ANSI A21.11, with factory installed restraints.
4.	Restrained Joints	Where indicated and where required for thrust restraint, joints shall be restrained. Restrained joints shall be mechanically interlocking joints. Restrained joints shall be U.S. Pipe TR Flex for 4-inch thru 36-inch (350 psi for 4" – 24", 250 psi for 30" - 36"), HP LOK for 30-inch thru 64-inch (350 psi), and High Deflection Single Slot (HDSS) for 24-inch thru 48-inch (350 psi) when needing higher deflection capability; American Ductile Iron Pipe "Flex Ring"; or McWane Ductile TR-Flex Restrained Joint Pipe. Restraining fittings using set screws, restraining gaskets, gripper type glands, and field-cuts of restrained joints shall be Megalug, or approved equal. Restrained joints shall be capable of sustaining the design pressure as specified herein. The push-on restraining gaskets for 4" - 24" pipe shall be US Pipe FIELD-LOK 350 gaskets, American FastGrip gaskets, or McWane Ductile SURE STOP 350.
5.	Fittings	ANSI A21.10 or A21.53; Push-On Joints with factory installed restraints or Mechanical Joints (MJ) with MJ Restraints, in accordance with ANSI A21.11.
6.	Grooved Fittings	Victaulic ANSI A21.10/AWWA C-110.
7.	MJ Restraints	EBAA Iron Megalug Series 1100 or approved equal.
8.	Grooved Couplings	Victaulic Style 31, ASTM A536, Grade 65-45-12. Provide ASTM F593, Group 2, Type 316 stainless steel, Condition CW oval neck track bolts and ASTM F594, Group 2, 316 stainless steel, Condition CW heavy hex nuts.

C. Steel Pipe – Exposed/Interior:

1.	Pipe	Flanged, ANSI/AWWA C200, wall thickness .375".
2.	Interior Lining	Epoxy paint lined in accordance with ANSI/AWWA C210. Lining shall be Tnemac H.S. Epoxy Series 104, 30 mil minimum thickness, or approved equal.
3.	Coatings	Zinc chromate primer and painted in accordance with Section 09900.

4.	Flanges	Flanges will be 150 lb. steel plate flanges in accordance with AWWA C207 Class D.
5.	Welding	Welding procedure and performance and qualification shall be in accordance with ANSI/AWS B2.1 and the structural welding code ANSI/AWS D1.1.
6.	Field Welding	Field welds shall be in accordance with ANSI/AWWA C206.
7.	Couplings	Bolted, sleeve-type couplings for plain-end shall be in accordance with ANSI/AWWA C219.
8.	Dimensions	The dimensions for fabricated steel shall be in accordance with ANSI/AWWA C208.

D. PVC Drain Pipe:

1.	Pipe	Cellular Core, ASTM F891.
2.	Fittings	PVC DWV fittings, ASTM D2665.
3.	Joints	Solvent-cemented, ASTM F656 and ASTM D2564.

E. Galvanized Steel Pipe:

1.	Pipe	Sch. 40 galvanized, ASTM A53.
2.	Nipples	Sch. 40 galvanized, ASTM A733, seamless steel pipe.
3.	Unions	Malleable-Iron, ASME B16.39, Class 150, hexagonal-stock body with ball-and-socket, metal-to-metal, bronze seating surface and female threaded ends.
4.	Grooved Couplings	Victaulic Style 07/W07 (rigid). Victaulic Style 77/W77 (flexible).
5.	Grooved Fittings	Victaulic; Ductile-Iron ASTM A536; ASTM A234 wrought steel; ASTM A53 factory fabricated.
6.	Threaded Fittings	Gray-Iron galvanized, ASME B16.4, Class 125 standard pattern.
7.	Flanged Fittings	Cast-Iron galvanized, ASME B16.1, Class 125.

F. Stainless Steel Pipe:

1.	Pipe	ASTM A312, Type 304/304L, Schedule 5S, full finish annealed.
2.	Fittings	Precision, cold drawn, austenitic stainless steel with elastomer O-ring seals.
3.	Joints	Vic-Press 304™ with Victaulic 'PFT' series tools.

G. Pipe Couplings shall be harnessed with Dresser STAR Anchor Restraint System, restrained Victaulic Depend-O-Lock® FxF type, or approved equal, with number and size of tie rods as required by the manufacturer for the diameter and pressure rating of the pipe on which they are to be installed.

H. Wall Castings and sleeves in walls for pipes 4 inches and larger shall be minimum ductile iron Class 250 of the lengths, shapes and sizes necessary, and shall be complete with waterstop flanges. The ductile iron wall castings and wall sleeves shall conform to ANSI A21.10.

I. Watertight Sleeve Seals shall be PSI-ThunderLine Link-Seal EPDM modular sealing elements with composite pressure plates and type 316 stainless steel connecting bolts and nuts.

J. Protective Coatings:

1.	Buried Piping	Coat buried piping and fittings with one mil thickness of asphaltic coating per AWWA C151, C110 and C153, as applicable. When indicated on the Contract Drawings, all buried ductile iron pipe and fittings shall have a tube-type polyethylene encasement, V-BIO enhanced polyethylene encasement as manufactured by US Pipe, or approved equal, in accordance with AWWA C105. Polyethylene encasement shall be 8 mils thick. Both ends of the pipe shall be thoroughly sealed with adhesive tape or plastic tie straps at the joint overlap. Place circumferential wraps of tape at 2-foot intervals along the barrel of the pipe to minimize the space between the encasement and the pipe.

2.	Exposed/Interior Piping	Furnished with a suitable shop primer and finish coated in accordance with Section 09900. Shop primer shall be approved by the finish coat paint manufacturer.

2.02 MISCELLANEOUS

A. Pump discharge piping shall have a pressure gauge with a range of approximately twice the design operating pressure. Pressure gauges shall be Ashcroft #45-1279SSH-04L-XLL, or approved equal.

B. Pump suction piping shall have a compound pressure and vacuum gauge graduated from 30 in. Hg vacuum to 15 psi. Gauges shall be 316 stainless steel Ashcroft Type 1279 with XLL and hermetically sealed options, or approved equal.

C. Pressure gauges shall be installed with a 316 stainless steel, silicone-filled diaphragm seal with flushing connection, Ashcroft Type 201, or approved equal, for discharge piping pressure gauges and Ashcroft Type 741, or approved equal, for suction piping pressure gauges.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Flange bolts shall be tightened sufficiently to slightly compress the gasket and effect a seal, but not so tight as to distort the flanges.

B. All pipes passing through walls or slabs which have one side in contact with earth or exposed to the weather shall be sealed watertight with special rubber gasketed sleeve and joint assemblies or with sleeves and modular rubber sealing elements.

C. Pipe shall be installed as indicated, or in the absence of a detailed piping arrangement, as approved by the Engineer. Piping shall not obstruct openings or passageways.

D. Pipe shall be cut from measurements taken at the site and not from the drawings, and all necessary provisions shall be taken in laying out piping to allow for expansion and contraction.

E. Connections to pumps shall be made in a manner to eliminate strains on piping and pumps.

F. Vic-Press 304™ fittings and stainless steel pipe may be used on applicable systems 2” and smaller in lieu of welded/threaded steel or flanged/threaded ductile iron. Install in accordance with the manufacturer’s latest installation instructions. Pipe shall be square cut, +/-0.030”, properly deburred, and cleaned. Mark pipe ends at the required location, using a gauge supplied by Victaulic, to ensure full insertion

into the coupling or fitting during assembly. Use a Victaulic 'PFT' series tool with the proper sized jaw for pressing.

G. Grooved joint couplings and fittings shall be installed in accordance with the manufacturer's written installation instructions. Grooved ends shall be clean and free from indentations, projections, and roll marks in the area from pipe end to groove. Gaskets shall be verified as suitable for the intended service prior to installation. Gaskets shall be molded and produced by the coupling manufacturer. The grooved coupling manufacturer's factory trained representative shall provide on-site training for contractor's field personnel in the use of grooving tools, application of groove, and installation of grooved joint products. The manufacturer's representative shall periodically visit the jobsite and review installation. Contractor shall remove and replace any joints deemed improperly installed.

1. All grooved joint couplings, fittings and specialties shall be the products of a single manufacturer. Grooving tools shall be of the same manufacturer as the grooved components.

H. Annular space between pipe and wall sleeves shall be sealed with mechanical seals to fill the space and form a watertight seal.

I. Tighten flange bolts so that the gasket is uniformly compressed and sealed, do not distort flanges, and do not exceed the manufacturer's recommended maximum torque.

J. Flange bolts shall project ⅛- to ¼-inch beyond the face of each nut after tightening.

K. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings in accordance with manufacturer's written instructions.

L. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.

M. Install buried PVC drain piping according to ASTM D2321 and ASTM F1668.

N. Join PVC drain piping according to ASTM D2855 for solvent-cemented joints.

3.02 CLEANING

A. The inside of all pipe, valves, and fittings shall be smooth, clean, and free from blisters, loose mill scale, sand, and dirt when erected. All lines shall be thoroughly blown clean before placing in service.

3.03 PAINTING

A. Paint all piping, valves and fittings as specified in Section 09900.

B. Color code all piping paint work as specified in Section 09900.

3.04 TESTING

A. Discharge and force main piping systems shall be hydrostatically tested in accordance with AWWA C600 to 1½ times working pressure, but not less than 150 psi.

B. Leakage shall be determined by loss of pressure, soap solution, or chemical indicator.

C. Provide all necessary piping between the reach being tested and the water supply, together with all required materials and equipment.

D. Provide dished heads, blind flange or bulkheads as necessary to isolate and test force main.

E. Methods and scheduling of tests to be approved by the Engineer.

F. Protect pipes and provide thrust restraint as required to complete the test.

3.05 STARTUP/TRAINING

A. The Owner reserves the right to videotape and archive all startup and training instruction provided by the manufacturer or authorized representative.

END OF SECTION

SECTION 15110

VALVES

PART 1 - GENERAL

1.01 DESCRIPTION

A. This section includes requirements for furnishing and installing all valves and appurtenances as indicated in accordance with the Contract Documents.

1.02 SUBMITTALS

A. Layout drawings for valves to assure no conflict with other piping and equipment. These drawings shall be coordinated with layout drawings for the base-mounted lift station pumps specified in Section 11310, sump pump specified in Section 11350, and piping specified in Section 15100.

B. Catalog data for all valves and appurtenances, including operators.

C. Shop drawings for all valves and appurtenances.

D. Manufacturer's installation recommendations.

E. Submit operation and maintenance manuals, including procedures for operation, instructions for maintenance and overhaul, lubrication schedules, safety precautions, test procedures and parts lists.

F. Submit manufacturer's certificates indicating that products furnished comply with the specifications.

1.03 QUALITY ASSURANCE

A. Valve manufacturer shall be regularly engaged in the design, manufacture and maintenance of valves for sewage service and shall have furnished valves of the same general design, type and comparable size specified herein, which have been used and proved satisfactory under similar test, service and operating conditions for at least five years. The manufacturer shall furnish satisfactory evidence of adequate facilities for furnishing parts for repairs and for maintenance of valves furnished.

1.04 WARRANTY

A. The Contractor shall submit to the Owner a written manufacturer’s warranty covering equipment defects and workmanship and shall be responsible for repairing or replacing at his own expense, including labor and shipping, all parts defective in material or workmanship for a period of two years from the date Contractor achieves Substantial Completion for the project.

PART 2 - PRODUCTS

2.01 GATE VALVES

A. Gate valves shall be ductile iron with stainless steel trim, solid wedge, tapered seat, non-rising stem, as shown on drawings, non-asbestos packing, and shall be in accordance with AWWA C500 and these specifications.

B. Valve bodies, bonnets, glands and discs shall be ductile iron ASTM A536 Grade 65-45-12. The body and bonnet wall thickness shall exceed the minimum wall thickness stated in AWWA Standard C500, Section 4.4, Table 1. Accurately machined bronze seating rings shall be secured in the valve body. Valve wedge shall be provided with bronze seating rings, machined and scraped, if necessary, to seat truly flat against body seating rings. All 14-inch and larger valves shall have bronze rollers and scrapers located on both sides of the gate, which shall travel in a bronze or 316 stainless steel lined groove in the body to keep the gate centered between the seats throughout its length of travel.

C. Valve stems shall be 304 stainless steel and rotate freely in the valve bonnet recess. Design of the stuffing box shall permit repacking under line pressure. Stuffing box glands shall be brass; gland followers shall be ductile iron.

D. All gate valves shall be rated for 250 psi working pressure and 300 psi hydrostatic test pressure.

E. Unless otherwise indicated or required, valves for above ground ductile iron pipe shall have flanged ends in accordance with ANSI B16.1, 125 pound class. All buried valves shall be provided with mechanical joint ends compatible with the adjoining pipe. Provide hand wheel and/or extension stem with operating nut, as indicated on the plans or as required by the particular installation. All valves 14-inch and larger shall be provided with a by-pass and bevel or spur gears, as applicable for the installation. When gears are required on valves smaller than 14-inch to change position or direction of the valve stem, gear ratio shall be 2:1.

F. Provide a valve position indicator for each valve, to fit inside the specified valve boxes and are suitable for use with the valves furnished.

G. Gate valves shall be Kennedy Metal Seat Solid Wedge Valve, or approved equal.

H. Body and bonnet fasteners shall be of rustproof material having the physical properties of ASTM A307. Packing and gaskets shall be of non-asbestos materials.

I. Internal and external coating (6-8 mils DFT), testing and inspections shall be in accordance with AWWA C500. Valves shall be marked with the requirements of AWWA C500 and MSS-SP25.

J. Gate valves shall be provided with a ductile iron manual operating nut, extension stem, and a floor or valve box as indicated on the Contract Drawings. Buried valves

shall be installed with a fully adjustable valve box trench adapter. Contractor shall furnish two (2) operating nut keys. The direction of rotation of the operating nut to open the valve shall be to the left (counterclockwise). Each valve body or operator shall have cast thereon the word “OPEN” and an arrow indication the direction to open.

K. 2-inch AWWA operating nut shall be constructed of ductile iron ASTM A536 Grade 65-45-12. The ductile iron operating nut shall be fusion bonded epoxy coated inside and out with no uncoated surface.

2.02 COMBINATION AIR VALVES

A. Combination air valves shall be float operated valves designed to release accumulated air or gas from a piping system while the system is in operation and under pressure. The valves shall discharge large quantities of air during pipe filling operations and intake large quantities of air during pipe draining and water column separation. All combination air valves shall be A.R.I. Model D26NS with a non-slam orifice, or approved equal.

B. The valve body shall be reinforced nylon and conical in shape to maintain an air gap between the wastewater and the sealing mechanism. Wastewater shall not come in contact with the sealing mechanism at any time during normal operation at the valve’s working pressure. The working pressure shall range from 0.3 to 150 psi and the valve shall be tested to 225 psi. The maximum working temperature shall be 140 degrees F with maximum intermittent temperatures of up to 194 degrees F.

C. The valve shall have a lower float and a funnel shaped lower body to automatically drain wastewater and other debris from the valve. The lower float shall be located in the main body of the valve and shall be constructed of reinforced nylon and polypropylene.

D. A spring guided linkage between the sealing mechanism and float/stainless steel rod assembly shall perform without jamming or allowing air to escape due to vibrations, float bouncing related to turbulence from pump start and stop, or from flow fluctuations.

E. The valve discharge elbow shall provide means of connecting a vent pipe or for use in valve flushing and cleaning. The valve body shall have 316 stainless intake connection and a 316 stainless steel discharge elbow connection in accordance with the schedule below.

F. The valve shall have a 316 stainless steel ball valve connected to the lower valve body to relieve internal pressure and permit backflushing.

G. All hardware shall be 316 stainless steel. All O-rings shall be of BUNA-N with pressure ratings equivalent to the overall working pressure of the valve.

Location	Intake Body Connection	Discharge Elbow Connection	Non-Slam Orifice
Force main as shown on the Contract Drawings	2” NPT	2” NPT	0.177”

2.03 AIR RELEASE VALVES

A. Air release valves shall be float operated valves designed to release accumulated air or gas from a piping system while the system is in operation and under pressure. The valves shall discharge large quantities of air during pipe filling operations and intake large quantities of air during pipe draining and water column separation. All combination air valves shall be A.R.I. Model D26 with a one-way out check valve component, or approved equal.

B. The valve body shall be reinforced nylon and conical in shape to maintain an air gap between the wastewater and the sealing mechanism. Wastewater shall not come in contact with the sealing mechanism at any time during normal operation at the valve’s working pressure. The working pressure shall range from 0.3 to 150 psi and the valve shall be tested to 225 psi. The maximum working temperature shall be 140 degrees F with maximum intermittent temperatures of up to 194 degrees F.

C. The valve shall have a lower float and a funnel shaped lower body to automatically drain wastewater and other debris from the valve. The lower float shall be located in the main body of the valve and shall be constructed of reinforced nylon and polypropylene.

D. A spring guided linkage between the sealing mechanism and float/stainless steel rod assembly shall perform without jamming or allowing air to escape due to vibrations, float bouncing related to turbulence from pump start and stop, or from flow fluctuations.

E. The valve discharge elbow shall provide means of connecting a vent pipe or for use in valve flushing and cleaning. The valve body shall have 316 stainless intake connection and a 316 stainless steel discharge elbow connection in accordance with the schedule below.

F. The valve shall have a 316 stainless steel ball valve connected to the lower valve body to relieve internal pressure and permit backflushing.

G. All hardware shall be 316 stainless steel. All O-rings shall be of BUNA-N with pressure ratings equivalent to the overall working pressure of the valve.

Location	Intake Body Connection	Discharge Elbow Connection	Check Valve
Pump Room as shown on the Contract Drawings	2” NPT	2” NPT	One-way out
Force main as shown on the Contract Drawings	2” NPT	2” NPT	One-way out

2.04 MISCELLANEOUS VALVES

A. Gate valves 4-inch and larger shall be as specified above. Gate valves smaller than 4-inch shall be of the solid wedge type with threaded ends; Crane 431UB, Stockham B-105, or approved equal.

B. Check valves smaller than 4-inch shall be bronze horizontal swing check valves with threaded ends; Crane 36, Stockham B-345, or approved equal.

C. Ball valves 2-inch and smaller shall be full port 316 stainless steel 2 piece ball valves with threaded ends; Crane 9431 or approved equal.

2.05 EXTENSION STEMS

A. Extension stems shall be provided for operation of valves where required or shown on the Contract Drawings, sized so as to transmit full torque from the operating mechanism to the valve without binding, twisting or bending. The Contractor shall confirm the lengths of each extension stem.

B. At a minimum, extension stems shall be constructed of hot dipped galvanized 1¼-inch diameter solid ASTM A36 hot rolled steel round bar, shall include a 2-inch square, 1.875-inch tall solid ASTM A5 ductile iron nut coupling (bottom) with four (4) set screws for attachment to the valve operating nut, and shall include a 2-inch square, 1¾-inch tall solid ASTM A5 ductile iron operating nut (top) located in the floor/valve box. All extension stems for buried valve applications shall have 0.375-inch thick by 4½-inch diameter ASTM A5 ductile iron centering rings spaced 6 feet on center, with the upper most centering ring no further than 6 inches below the operating nut, such that it is contained within the top section of the valve box. Extension stems shall be manufactured by Higgins Engineering, Inc. (434) 946-7170, or approved equal. Where required, universal joints shall be provided for deflection or offset.

C. Stem guides shall be high-strength ductile iron and installed as necessary, but at a minimum so that extension stems do not go unsupported for lengths of more than eight (8) feet. Stem guides shall be adjustable and shall include a bronze bushing with an inside diameter $^{1}/_{16}$” larger than the outside diameter of the extension stem.

Stem guides shall be Item No. 367-XXXX as manufactured by Trumbull Industries, Inc., or approved equal. The Contractor shall provide sufficient supports as required by the valve manufacturer.

2.06 HANDWHEELS

A. Handwheels shall be provided for operation of valves where required or shown on the Contract Drawings. Handwheels shall be 14 inches in diameter, made from either cast iron or ductile iron, and shall include a directional arrow indicating the rotation to open the valve. Handwheel shall be Item No. 367-4961 as Manufactured by Trumbull Industries, Inc., or approved equal.

2.07 VALVE BOXES

A. Valve boxes for all buried valves shall be cast iron, screw type assembled units consisting of tops, bottoms and lids, and extensions as necessary, depending on depth of valve burial. Valve box assembly shall be fully adjustable to accommodate grade changes. Valve boxes for all interior valves shall be cast iron, slip type consisting of tops and lids, and shall be installed with the top of the valve box adaptor flush with the top of the concrete slab, as shown on the Contract Drawings. Valve boxes shall be Tyler/Union valve boxes or approved equal. Valve boxes shall be suitable to accommodate the valve box adaptor and position indicator specified.

B. All valve boxes shall be equipped with a position indicating device to provide the position of the underlying valve and shall be directly coupled to any stem extension configuration comprised of a shaft and 2-inch AWWA nut. The indicator shall be supplied as an assembly consisting of a valve box adaptor, an indicator, and an operating stem adaptor. The valve box adaptor shall have a hole large enough to fit a 2” square socket through it so that extension stems can be added or removed without removing the valve box adaptor. The indicator shall be of a digital read out capable of reading from 0 to 9999.9 turns. The indicator body shall be shock proof, self-extinguishing techno polymer case that meet IP64 standards, and shall be encased in a transparent silicon casing which extends over the extension stem to ensure no water can penetrate the indicator where the operating stem attaches to the indicator bushing. Turns to open shall be indicated by a label next to the digital read out, and the label shall be replaceable in the event that the indicator is used for a different valve. The valve position indicator and accessories shall be Model API_OP9FB as manufactured by Troy Valve or approved equal.

C. All lids shall be marked with “SEWER”, “WATER”, etc., as appropriate for the service on which they are to be installed.

D. A 3-inch by 1-inch stainless steel nameplate with black infill text, to identify the associated valve below, shall be attached to the valve box lid using stainless steel pop rivets. Nameplate shall be an Engraved Equipment Nameplate as manufactured by Seton or approved equal.

2.08 FLOOR BOXES

A. Floor boxes shall be installed in the concrete slab, as shown on the Contract Drawings, to provide support for extension stems of the non-rising stem type and to provide a cover for the operating nut on the extension stem. The floor boxes shall have a bronze bushing and be designed for the concrete slab thicknesses in which they are to be installed with the top of the floor box flush with the top of the concrete slab or installed with a floor box top extension so that top is flush with finish grade, as shown on the Contract Drawings.

B. A 3-inch by 1-inch stainless steel nameplate with black infill text, to identify the associated valve below, shall be attached to the valve box lid using stainless steel pop rivets. Nameplate shall be an Engraved Equipment Nameplate as manufactured by Seton or approved equal.

PART 3 - EXECUTION

3.01 GENERAL

A. All valves shall be installed in accordance with the manufacturer's instructions and as required herein.

B. A flanged or union connection shall be provided within 2-feet of each valve unless otherwise approved by the Engineer.

C. Position indicators shall be installed in accordance with the manufacturer's instructions and as required herein.

3.02 TESTING

A. Operate all valves twice through a complete open/close cycle. Check for valve seating to be drip tight. If leaking occurs, adjust or replace valve packing, as necessary, and retest. Replace valves if persistent leaking occurs.

3.03 PAINTING

A. Paint valves as specified in Section 09900.

END OF SECTION

SECTION 15130

SLUICE GATE

PART 1 - GENERAL

1.01 DESCRIPTION

A. The work to be performed under this section includes, but is not limited to, furnishing all labor, tools, materials and services necessary for providing a sluice gate as indicated on the Contract Documents.

1.02 SUBMITTALS

A. Shop Drawings: Showing dimensions, fabrication, assembly, and installation, including operating stem and lifting mechanism.

B. Catalog Data: Providing product information and materials of construction for gate and all appurtenances including extension stem, stem guides and operator.

1.03 QUALITY ASSURANCE

A. The manufacturer shall have experience in production of substantially similar equipment and shall show evidence of satisfactory operation in at least 15 installations. The manufacturer's shop welds, welding procedures and welders shall be qualified and certified in accordance with the requirement of the latest edition ASME section IX or AWS D1.6.

B. The fully assembled gate shall be shop inspected, tested for operation and leakage and adjusted before shipping. There shall be no assembling or adjusting on the job site other than for the lifting mechanism.

1.04 WARRANTY

A. The Contractor shall submit to the Owner a written manufacturer's warranty covering equipment defects and workmanship and shall be responsible for repairing or replacing at his own expense, including labor and shipping, all parts defective in material or workmanship for a period of two years from the date Contractor achieves Substantial Completion for the project.

PART 2 - MATERIALS

2.01 GENERAL

A. Sluice gate shall be wall-mounted, self-contained, non-rising stem, constructed of Type 316 stainless steel and conforming to the applicable requirements of AWWA

C561. Sluice gate shall be Fontaine-Aquanox Series 20 or equivalent by Whipps, RW Gate, or approved equal.

B. All parts shall be standard size and gauge so that repair parts, when furnished at any time, can be installed in the field without any fitting, chipping, or remachining. Like parts shall be interchangeable. The gate shall be completely assembled in the shop to ensure that all parts fit together properly. There shall be no assembling or adjusting on the job site other than for the lifting mechanism.

C. Anchor bolts which are required for installation of the gate, stem guides and operators shall be Type 316 stainless steel as specified in Section 05500.

2.02 SLUICE GATE

A. Sluice gate shall meet the following design requirements:

1. Location: Wetwell

2. Quantity: 1

3. Dimensions: 18" x 18”

4. Seating Head: 20 feet of water

5. Unseating Head: 20 feet of water

6. Gate Type: Wall-mounted

7. Leakage: Sluice gate shall be substantially watertight under the design head conditions. Leakage shall not exceed AWWA allowable leakage rates.

B. Frames:

1. Gate frame shall be stainless steel conforming to ASTM A240, Type 316L. The gate frame will be constructed of structural members or formed plate welded to form a rigid one piece-frame. The frame shall be designed for the maximum head indicated with a minimum safety factor of 5 with regard to tensile, compressive, and shear strength. The frame shall be of the flange back design suitable for mounting directly to the concrete wall over an embedded wall sleeve. The guide slot shall be of ultra high molecular weight polyethylene.

2. The frame configuration shall allow the replacement of the top and side seals without removing the gate frame from the concrete wall.

C. Slides:

1. The slide shall consist of a flat plate reinforced with formed plates or structural members to limit its deflection to 1/720 of the span of the gate under the design head. The frames shall be designed for the maximum head indicated with a minimum safety factor of 5 with regard to tensile, compressive, and shear strength. All components shall be Type 316 stainless steel.

D. Guides and Seals:

1. The guides shall be made of ultra high molecular weight polyethylene, ASTM D4020, and shall be of such length as to retain and support at least two thirds (⅔) of the vertical height of the slide in the fully-open position.

2. Side and top seals shall be made of ultra high molecular weight polyethylene of the self-adjusting type. A continuous compression cord made of EPDM conforming to ASTM D2000 shall ensure contact between the ultra high molecular weight polyethylene guide and the gate in all positions. The sealing system shall maintain efficient sealing in any position of the slide and allow water to flow only through the opened part of the gate. Seals shall be continuous along top and sides of gate frame.

3. The bottom seal shall be EPDM conforming to ASTM D2000, set into the bottom member of the frame.

E. Stem and Coupling:

1. Operating stem shall be Type 316 stainless steel designed to transmit in compression at least 2 times the rated output of the operating manual mechanism with a 40-pound effort on a crank or handwheel.

2. The stem shall have a slenderness ration (L/r) less than 200. The threaded portion of the stem shall have machined cut or machine rolled threads of the full depth Acme type.

3. A stem in more than one piece and with a diameter of 1¾ inches and larger, the different sections shall be joined together by solid coupling. A stem that is smaller than 1¾ inches diameter shall be solid or pinned to an extension tube. The couplings shall be bronze conforming to ASTM B584 and be grooved and keyed and shall be of greater strength than the stem.

4. Type 316L stainless steel universal joints and supports shall be provided as necessary to provide offsets, if required.

F. Stem Guides:

1. Stem guides shall be fabricated from Type 316 stainless steel with an ultra high molecular weight polyethylene bushing.

2. Guides shall be adjustable and spaced in accordance with the manufacturer's recommendation. The L/r ratio shall not be greater than 200.

2.03 LIFTING MECHANISM

A. The extension stem shall have an AWWA 2-inch operator nut on top, which shall be mounted just below the new floor box cover in the wetwell top slab. Manufacturer shall supply a portable operator, which shall be designed specifically to operate the sluice gate furnished.

B. Operator shall be designed to operate the gate under the seating and unseating heads by using a maximum effort of 40-pounds on the crank, and shall be able to withstand, without damage, an effort of 80-pounds.

2.04 YOKE

A. Self-contained gate shall be provided with a yoke made of Type 316 stainless steel structural members or formed plates. The maximum deflection of the yoke shall be 1/360 of the gate's span. The self-contained sluice gate yoke shall be located such that it either permits full opening of the sluice gate or is above the HWA elevation shown on the Contract Drawings, whichever is greater.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Sluice gate and appurtenances shall be handled and installed in accordance with the manufacturer's recommendations. Sluice gate shall be installed and adjusted so that it does not leak or bind. Extension stems shall be installed in perfect alignment.

B. All bolts shall be tightened and all items requiring lubrication shall be lubricated. Each gate assembly shall be left in perfect operating condition.

3.02 TESTING

A. Following completion of the sluice gate installation, the gate shall be operated through at least two complete open/close cycles and check for free non-binding operation and full opening and seating. Make adjustments as necessary and repeat testing until gate is in proper operating condition.

B. Field test the installed sluice gate seating and unseating leakage with water in accordance with AWWA C561. The use of plugs and/or the bypass pumping

system shall be utilized to allow the maximum possible water level on each side of the sluice gate to be achieved without resulting in an overflow or spillage of sewage. Leakage rate shall not exceed that specified herein. If leakage is excessive, make adjustments as necessary and repeat testing until gate performance meets the specified leakage criteria.

END OF SECTION

SECTION 15400

PLUMBING

PART 1 - GENERAL

1.01 DESCRIPTION

A. Work performed under this section shall include installing potable water pipe, fittings, and valves, drain piping, service sink, water heater, eyewash, backflow prevention, toilet and appurtenances as shown and as specified.

B. The Contractor shall verify all clearances and obstructions by field measurement prior to preparing working drawings for the plumbing fixtures, drain piping and appurtenances.

C. Comply with IBC plumbing code, latest edition.

1.02 SUBMITTALS

A. Product Data: For each type of plumbing fixture indicated. Include selected fixtures and trim, fittings, accessories, appliances, appurtenances, equipment, and supports. Indicate materials and finishes, dimensions, construction details, and flow control rates.

B. Shop Drawings: Layout drawings for potable water piping and valves and drain piping and fittings.

1.03 QUALITY ASSURANCE

A. NSF Standard: Comply with NSF 61, “Drinking Water System Components—Health Effects,” for materials that will be in contact with potable water.

B. Piping materials shall bear label, stamp or other markings of specified testing agency.

C. Comply with NSF 61 for materials for water service piping and specialties for domestic water.

PART 2 - PRODUCTS

2.01 POTABLE WATER PIPE AND FITTINGS

A. Soft Copper Tube: ASTM B88, Type K, water tube, annealed temper.

B. Hard Copper Tube: ASTM B88, Type K or L, water tube, drawn temper.

C. Copper Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper, solder-joint pressure type.

D. Copper Unions: MSS SP-123, cast copper alloy, hexagonal-stock body with ball-and-socket, metal-to-metal seating surfaces, and solder joint ends.

2.02 JOINING MATERIALS

A. Transition Couplings:

1. Pipe fitting same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.

B. Soldering Flux: ASTM B813, water flushable type.

C. Solder Filler Metal: ASTM B32, lead-free type with 0.20 percent maximum lead content.

2.03 POTABLE WATER VALVES

A. Ball Valves:

1. Ball valves 2” and smaller shall be rated 100 psi SWP and 600 psi non-shock CWP. Valves shall be lead-free meeting NSF standards for potable water systems, and shall have a 2 piece silcone bronze body, reinforced PTFE seats, full port, separate pack-nut with adjustable stem packing, anti-blowout stems and Type 316 stainless steel ball. Valve ends shall be either full depth ANSI threads or extended solder connections and shall be manufactured to comply with MSS SP-110. Where piping is insulated, ball valves shall be equipped with 2” extended handles of non-thermal conductive material, and a protective sleeve that allows operation of the valve without breaking the vapor seal or disturbing the insulation. Memory stops, which shall be fully adjustable after insulation is applied, shall also be included. Valves shall be NIBCO T/S585-66LF or approved equal.

B. Gate Valves:

1. Gate valves 2½” and smaller shall be rated 100 psi SWP and 300 psi non-shock CWP. Valves shall be lead-free meeting NSF standards for potable water systems, and shall be non-rising stem, screw-in bonnet, solid wedge and manufactured in accordance with MSS SP-139. Body, bonnet, external stuffing box and wedge are to be of ASTM B584 silicone bronze alloy. Stems shall be of ASTM B371 dezincification-resistant silicon bronze or B99 low-zinc alloy, non-asbestos packing and malleable handwheel. Valve ends shall be either threaded or solder-type. Valves shall be NIBCO T/S113LF or approved equal.

2.04 DRAIN PIPING

A. Drain piping shall be installed where required and shall, in general, conform to the locations indicated on the drawings.

B. Pipe and fittings which are required to be buried beneath floors or underground shall be as indicated on the drawings or other applicable specification sections and shall be centrifugally cast SV hub and spigot ASTM A74 coated cast iron soil pipe. Hydrostatic tests will not be required. Joints shall be push tight with elastomeric gaskets, ASTM C564, Ty-Seal of Tyler Pipe, Charlotte-Seal of Charlotte Foundry, or approved equal. Provide plain beveled end with centering recess in the hub for use with gasket joint. Cast iron soil pipe shall be as manufactured by Charlotte Pipe and Foundry, Tyler Pipe/Utilities Division, U.S. Pipe and Foundry, or equal.

C. Pipe and fittings above grade may be any one of the following at the Contractor's option:

1. Standard weight galvanized steel conforming to ASTM A53, Schedule 40, using cast iron screwed recess pattern drainage fittings.

2. Type "L" hard copper tubing ASTM B88 using DWV copper drainage fittings and lead-free tin alloy, 95-5 tin antimony solder or silver-bearing tin equal to Harris "Stay-Brite", "Stay-Brite 8" or "Bridgit".

3. No-hub cast iron pipe and fittings ASTM B88 with hubless type joints consisting of neoprene gasket ASTM C564 stainless steel shield and stainless steel bands.

D. Traps shall be same material as the connecting piping.

2.05 SERVICE SINK

A. Service sink shall be wall-hung, acid resistant enameled cast iron with wall hanger and nominal dimensions of 22-inches by 18-inches by 12-inches deep. Service sink shall have a rim guard strainer, cast iron P-trap with cleanout and floor stand, and shall be drilled for back-mounted cold and hot water faucets. Sink shall be Kohler Model K-6714 or approved equal.

B. Faucets shall be solid brass construction with rough chrome finish, and have wall brace, ½-inch NPT female union nut inlets, ¾-inch male hose thread outlet, vacuum breaker, lever handles, and integral supply stops, Chicago Faucets No. 897, or approved equal.

2.06 SERVICE SINK ACCESSORIES

A. Paper towel dispenser shall be a high-capacity wall mounted dispenser, and shall hold an 8-inch diameter paper towel roll. Dispenser shall measure approximately 12" wide by 10" deep by 14" high. Three (3) spare rolls of paper towels compatible with the dispenser shall be furnished to the Owner. Paper towel dispenser shall be Model No. 54338 as manufactured by Georgia Pacific or approved equal.

B. Soap dispenser shall be a push style and wall mounted dispenser capable of holding 2000 mL of hand cleaner. Three (3) spare 2000 mL refills compatible with the dispenser shall be furnished to the Owner. Soap dispenser shall be Model Gojo PRO TDX 2000 or approved equal.

C. Hand sanitizer dispenser shall be a push style and wall mounted dispenser capable of holding 1000 mL of sanitizing gel. Three (3) spare 1000 mL refills compatible with the dispenser shall be furnished to the Owner. Hand sanitizer dispenser shall be Model PURELL NXT Space Saver or approved equal.

2.07 WATER HEATER

A. Water heater shall be a Rheem Model EGSP15 electric point-of-use water heater with a 15 gallon tank capacity. Heater shall have a 120V connection, rated for 1,500 watts to provide a minimum delivered water temperature of 110-degrees F and maximum delivered water temperature of 170-degrees F. Water heater shall have a recovery capacity 6 gallons per hour at a 100-degrees Fahrenheit temperature rise.

B. Water heater shall have the UL/CSA seal of certification and be factory equipped with an CSA/ASME rated temperature and pressure relief valve. Tank(s) interior shall be coated with a high temperature porcelain enamel and furnished with an R-Tech resistored magnesium anode rod rigidly supported. Water heater(s) shall meet or exceed the energy factor requirements of ASHRAE. Tanks shall have a working pressure rating of 150 psi, and shall be completely assembled. Water heater(s) shall be equipped with a copper, resistored, "screw-in" type element. Tank shall be insulated with rigid polyurethane foam insulation. Water heater(s) shall be equipped with a surface mounted thermostat with an integral, manual reset, high limit control. Water heater(s) shall be covered by a three year limited warranty against tank leaks.

C. Heater shall be fitted with integral ¾-inch NPT fittings to eliminate the need for soldering.

D. Heater shall be rated for electrical service as shown on the electrical drawings.

E. Provide 2 gallon water heater expansion tank piped to cold water supply and water heater to ensure completely functional. Expansion tank shall be Amtrol ST-5 or approved equal.

2.08 HOSE BIBBS

A. Hose bibbs shall be solid brass construction, angle pattern, and renewable washer. Sweat copper to standard ¾-inch hose and outlet, NIBCO QT763X, or approved equal.

2.09 HOSE-CONNECTION, BACKFLOW-PREVENTION DEVICES

A. General: ASSE standard, tamper resistant, backflow-prevention devices with ASME B1.20.7, garden-hose threads on outlet.

B. Hose-Connection Vacuum Breakers: ASSE 1011, copper silicon alloy body, with manual drain feature and break away set screw.

C. Provide a Watts Series LFNF8, or approved equal, hose connection backflow preventer on all hose bibbs and on the sink faucet outlet.

2.10 EYEWASH (WALL MOUNTED)

A. Eyewash shall be wall mounted eyewash with a stainless steel 11-inch round bowl, an antimicrobial treated eyewash head to help protect against the growth of mold and mildew on the treated components, and shall feature inverted directional laminar flow which achieves zero vertical velocity supplied by an integral 3.7 gpm flow control, chrome-plated brass stay-open ball valve equipped with stainless steel ball and stem, and chrome-plated brass in-line 50 by 50 mesh water strainer. Eyewash shall include a cast-aluminum chromate protected wall bracket, yellow plastic pop-off dust cover for eyewash head, universal sign, ½-inch IPS inlet, 1¼-inch IPS waste, and a stainless steel dust cover as supplied by the manufacturer. The eyewash shall be Haws Model 7360B-7460B or approved equal.

B. Thermostatic mixing valve shall mix hot and cold water to provide controlled outlet tempered water to eyewash fixture. Thermostatic mixing valve shall employ a thermostatic mixing element to safely temper water supply, reduce all incoming hot water to a maximum of 0.2 GPM in the event the cold water supply is lost, and shall allow a minimum of 10 GPM cold water bypass in the event the water supply becomes interrupted or the thermostatic element fails. Thermostatic mixing valve shall be set to 85 degrees F, and shall be Haws No. 9201EFE, or approved equal.

C. Eyewash and mixing valve shall comply with ANSI Z358.1.

2.11 BACKFLOW PREVENTER

A. Lead free backflow preventer shall be ¾-inch of the reduced-pressure principal type, installed on the existing incoming water service line to the pumping station. Backflow preventer shall be Watts Regulator No. LF909 QT, or approved equal, with strainer and air gap. Repair Kit No. LFRK 909-RT shall be included to provide a complete set of rubber repair parts.

2.12 TOILET

A. The elongated two-piece toilet shall be made of vitreous china, and shall have a flushing system capable of 1.28 gpf. Toilet shall be ADA compliant, Catalog Number K-3817-U as manufactured by Kohler, or approved equal.

B. Toilet shall be equipped with elongated toilet seat, tank cover, trip lever, supply tube and supply stop, accessory packs and all other appurtenances for a complete installation.

C. A stainless steel surface mounted toilet paper holder, including mounting plate and hardware, shall be installed with each toilet furnished. Toilet paper holder shall be Model Number 7305-B as manufactured by American Specialties, Inc., or approved equal.

2.13 WATER PRESSURE REDUCING VALVES

A. A water pressure reducing valve with integral stainless steel strainer shall be installed where water service pressure exceeds 60 psi. The valve shall feature a lead free cast copper silicon alloy body suitable for water service pressures up to 300 psi and shall be adjustable from 25 psi – 75 psi. Pressure reducing valve shall include a gauge tapping and 160 psi gauge, and shall be Watts Series LF25AUB-Z3, or approved equal, for ½”-2” water service lines, or Watts LFN223BS, or approved equal, for 2 ½”-3” water service lines.

B. Provide isolation gate valves on both sides of each pressure reducing valve to permit replacement without draining water distribution system.

2.14 WATER HAMMER ARRESTORS

A. A minimum of one (1) water hammer arrestor shall be installed in the water distribution piping, downstream of the backflow preventer, to protect all plumbing fixtures and piping. Water hammer arrestor shall be Watts Series 15 or approved equal. Additional water hammer arrestors, including size and placement, shall be in accordance with manufacturer’s selection and sizing tables.

B. As necessary, water hammer arrestors used to protect individual fixtures shall be Amtrol Mini-Trol, Watts No. LF150A Series, or approved equal.

C. Provide isolation gate valve with each water hammer arrestor to permit replacement without interruption to water distribution system.

PART 3 - EXECUTION

3.01 PIPING APPLICATION

A. Flanges, unions, keyed couplings, and special fittings may be used, instead of joints indicated.

B. Piping: NPS ¾ to NPS 3, hard copper tube, Type K; wrought-copper fittings; and soldered joints.

C. Piping: NPS ¾ to NPS 3, hard copper tube, Type L; copper fittings; and soldered joints.

3.02 JOINT CONSTRUCTION

A. Make pipe joints according to the following:

1. Copper Tubing Soldered Joints: ASTM B828. Use flushable flux and lead-free solder.

3.03 INSTALLATION

A. Install copper tube and fittings according to CDA's "Copper Tube Handbook".

B. Drain pipe shall be reamed to remove all burrs. Horizontal pipe shall be carefully aligned to assure even pitch. The pipe shall be pitched a minimum of ⅛-inch per foot, unless indicated otherwise. All adaptors from one material to another shall be a standard manufactured product designed for that specific use. Contractor shall not run piping above electrical switchgear.

C. Cleanouts shall be same size as pipe through 4-inch size. Maximum size of cleanouts shall be 4-inch diameter unless larger units are required for testing or special access purposes. Provide cleanouts at locations where deemed advisable. Location of cleanouts as stipulated by applicable code shall be considered as the minimum requirement.

D. Install water heater level and in accordance with manufacturer's written instructions. Arrange unit so that controls and devices needing service are accessible. Arrange piping for easy removal of water heater.

E. Assemble plumbing fixtures, trim, fittings, and other components in accordance with manufacturers' written instructions. Install all fixtures level and plumb.

F. Install off-floor supports, affixed to building substrate, for wall-mounting fixtures. Install wall-mounting fixtures with tubular waste piping attached to supports.

G. Install water-supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind or under fixtures. Install stops in locations where they can be easily reached for operation. If supply stops are not specified or included with fixture, use ball, gate or globe valves.

H. Install trap or tubular waste piping on drain outlet of each fixture and connect to sanitary drainage piping.

I. Seal joints between fixtures and walls and floors using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color.

J. Install each pressure reducing valve in accordance with manufacturer's written installation instructions.

K. Install each water hammer arrestor in accordance with manufacturer's written installation instructions.

3.04 TESTING

A. Water Piping Tests: Fill pipeline 24 hours before testing and apply pressure to stabilize system. Use only potable water.

1. Hydrostatic Tests: Test at not less than 1½ times the 125 psig working pressure for two (2) hours.

2. Increase pressure in 50-psig increments and inspect each joint between increments. Hold at test pressure for one (1) hour; decrease to 0-psig. Slowly increase again to test pressure and hold for one (1) more hour. Maximum allowable leakage is 2 quarts per hour per 100 joints. Remake leaking joints with new materials and repeat test until leakage is within the allowed limits.

3. Prepare and submit reports of testing activities.

B. Testing for drain piping shall include a rough test and final test, in conformance to local plumbing code requirements.

C. Leaks discovered during testing shall not be patched. Threaded or flanged connections shall be either tightened or replaced. Small leaks in welded pipe may be chipped and rewelded.

D. After installation of water heater, test it for leaks. Repair leaks and retest until no leaks exist. After electrical circuitry to water heater has been energized, confirm proper operation. Test and adjust controls. Replace damaged or malfunctioning controls and equipment. Remove and replace water heater if it does not pass tests and inspections and retest. Train Owner's maintenance personnel to adjust, operate, and maintain the water heater.

END OF SECTION

SECTION 15500

HEATING AND VENTILATION EQUIPMENT

PART 1 - GENERAL

1.01 DESCRIPTION

A. This section includes requirements for providing ventilation fans, louvers, dampers, heaters, controls, ducts, grilles and registers, and requisite accessories and appurtenances necessary for furnishing and installing heating and ventilation systems in accordance with the Contract Documents.

B. All work shall be done in accordance with the applicable Codes and Standards.

C. Completely coordinate with work of all other trades.

D. Not all types of heating and ventilation equipment specified herein are necessarily required for this project. Refer to the respective schedules and callouts on the Contract Drawings for the specific types of equipment and quantity of each to be provided.

1.02 QUALITY ASSURANCE

A. All equipment shall be the product of recognized and reputable manufacturers. Equipment shall be locally serviceable and replacement parts shall be readily available.

B. Reference Standards:

1. ASHRAE: American Society of Heating, Refrigeration, and Air Conditioning Engineers.

2. AMCA: Air Movement and Control Association.

3. OSHA: Occupational Safety and Health Administration.

4. SMACNA: Sheet Metal and Air Conditioning Contractor's National Association.

1.03 SUBMITTALS

A. Catalog data, specifications and color selection charts for fans, louvers, dampers, heaters, grilles and registers, and appurtenances.

B. Wiring diagrams, control diagrams and electrical schematic for the operation, control and power supply of the fans, motor operated dampers, and heaters.

C. Layout drawings showing fans, louvers, dampers, ducts, heaters, grilles and registers, supports, and other accessories necessary for a complete ventilation system. Air flow rates shall be included on all layout drawings.

D. Manufacturer's curves or tables for all fans, louvers, dampers, and grilles and registers indicating air flow versus static pressure losses and leakage adjusted to account for bird screen losses.

E. Operation and Maintenance Manual for fans, louvers, dampers, controls and heaters.

F. Manufacturer's installation instructions for all equipment.

1.04 WARRANTY

A. The Contractor shall submit to the Owner a written manufacturer's warranty covering equipment defects and workmanship for each piece of equipment and shall be responsible for repairing or replacing at his own expense, including labor and shipping, all parts defective in material or workmanship for a period of two years from the date Contractor achieves Substantial Completion for the project.

PART 2 - MATERIALS

2.01 GENERAL

A. All fans shall be furnished and installed complete with motors, drives, controls, and accessories as required for satisfactory operation and as herein specified. All fans shall be rated in accordance with the standards of the Air Movement and Control Association (AMCA) and shall bear the AMCA Certificate Rating label unless otherwise specified herein. All fans shall be UL listed, and all rooftop fans shall have an integral NEMA 1 disconnect.

B. All fans shall be statically and dynamically balanced by the manufacturer before shipment.

C. All fans shall be guaranteed to deliver the specified air quantities and pressure when tested in accordance with the latest AMCA standards. Fans shall be quiet in operation, and free from objectionable vibration. All fans shall be provided with either integral or supplementary vibration or sound-absorbing mountings.

D. Fan motors shall be accessible for repairs and maintenance and shaft guards shall be provided in accordance with OSHA standards. TECO-Westinghouse motors are not acceptable.

2.02 CENTRIFUGAL SQUARE INLINE FANS

A. Fan shall be duct mounted, belt driven centrifugal square inline fan; Model SQN-B as manufactured by Loren Cook Company or approved equal.

B. Certifications: Fan shall be UL 705 listed. Fan shall bear the AMCA certified ratings seal for sound and air performance.

C. Construction: The fan shall be of bolted construction utilizing corrosion resistant fasteners. Housing shall be minimum 18-gauge galvanized steel with integral duct collars. Bolted access doors shall be provided on three sides, sealed with closed cell neoprene gasketing. Pivoting motor plate shall utilize threaded L-bolt design for positive belt tensioning. Housing shall be pre-drilled to accommodate universal mounting feet for vertical or horizontal installation. Unit shall bear an engraved aluminum nameplate, which shall indicate design CFM, static pressure, and maximum fan RPM. Unit shall be shipped in ISTA certified transit tested packaging.

D. Wheel: Wheel shall be centrifugal backward inclined, constructed of 100% aluminum, including a precision machined cast aluminum hub. Wheel inlet shall overlap an aerodynamic aluminum inlet cone to provide maximum performance and efficiency. Wheel shall be balanced in accordance with AMCA Standard 204-96, Balance Quality and Vibration Levels for Fans.

E. Motor: Motor shall be premium efficiency, ODP and suitable for use with permanently lubricated sealed ball bearings and furnished at the specified voltage, phase and frequency as shown on the Electrical Drawings.

F. Bearings: Bearings shall be designed and individually tested specifically for use in air handling applications. Construction shall be heavy duty regreasable ball type in a cast iron pillow block housing and selected for a minimum L50 life in excess of 200,000 hours at maximum operating speed.

G. Belts and Drives: Belts shall be oil and heat resistant, non-static type. Drives shall be precision machined cast iron type, keyed and securely attached to the wheel and motor shafts. Drives shall be sized for 150-percent of the installed motor horsepower. The variable pitch motor drive must be factory set to the specified fan RPM.

H. Flexible Duct Connectors: Fans shall be furnished with inlet and outlet flexible duct connectors where indicated on the Contract Drawings and as specified herein. The flexible duct connectors shall be constructed of reinforced neoprene coated fiberglass fabric and 0.032-inch aluminum bands.

I. Accessories: Fan accessories, which shall be furnished in accordance with the fan schedules as shown on the Contract Drawings, are intended to be standard equipment of the specified manufacturer or approved equal.

J. Controls: Fan controls are to be furnished in accordance with the control schematics as shown on Contract Drawings, and as specified herein.

2.03 FIBERGLASS DUCT AXIAL FANS

A. Fan shall be fiberglass belt driven axial fan; Series 35 as manufactured by Hartzell Fan, Inc. or approved equal.

B. Fan shall be constructed in accordance with ASTM D4167 standard specifications for fiber-reinforced plastic fans and blowers to ensure structural integrity. All parts exposed to the gas stream shall be constructed of, or encapsulated in, FRP. Fan construction and installation shall also include conductive layers, screens and grounding lugs to safely control and remove static electricity.

C. The fan housing shall be constructed of polyester resin with an ASTM E84 Class I flame spread rating of 25 or less and shall comply with NFPA Code 91. Interior housing surfaces shall have a synthetic surfacing veil. The fan housing shall be of rugged construction with integrally molded flanged ends.

D. The fan propeller shall be constructed of polyester resin with an ASTM E84 Class I rating of 25 or less. The FRP propeller blades shall have an airfoil design and shall be attached to a FRP hub. The propeller shall be solid fiberglass with an aluminum insert molded into the hub for secure attachment to the shaft. The cap shall be mounted to the hub with silicone sealant and stainless steel cap screws.

E. A polypropylene shaft seal shall be furnished to isolate the drive tube from the air stream gasses. A neoprene gasket shall be furnished between the drive tube and cover plate.

F. Motor: Motor shall be premium efficiency, explosion proof. Motor shall have permanently lubricated sealed ball bearings and furnished at the specified voltage, phase and frequency as shown on the Electrical Drawings.

G. Motor and drive shall be protected by a fiberglass motor cover.

H. Shafts shall be 316 stainless steel, precision turned, ground and polished. The shaft's critical speed shall be at least 125% of the fan's maximum operating speed.

I. Bearings are to be precision anti-friction, self-aligning, flanged design. Bearings shall be designed for an average L-10 life of 50,000 hours when rated at the fan's maximum cataloged operating speed. Bearings shall be protected from the air stream by a fiberglass drive tube mounted on fiberglass supports. Nylon lubrication lines shall extend to unit exterior and shall include grease fittings.

J. Flexible Duct Connectors: Fans shall be furnished with an outlet flexible duct connector to provide a flexible connection between the fan and the exhaust stack as indicated on the Contract Drawings. The flexible duct connector shall be constructed of 316 stainless steel frame and $^{3}/_{16}$" thick EPDM rubber sleeve resistant to aging, ozone and UV rays, as manufactured by BAM Fan Accessories, Inc. or approved equal. All mounting hardware and incidentals shall be 316 stainless steel.

K. Accessories: Fan accessories, which shall be furnished in accordance with the fan schedules as shown on the Contract Drawings, are intended to be standard equipment of the specified manufacturer or approved equal.

L. Controls: Fan controls are to be furnished in accordance with the control schematics as shown on Contract Drawings, and as specified herein.

2.04 LOUVERS

A. 4-inch Stationary Louvers

1. Louvers and dampers shall be installed in combination at the locations shown on the Contract Drawings. Fixed weatherproof louvers with drainable blades shall be Ruskin Manufacturing Company Type ELF 375DXH or approved equal. Performance data shall be included with shop drawings.

2. Louvers shall be stationary drainable type with drain gutters in each blade and downspouts in jambs and mullions. Louvers shall have a minimum of 54-percent free area based on a 48-inch by 48-inch size. Stationary drainable blades shall be contained within a 4-inch frame. Louver heads, jambs, sills, blades, & mullions shall be factory assembled by the louver manufacturer. Louver sizes too large for shipping shall be built up by the contractor from factory assembled louver sections to provide overall sizes required. Louver design shall limit span between visible mullions to 10 feet and shall incorporate structural supports required to withstand a wind load of 20 PSF.

3. Louver frames shall be four inches deep and shall be constructed of 6063-T5 extruded aluminum with 0.125-inch nominal wall thickness. Include downspouts and caulking surfaces.

4. Blades shall be constructed of 6063-T5 extruded aluminum with 0.125-inch nominal wall thickness, positioned at 37½ degree angle and spaced approximately $5^{3}/_{32}$ inches on center.

5. Bird screen of ¾-inch x 0.051-inch expanded, flattened aluminum in removable frame shall be installed on all louvers.

6. Louvers shall be furnished with a Kynar finish.

B. 6-inch Stationary Louvers

1. Louvers and dampers shall be installed in combination at the locations shown on the Contract Drawings. Fixed weatherproof louvers with drainable blades shall be Ruskin Manufacturing Company Type ELF6375DXH or approved equal. Performance data shall be included with shop drawings.

2. Louvers shall be stationary drainable type with drain gutters in each blade and downspouts in jambs and mullions. Louvers shall have a minimum of 57-percent free area based on a 48-inch by 48-inch size. Stationary drainable blades shall be contained within a 6-inch frame. Louver heads, jambs, sills, blades, & mullions shall be factory assembled by the louver manufacturer. Louver sizes too large for shipping shall be built up by the contractor from factory assembled louver sections to provide overall sizes required. Louver design shall limit span between visible mullions to 10 feet and shall incorporate structural supports required to withstand a wind load of 20 PSF.

3. Louver frames shall be six inches deep and shall be constructed of 6063-T5 extruded aluminum with 0.125-inch nominal wall thickness. Include downspouts and caulking surfaces.

4. Blades shall be constructed of 6063-T5 extruded aluminum with 0.125-inch nominal wall thickness, positioned at 37-½ degree angle and spaced approximately $5^{29}/_{32}$ inches on center.

5. Bird screen of ¾-inch x 0.051-inch expanded, flattened aluminum in removable frame shall be installed on all louvers.

6. Louvers shall be furnished with a Kynar finish.

2.05 DAMPERS

A. Thin Line Control Dampers

1. Thin line control damper shall be Ruskin Manufacturing Company Type CD40 or approved equal. Performance data shall be included with shop drawings.

2. Damper frame shall be four inches deep and be constructed of 6063-T5 extruded aluminum with mounting flanges on both sides of frame.

3. Damper blades shall have air foil shape and be constructed of 6063-T5 extruded aluminum with integral structural reinforcing tube running full length of each blade. Blade edge seals shall be extruded vinyl double edge design with inflatable pocket which enables air pressure from either direction to assist in blade to blade seal off. Blade seals shall be mechanically locked in extruded blade slots. Adhesive or clip-on type seals are unacceptable.

Bearings shall be non-corrosive molded synthetic. Axles shall be hexagonal positively locked into the damper blades and linkage. Linkage shall be concealed in the frame, out of the airstream.

4. Electric actuators for dampers shall be properly sized to control the respective dampers without overloading. Position indicators shall be furnished and installed on each actuator. Actuators shall be totally enclosed, dustproof, and shall include mounting brackets suitable for mounting on the damper frame. Actuator shall be furnished at the specified voltage, phase and frequency and shall include a spring-return-to-damper position as shown on the Contract Drawings. Actuators shall be Invensys MA400 Series or approved equal.

5. Dampers shall be furnished with an anodized finish.

B. Low Leakage Control Dampers

1. Low leakage control damper shall be Ruskin Manufacturing Company Type CD60 or approved equal. Performance data shall be included with shop drawings.

2. Damper frame shall be five inches deep and be constructed of 16 gage galvanized steel hat channel reinforced with corner braces for structural strength.

3. Damper blades shall be galvanized steel air foil shaped, double skin construction of 14 gage equivalent thickness, with a nominal width of 6 inches. Blade edge seals shall be extruded vinyl for ultra-low leakage and shall be mechanically attached to blade edge. Bearings shall be self-lubricating stainless steel sleeve, turning in extruded hole in frame. Axles shall be a minimum ½-inch diameter plated steel with a hex-shaped, mechanically attached to blade. Linkage shall be concealed out of airstream, within the damper frame to reduce pressure drop and noise.

4. Electric actuators for dampers shall be properly sized to control the respective dampers without overloading. Position indicators shall be furnished and installed on each actuator. Actuators shall be totally enclosed, dustproof, and shall include mounting brackets suitable for mounting on the damper frame. Actuator shall be furnished at the specified voltage, phase and frequency and shall include a spring-return-to-damper position as shown on the Contract Drawings. Actuators shall be Invensys MA400 Series or approved equal.

5. Epoxy coating is required when used within a wetwell ventilation system.

2.06 HEATERS

A. Unit Heaters

1. Unit heaters shall be forced air with totally enclosed fan motor, power rating and service as shown on the Contract Drawings. Unit heaters shall be Q-Mark Type QWD or approved equal.

2. The unit heater case shall be constructed of heavy 16 gauge type 304 stainless steel for corrosion resistance and assembled with stainless steel hardware. The heating elements shall be corrosion resistant 300 stainless steel sheathed with 316 stainless steel fins for maximum heat dissipation. The elements are to be attached to junction box with leak resistant stainless steel fittings. A stainless steel combination wall and ceiling swivel type mounting bracket to be supplied with the unit heater.

3. The fan and motor assembly shall include a totally enclosed, permanently lubricated, ball bearing motor, epoxy coated for corrosion resistance. The fan shall be aluminum with corrosion resistant coating, directly connected to the motor, and be dynamically balanced. An epoxy sealed thermal fan delay shall be provided to allow the fan to continue to operate after heating thermostat has been satisfied to maximize transfer of generated heat to space being heated. The fan and motor shall be protected by an adjustable louvered outlet grille to direct flow up or down, painted with one coat zinc chromate primer and two coats of corrosion resistant paint.

4. The controls shall be factory prewired and tested and enclosed in a NEMA 4X molded fiberglass control enclosure mounted beneath the heater cabinet. The control center shall include contactors, automatic reset over-temperature protector, fan delay relay, motor contactor and fused transformer for 24V control circuit. Terminal blocks shall be included for remote thermostat connection.

5. Unit heaters shall have a mode switch accessible from outside the NEMA 4X enclosure to permit air flow with or without energizing the heating elements, a pilot light to indicate when heating elements are energized, internal fusing, manual reset switch, built in over temperature protection via an automatic reset thermal cutout, and ON/OFF disconnect switch.

6. Unit heaters shall have a heater manufacturer’s integral thermostat with a temperature range of 40 to 90-degrees F.

7. All unit heaters shall be UL listed for corrosive areas and NEMA 4X wash down requirements and meet the requirements of the National Electrical Code. Electrical components for unit heaters shall be listed and labeled by UL.

2.07 CONTROLS

A. Thermostats

1. Thermostats for ventilation fans shall be wall-mounted on a 1-inch thick insulating board at the locations shown on the Contract Documents and installed at a height of five feet six inches above the finished floor.

2. Thermostats for ventilation fans shall be a line voltage thermostat, with single pole, single throw (SPST), hydraulic action close on rise temperature control, and a switch mechanism rating for 16 ampere full load at 120 volts. Thermostats shall have a coiled bulb to indicate temperature within the space, an operating range between 20 degrees F to 90 degrees F, and an adjustable differential range between 3 degrees F to 20 degrees F. Thermostats shall be White Rodgers Model 201-8 or approved equal.

B. Freezestats

1. Freezestat for ventilation fans shall be wall-mounted at location shown on the contract documents and shall be installed at a height of five feet six inches above the finished floor. Freezestat shall have adequate capillary length to mount bulb style temperature sensing element to the exterior of the pumping station. Temperature sensing element shall be protected from direct sunlight and outdoor elements, while still allowing accurate ambient air temperatures to be measured. The setting shall be visible without removing the cover. Freezestat shall be White Rodgers Model 1609 or approved equal.

2. Freezestat shall have a range of -30 degrees F to 90 degrees F, an adjustable differential from 3.5 to 40 degrees F, and a switch mechanism rating for 16 ampere full load at 120 volts. Switch action shall close on rise.

2.08 DUCT

A. Metal Duct

1. All drywell and operating room ventilation fan ducts shall be metal. Comply with SMACNA' "HVAC Duct Construction Standards—Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

2. Metal ducts shall be aluminum sheet, ASTM B209, alloy 3003, temper H14; with standard, 1-side bright finish.

3. Tie rods shall be galvanized steel, ¼-inch minimum diameter for lengths 36-inches or less; ⅜-inch minimum diameter for lengths longer than 36-inches.

B. Fiberglass Reinforced Plastic (FRP) Duct

1. All wetwell ventilation fan ducts shall be FRP. The resin used shall be a commercial grade thermoset that has either been evaluated in a laminate test in accordance with ASTM D3982, Practice C581, or that has been determined by previous documented service to be acceptable for the service conditions. The resin may contain fillers or pigments in accordance with C582.

2. A thixotropic agent may be added up to 5% by weight of resin.

3. Corrosion barrier shall consist of the conductive inner surface followed by the interior layer which has a minimum total calculated thickness of 0.096-inches.

4. Inner surface shall have a surfacing veil having 0.010- to 0.020-inches calculated thickness. Interior layer shall have a minimum of two plies of 1.5 ounce/square foot chopped-strand mat or chopped roving equivalent with a compatible sizing system with approximately 75% resin and 0.086-inch minimum calculated thickness. Fiber length shall be ½-inch minimum to 2-inch maximum.

5. Structural layer shall consist of chopped-strand mat plies of nominally 1.5 ounces/square foot and have a ½-inch minimum to 2-inch maximum fiber length or shall consist of a chopped roving equivalent in the spray-up method. When necessary, woven-roving plies shall be used and shall consist of 24 ounces/square yard with a five by four weave.

6. Duct construction and installation shall also include conductive layers, screens and grounding lugs as necessary, to safely control and remove static electricity.

2.09 TURNING VANES

A. Manufactured Turning Vanes for Metal Ducts: Curved blades of aluminum sheet; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.

B. Manufactured Turning Vanes for Nonmetal Ducts: Fabricate curved blades of resin-bonded fiberglass with acrylic polymer coating; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.

C. Vane Construction: Single wall for ducts up to 48 inches wide and double wall for larger dimensions.

2.10 INTAKE/EXHAUST STACKS

A. The stack shall be fiberglass reinforced vinyl ester and shall be constructed of the same material as the FRP duct.

B. Stack shall be designed to be connected to the concrete top slab or exhaust fan, as shown, and shall be flange mounted to the concrete slab or stack support chair. Stainless steel bands and mounting brackets shall be provided and used to attach the stack to the adjacent building wall but shall not be considered for lateral or vertical support of the FRP stack. The stack shall be designed to withstand a 100 MPH wind load. The stack shall be supported independently of the exhaust fan so that the fan can be removed for routine maintenance. The fabricator shall provide stack design calculations, signed and sealed by a Professional Engineer registered in the State of Maryland. Calculations shall include the design of the Type 316 stainless steel stack support chair.

C. The exhaust stack shall be furnished with an FRP stackhead, which shall be provided by the stack manufacturer.

D. Stack construction and installation shall also include conductive layers, screens and grounding lugs as necessary, to safely control and remove static electricity.

2.11 GRILLES & REGISTERS

A. General Purpose

1. Construction of general purpose grilles and registers shall consist of extruded aluminum blades, and an extruded aluminum frame having 1¼-inch wide border and mitered corners. Each Grille and register shall have countersunk screw holes for surface mounting, an aluminum opposed blade volume damper, and stainless steel mounting screws. Grilles and registers shall have a clear or satin anodized finish.

2. Supply grilles and registers in all areas except the wetwell shall have individually adjustable blades spaced ¾-inch on centers in the horizontal. Supply grilles and registers shall be Tuttle & Bailey Model A50, Krueger Model 580 or approved equal.

3. Return grilles and registers in all areas except the wetwell shall have fixed blades spaced ¾-inch on centers in the vertical, with a blade deflection angle of 0-degree. Return grilles and registers shall be Tuttle & Bailey Model A80, Krueger Model S580 or approved equal.

B. Corrosion Resistant

1. Construction of corrosion resistant grilles and registers shall consist of 316 stainless steel blades, and a 316 stainless steel frame having 1¼-inch wide border and mitered corners. Each Grille and register shall have countersunk

screw holes for surface mounting, a heavy gauge stainless steel opposed blade volume damper, and stainless steel mounting screws. Grilles and registers shall have a satin polished finish.

2. Supply grilles and registers in the wetwell shall have individually adjustable blades spaced ¾-inch on centers in the horizontal. Supply grilles and registers shall be Tuttle & Bailey Model T50SS, Krueger Model 980 or approved equal.

3. Return grilles and registers in the wetwell shall have fixed blades spaced ¾-inch on centers in the vertical, with a blade deflection angle of 0-degree. Return grilles and registers shall be Tuttle & Bailey Model T80SS, Krueger Model 9S80 or approved equal.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install all items to be furnished under this section of the Specifications in accordance with the manufacturer's instructions and as required herein using stainless steel anchors and fasteners.

B. All apparatus housings and other items shall be erected with all runs straight and true, smooth on the inside with neatly finished air-tight joints. All equipment shall be securely anchored to the building or other support means with reinforcing, as required to be completely free from vibration.

C. The inside of all equipment in the ventilation system shall be cleaned of metal cuttings, paper, loose pieces of insulation and all other debris.

D. Exterior joints around louvers shall be caulked in accordance with Section 07900.

E. Fabricate, install and support metal ducts according to SMACNA’s “HVAC Duct Construction Standards—Metal and Flexible”.

F. Fabricate, assemble, install and support FRP ducts according to SMACNA’s “Thermoset FRP Duct Construction Manual.”

G. Support horizontal ducts within 24-inches of each elbow and within 48-inches of each branch intersection. Support vertical ducts at maximum intervals of 15-feet and at each floor or slab.

H. Make duct connections to equipment with flexible connectors. Comply with SMACNA’s “HVAC Duct Construction Standards—Metal and Flexible” for branch, outlet and inlet, and terminal unit connections.

I. Fans controls that include a thermostat for automatic operation shall provide for ventilation at a fixed, non-adjustable setting. Thermostat shall be fully wired and adjusted to energize fan(s) when space temperature rises to 90-degrees F or higher. On a fall in temperature, fans shall de-energize at and below 85-degrees F. Provide all wiring and devices required for operation. Thermostat shall be mounted on a 1-inch thick insulating board.

J. Fan controls that include thermostats and a VFD for automatic operation shall provide for ventilation at two adjustable set points. Thermostat #1 shall be fully wired and adjusted to energize fan(s) at an adjustable flow rate when space temperature rises to 90-degrees F or higher. Thermostat #2 shall be fully wired and adjusted to energize fan(s) at full flow rate when space temperature rises to 95-degrees F or higher. On a fall in temperature, thermostat #2 shall de-energize at and below 90-degrees F. On a fall in temperature, thermostat #1 shall de-energize at and below 85-degrees F. Provide all wiring and devices required for operation. Thermostats shall be mounted on a 1-inch thick insulating board.

K. Fan controls that include a cycle timer shall be set to provide a minimum of four (4) complete air changes per hour. During periods when temperatures drop below 45°F, the cycle timer(s) shall be de-energized by means of a freezestat.

L. Fan controls that include integration with the pump room switches shall operate the fans continuously any time a light is on.

M. Wetwell exhaust fan(s) that are constant speed shall be energized by a wall switch and shall operate the fan at full speed anytime the switch is activated prior to entry into the wetwell. Fan shall also include a cycle timer that is set to provide a minimum of two (2) complete air changes per hour.

N. Adjust supply grille blades to provide a uniform air distribution to the space being ventilated.

3.02 TESTING, ADJUSTING AND BALANCING

A. Dampers shall be tested once from full open to closed position. Blades shall be checked for binding and motors checked for bracket movement.

B. Fans shall be tested in manual and automatic positions. Check for excessive vibration, noisy operation, or motor overheating. Check motor current against rated amperes.

C. Heaters shall be started up and operated to demonstrate capability and compliance with all requirements.

D. All ductwork shall undergo leakage tests at 2-inches water gauge. Total leakage from each system shall not exceed 1-percent of the total system air handling capacity of the system. If the system is tested in sections, the total leakage will be the sum of the leakage from the individual sections. Repair all leaks which are

audible, regardless of leakage rate of the system as a whole, by remaking the entire defective joint or seam. Spot sealing of ducts in place is unacceptable.

E. Review all system designs and equipment manufacturers' data and become completely familiar with the work before proceeding.

F. Inspect all systems and determine that the work is complete and ready for testing and balancing before proceeding.

G. System balancing shall be performed by an independent test and balance agency that specializes in, and whose business is limited to, the testing and balancing of mechanical systems. The agency must be fully certified by the Associated Air Balance Council and have an engineer certified by the National Examining Board. All final reports shall be signed and officially stamped by the certified testing and balancing engineer.

H. Furnish complete and up-to-date contract documents, shop drawings, installation and coordination drawings, submittal data, and other information to the testing and balancing agency so that the work is performed using all required system and equipment data.

I. Plan and schedule testing and balancing at required time during construction. Review all plans, schedules, operations, and procedures with the Engineer before proceeding. Make system layouts and diagrams where required.

J. Prepare all systems for testing and balancing.

K. Coordinate the testing and balancing work with the work of other trades.

L. Perform all testing and balancing in complete accordance with AABC National Standards for Field Measurement and Instrumentation, Form No. 81266, Volume One.

M. Furnish all test instruments and equipment. All instruments shall have been calibrated within six (6) months prior to use and shall be checked for accuracy prior to and during the work.

N. Test and balance all ventilation systems. The work shall include but not be limited to the following:

1. Leak-test all ductwork and air distribution systems.

2. Balance and adjust all air distribution systems to within 5% of design air quantities.

3. Adjust all fans to required speeds for design air flow.

4. Adjust all air terminal devices for proper throw, distribution, and quiet operation.

5. Test capacity and performance of all equipment and adjust to design conditions.

6. Operate and test all systems under all sequences of operation and adjust equipment and controls for efficient and stable operation.

O. After testing capacity and performance of all equipment, make all necessary adjustments to design conditions.

P. Make all necessary adjustments and repairs to the work, correcting any malfunctions or deficiencies which are disclosed by testing and balancing.

Q. Report all malfunctions of deficiencies to the Contractor so that corrective action can be taken. Repeat tests where required until design conditions are achieved.

R. Retest or rebalance the systems as required during the warranty period.

S. Maintain complete and accurate records of all tests results showing initial and final conditions. Record all temperatures, pressures, flows, speeds, current, voltages, control settings, ambient conditions, time, date and other pertinent data.

T. Where systems or equipment cannot be balanced or adjusted to design conditions, determine cause and submit complete report to the Engineer.

U. Upon completion of the work and before final acceptance, submit three (3) copies of complete testing and balancing report to the Engineer showing all recorded data and results.

V. If, in the opinion of the Engineer, test results or portions thereof are incomplete or inconclusive, repeat necessary portions of the work to the satisfaction of the Engineer.

END OF SECTION

SECTION 15700

MINI-SPLIT HEAT PUMP AIR CONDITIONING SYSTEM

PART 1 - GENERAL

1.01 DESCRIPTION

A. This section includes requirements for providing a split system series heat pump air conditioning system. The system shall consist of a compact, wall mounted indoor fan coil section with wireless remote controller and a horizontal discharge outdoor unit which shall be of an inverter driven heat pump design, and include all appurtenances as required for a complete and fully functional system.

B. Refer to the respective schedules and callouts on the Contract Drawings for the specific types of equipment and quantity of each to be provided.

1.02 QUALITY ASSURANCE

A. All equipment shall be the product of recognized and reputable manufacturers. Equipment shall be locally serviceable and replacement parts shall be readily available.

B. The system components shall be tested by a Nationally Recognized Testing Laboratory (NRTL) and shall bear the ETL label.

C. All wiring shall be in accordance with the National Electrical Code (N.E.C.) and local codes, as required.

D. The units shall be rated in accordance with Air-conditioning Heating, Refrigeration Institute's (AHRI) Standard 240 and bear the AHRI Certification label.

E. The units shall be manufactured in a facility registered to ISO 9001 and ISO 14001, which is a set of standards applying to product and manufacturing quality and environmental management and protection set by the International Standard Organization (ISO).

F. A dry air holding charge shall be provided in the indoor unit.

G. System efficiency shall meet or exceed 20.5 SEER.

H. Indoor and outdoor units shall be stored and handled according to the manufacturer's recommendations.

I. The controller shall be shipped separately and shall be able to withstand 105°F storage temperatures and 95% relative humidity without adverse effect.

1.03 SUBMITTALS

A. Catalog data, specifications and selection charts for indoor and outdoor units, including controller.

B. Wiring diagrams, control diagrams and electrical schematic for the operation, control and power supply of the ductless mini-split system.

C. Layout drawings showing outdoor unit, indoor unit, supports, refrigeration piping, condensate piping, and other accessories necessary for a complete installation.

D. Operation and Maintenance Manual.

E. Manufacturer's installation instructions for all equipment.

F. Bracket supporting hardware and anchorage system design and product literature.

G. Manufacturer's curves or tables for plotting total capacity, exterior temperatures, sensible heat capacity and indoor dry bulb and wet bulb temperatures.

1.04 WARRANTY

A. The Contractor shall submit to the Owner a written manufacturer’s warranty covering parts and equipment defects for a period of five years from the date Contractor achieves Substantial Completion for the project. The compressor shall have an extended warranty of seven (7) years from date of installation.

PART 2 - MATERIALS

2.01 GENERAL

A. The outdoor unit shall be compatible with the indoor unit. The connected indoor unit capacity shall be of the same capacity as the outdoor unit.

B. The outdoor unit must have the ability to operate over the full capacity range with a maximum height difference of 50 feet, and have refrigerant tubing length of up to 100 feet (with a maximum number of 10 bends) between the indoor and outdoor units.

C. Outdoor unit shall be pre-charged with R-410a refrigerant for a minimum of 33 feet of refrigerant tubing.

D. All refrigerant lines between outdoor and indoor units shall be of annealed, refrigeration grade copper tubing, ACR Type, meeting ASTM B280 requirements, individually insulated in twin-tube, flexible, closed-cell, CFC-free (ozone depletion potential of zero), elastomeric material for the insulation of refrigerant pipes and tubes with thermal conductivity equal to or better than 0.27 BTU-inch/hour per Sq Ft

/ °F, a water vapor transmission equal to or better than 0.08 Perm-inch and superior fire ratings such that insulation will not contribute significantly to fire and up to 1" thick insulation shall have a Flame-Spread Index of less than 25 and a Smoke-development Index of less than 50 as tested by ASTM E84.

E. All refrigerant connections between outdoor and indoor units shall be flare type.

F. Condensate drain line shall be SCH 40 PVC and sized in accordance applicable codes. Size piping and provide cleanout, traps and vents, insulation, and condensate switches as required by applicable codes

G. Performance:

Manufacturer	Mitsubishi
Outdoor Unit Model Number	MUZ-GL24NA
Indoor Unit Model Number	MSZ-GL24NA
Rated Cooling Capacity	22,400 Btu/h
Cooling Capacity Range	8,200 – 31,400 Btu/h
Sensible Heat Factor	0.75
SEER	20.5
Rated Heating Capacity @ 47°F	27,600 Btu/h
Total Power Watts (Heating) @ 47°F	2,340 W
Rated Heating Capacity @ 17°F	24,600 Btu/h

H. Operating Range:

Operating Range		Indoor Intake Air Temperature	Outdoor Intake Air Temperature
Cooling	Maximum	D.B. 90°F/W.B. 73°F	D.B. 115°
	Minimum	D.B. 67°F/W.B. 57°F	D.B. 14°F
Heating	Maximum	D.B. 80°F	D.B. 75°F
	Minimum	D.B. 70°F	D.B. -4°F

2.02 OUTDOOR UNIT

A. Unit Cabinet:

1. The unit cabinet casing shall be fabricated of galvanized steel, bonderized, finished with an electrostatically applied, thermally fused acrylic or polyester powder coating for corrosion protection. Assembly hardware shall be cadmium plated for weather resistance. Cabinet color shall be Munsell 3Y 7.8/1.1.

2. Mounting feet shall be provided and shall be welded to the base of the cabinet and be of sufficient size to afford reliable equipment mount and stability. Cabinet mounting and construction shall be sufficient to withstand

155 MPH wind speed conditions. Provide heavy duty stainless steel mounting support designed to support 500 lbs and for mounting to the exterior pump station wall. Mounting, support, and hardware shall be provided and installed by the Contractor to meet Hurricane Code Conditions.

3. Easy access shall be afforded to all serviceable parts by means of removable panel sections.

B. Fan:

1. The unit shall be furnished with a direct drive, high performance propeller type fan.

2. The fan motor shall be a direct current (DC) motor and shall have permanently lubricated bearings.

3. The fan motor shall be mounted with vibration isolation for quiet operation.

4. The fan shall be provided with a raised guard to prevent contact with moving parts.

5. The outdoor unit shall have horizontal discharge airflow.

6. Outdoor unit sound level shall not exceed 55 dB.

C. Coil:

1. The outdoor unit coil shall be of nonferrous construction with lanced or corrugated plate fins on copper tubing.

2. The coil shall be protected with an integral guard.

3. Refrigerant flow from the outdoor unit to the indoor unit shall be regulated by means of an electronically controlled, precision, linear expansion valve.

D. Compressor

1. The compressor shall be a high performance, hermetic, inverter driven, variable speed, dual rotary type.

2. The compressor motor shall be direct current (DC) type equipped with a factory supplied and installed inverter drive package.

3. The outdoor unit shall be equipped with a suction side refrigerant accumulator.

4. The compressor will be equipped with internal thermal overload protection.

5. The compressor shall be mounted to avoid the transmission of vibration.

E. Electrical:

1. Power supply shall be furnished at the specified voltage, phase and frequency as shown on the Contract Drawings.

2. A 12 to 24 volt DC data stream shall communicate between the units providing all necessary information for full function control.

3. Power for the indoor unit shall be supplied from the outdoor unit using 3-wire, 14 gauge AWG conductors plus ground wire.

F. The outdoor unit shall be equipped with Pulse Amplitude Modulation (PAM) compressor inverter drive control for maximum efficiency with minimum power consumption.

G. The outdoor unit shall be completely factory assembled, piped, and wired. Each unit must be test run at the factory.

H. Outdoor unit shall be Model MUZ-GL Series as manufactured by Mitsubishi Electric, or approved equal.

2.03 INDOOR UNIT

A. The indoor unit shall be factory assembled, wired and tested. Contained within the unit shall be all factory wiring, piping, control circuit board, fan and fan motor. The unit shall have a self-diagnostic function, 3-minute time delay mechanism, and an auto restart function after power interruption. Indoor unit shall be purged with dry air before shipment from factory.

B. Unit Cabinet:

1. The casing shall have a smooth front, white finish - Munsell 1.0Y 9.2/0.2.

2. Multidirectional drain connection and refrigerant piping, offering three (3) direction pipe alignments for all refrigerant piping and two (2) direction pipe alignments for condensate draining.

3. There shall be a separate, metal installation-plate that secures the indoor unit firmly to the wall. The installation-plate shall be securely attached to the wall using appropriate anchor method. Contractor shall determine the best method and be responsible for proper mounting of the installation plate to the wall.

C. Fan:

1. The indoor unit fan shall be an assembly with a line-flow fan direct driven by a single motor.

2. The fan shall be statically and dynamically balanced and be powered by a motor with permanently lubricated bearing.

3. Manual adjustable guide vanes shall be provided with the ability to change the airflow from side to side (left to right).

4. An integral, motorized, multi-position, horizontal air sweep flow louver shall provide for uniform air distribution, up and down. Five (5) positions plus Auto and Swing shall be provided, controlled from the remote controller.

5. The indoor fan shall operate at one of five (5) speeds: Super High, High, Medium, Low, and Quiet plus Auto Fan Mode. All speeds shall be selected from the remote controller.

6. The indoor fan shall be an assembly with a turbo fan direct driven by a single motor.

D. Filter:

1. Return air shall be filtered by means of (2) easily removable, washable Nano Platinum Filters and an Anti-Allergy Enzyme Filter shall be filtered by means of a long-life washable filter.

E. Coil:

1. The indoor coil shall be of nonferrous construction with smooth plate fins on copper tubing.

2. The tubing shall have inner grooves for high efficiency heat exchange.

3. All tube joints shall be brazed with silver alloy.

4. The coils shall be pressure tested at the factory.

5. A sloped, condensate pan and drain shall be provided under the coil.

6. A drain pan level switch (SS610E), designed to connect to the control board, shall be provided and installed on the condensate pan to prevent condensate from overflowing. The unit shall include a condensate lift mechanism that will be able to raise drain water 19" above the condensate pan.

7. Both refrigerant lines between the indoor unit and outdoor unit shall be fully insulated.

F. Electrical:

1. The electrical power of the indoor unit shall be supplied by the outdoor unit allowing the indoor unit to be powered and controlled directly from the outdoor unit, providing both primary power and integrated, by-directional, digital control signal without additional connections.

2. The indoor units shall not have any supplemental or "back-up" electrical heating elements.

3. Indoor unit shall be Model MSZ-GL as manufactured by Mitsubishi Electric, or approved equal.

G. Indoor unit sound level shall not exceed 53 dB(A) at the highest fan speed and 34 dB(A) at the lowest fan speed.

2.04 SYSTEM CONTROL

A. General. The unit shall have a wireless handheld remote controller to perform input functions necessary to operate the system.

1. The wireless handheld controller shall have a Power On/Off switch, Mode Selector – Auto, Cool, Heat, Dry Modes - Temperature Setting, Timer Control with Clock, Fan Speed Select and Vane / Airflow Direction selector. Controller shall have a programmable Smart Set button for pre-selected Temperature, Fan Speed, and Vane position settings.

2. The indoor unit shall perform Self-diagnostic Function and Check Mode switching.

3. Temperature changes shall be by 1ºF increments with a range of 61 - 88ºF (16-31ºC).

4. The microprocessor located in the indoor unit shall have the capability of sensing return air temperature and indoor coil temperature, receiving and processing commands from the wireless or a wired controller, providing emergency operation and controlling the outdoor unit.

5. The system shall be capable of automatically restarting and operating at the previously selected conditions when the power is restored after power interruption.

6. Control system shall control the continued operation of the air sweep louvers, as well as provide On/Off, System/Mode function.

B. Wired Remote Controller. The Wired Remote Controller (PAR-40MAAU) shall be provided to include a MAC-334IF-E MA Series Terminal Interface for communications, which will be connected to the indoor unit control board on connector CN105. A two (2) conductor, stranded, 22 AWG twisted pair, jacketed cable shall connect the MAC-334IF-E to the PAR-40MAAU wall controller. Connection shall not be polarity sensitive and controller wire shall not exceed 33 feet (10m) length.

1. The wired remote controller shall be approximately 5” x 5” in size and white in color with a light-green LCD display. There shall be a built-in weekly timer with up to 8 pattern settings per day. The controller shall consist of an On/Off button, Increase/Decrease Set Temperature buttons, a Cool/Auto/Fan/Dry mode selector, a Timer Menu button, a Timer On/Off button, Set Time buttons, a Fan Speed selector, a Ventilation button, a Test Run button, and a Check Mode button. The controller shall have a built-in temperature sensor. Temperature shall be displayed in either Fahrenheit (°F) or Celsius (°C), and temperature changes shall be by increments of 1°F (0.5°C). The PAR-40MAAU shall have the capability of controlling up to a maximum of 16 systems, as a group with the same mode and set-point for all, at a maximum developed control cable distance of 1,500 feet (500 meters). Contractor shall provide all wiring and conduit as required to the wired remote controller.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install all items to be furnished under this section of the Specifications in accordance with the manufacturer's instructions and as required herein using stainless steel anchors and fasteners.

B. Install units level and plumb.

C. Install outdoor unit using manufacturer's heavy duty wall mounting brackets securely fastened to building structure. Install wall mounting bracket in accordance with the manufacturer's recommendations.

D. Install indoor unit to precast concrete building interior wall in accordance with manufacturer’s installation instructions.

E. Install refrigerant piping according to ASHRAE 15, with piping at right angles or parallel to building walls. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings. Piping shall be installed free of sags and bends.

F. Install condensate piping with adequate fall from the indoor unit to an exterior wall. Condensate piping shall be extended outdoors and down the exterior side of the

wall to 3 inches above finished grade. Install condensate drain in accordance with all applicable codes.

G. Provide hangers and supports to secure the piping to the structure. Hangers and supports shall be compatible with the piping.

3.02 CONNECTIONS

A. Piping installation requirements shall be in accordance with the manufacturer's requirements.

B. Install piping adjacent to unit to allow service and maintenance.

C. Ground equipment and make electrical connections in accordance with the Contract Documents.

3.03 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.

B. Perform the following field tests and inspections and prepare test reports:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.

2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

C. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Provide written certification that the installation is per the manufacturer's installation requirements and is acceptable for use.

E. Remove and replace malfunctioning units and retest as specified above.

3.04 STARTUP SERVICE

A. Complete installation and startup checks according to manufacturer's written instructions.

3.05 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION

SECTION 16010

ELECTRICAL GENERAL REQUIREMENTS

PART 1 - GENERAL

1.01 DESCRIPTION

A. Work Included:

1. All items of labor, materials and equipment, not specified in detail or shown on drawings but necessary for complete installation and proper operation of work described or implied, shall be furnished and installed.

2. Test all electrical conductors, after completion of installation of wiring and apparatus, to insure continuity, proper splicing, freedom from grounds, except "made grounds" and those required for protection and insulation resistance. Use testing instruments, i.e. megger. Activation of each circuit will be required as final test. Testing shall be done at no additional expense to the Owner.

3. Drawings are indicative of work to be installed but do not indicate all bends, fittings, boxes, etc. that will be required in this Contract. The structural and finished conditions of the project shall be investigated prior to construction.

4. Coordinate work to avoid interferences between piping, ducts, equipment, architectural or structural features.

5. Visit the site to determine actual conditions. No extra compensation will be allowed by failure to determine existing conditions.

B. Additional Circuits:

1. A sum of money shall be included in the Lump Sum Bid for the installation of two (2) additional circuits. Each additional circuit shall include the following:

a. 50’ of 3/4” PVC conduit, and associated fasteners and connectors.
b. 150’ of #12 THHN/THWN wire
c. (1) PVC outlet box/pull box/junction box
d. 6’ of 3/4" flexible, liquid-tight conduit
e. Final connections to motor, receptacle, lighting control switch, instrument control or power wiring circuit, etc.

1.02 QUALITY ASSURANCE

A. Regulations, Standards and Publications:

ANSI	American National Standards Institute, Inc.
ASTM	American Society for Testing and Materials
BOCA	Building Officials and Code Administrators
IEEE	Institute of Electrical and Electronic Engineers
ISA	International Society of Automation
IPCEA	Insulated Power Cable Engineers Association
NEC	National Electrical Code of National Fire Protection Association
NEMA	National Electrical Manufacturers Association
NESC	National Electrical Safety Code
UL	Underwriters' Laboratories

1. The installation must comply with all Federal and State, municipal or other authority's laws, rules and/or regulations.

2. Electrical inspections shall be made by the Middle Department Inspection Agency, or equal. The cost of the inspections shall be paid by the Contractor.

3. All electrical equipment and its components and materials shall meet all applicable UL criteria and bear the appropriate label of the Underwriters' Laboratory.

4. All electrical equipment or apparatus of any one system shall be of the same quality as produced by one or more manufacturers, suitable for use in a unified system. The term "manufacturer" shall be understood as applying to a reputable firm who assumes full responsibility for its products.

1.03 SUBMITTALS

A. Shop Drawings:

1. All shop drawings shall be submitted to the Engineer for review. All shop drawing submittals shall clearly indicate, using arrows and/or highlighting on all copies, which item(s) are being submitted and that each item being submitted is in compliance with all requirements on the drawings and in these specifications. All pertinent specification and drawing requirements shall be indicated on the shop drawings. If incorrect, they shall be resubmitted in quantity according to Contract conditions until satisfactory. Work shown on shop drawings shall not be executed until such drawings are approved. Electrical items shall not be installed until final approval of the shop drawings has been given by the Engineer.

2. See specific sections for a breakdown of shop drawing items.

3. Submit certification that all equipment is UL listed.

4. Shop drawings shall indicate adequate clearance for operation, maintenance and replacement of operating equipment devices.

5. This list does not necessarily include all items of shop drawings required. The Engineer reserves the right to request additional shop drawings.

B. Installation, Operation and Maintenance Manuals:

1. Submit required number of installation, operation and maintenance manuals for all equipment being provided for the electrical system. These manuals shall be submitted in 3-ring loose-leaf binders and shall be complete, neat, orderly and indexed.

2. The installation, operation and maintenance manuals shall include a copy of the approved shop drawings for all electrical items installed on the project.

1.04 PRODUCT DELIVERY, HANDLING AND STORAGE

A. Product Handling:

1. Deliver all materials in good condition. Store in dry place, off ground, and keep dry at all times.

B. Protection of Installation:

1. All unfinished installations, construction materials and equipment shall be protected during construction.

PART 2 - PRODUCTS

2.01 SEE SPECIFIC SECTIONS FOR PRODUCTS

PART 3 - EXECUTION

3.01 INSTALLATION

A. Protection of Installation:

1. All equipment shall be protected during construction. All damaged equipment caused by noncompliance with this requirement shall be repaired at no expense to the Owner.

B. Position of Outlets and Equipment:

1. The Owner shall determine the position of all relocated outlets and equipment if the required location differs from that indicated on the drawings.

C. Moving Outlets and Equipment:

1. The Owner reserves the right to move any outlet, or equipment enclosure, a distance of ten feet before roughing in, at no additional expense.

D. Methods and Materials:

1. All work shall be installed in a first-class, neat and workmanlike manner by skilled mechanics. All materials shall be new. Firmly support all materials and equipment.

E. Cutting, Repairing and Finishing:

1. All cutting, repairing and finishing required for the installation of work under this Contract shall be performed under this Contract.

2. All disturbed surfaces shall be repaired and finished to match adjacent surfaces by skilled mechanics working in their respective fields.

F. Excavation and Backfilling:

1. Excavation and backfilling will be in accordance with the requirements of Division 2 and as required to complete the work according to details on the Drawings.

G. Concrete:

1. Concrete work shall be in provided in accordance with the requirements of Division 3 and as required to complete the work according to details on the Drawings. Concrete for electrical duct banks can be poured against the excavated earth.

H. Cutting and Patching of Macadam and Concrete Areas:

1. Openings in concrete or macadam required for Electrical construction shall be made by taking extreme precautions to prevent excessive

damage to existing facilities. Prior to completion, all disturbed areas shall be closed, restored to normal and finished to match surrounding areas.

I. Access:

1. Install all conduit, wire, cable, wiring devices and equipment to preserve access to all equipment installed under this Contract.

J. Layout of Wiring:

1. The layout of wiring as shown on the drawings shall not be considered as absolute. It shall be subject to changes where necessary to overcome obstacles in construction. Where a major deviation from the plans is indicated by practical consideration, shop drawings shall be submitted showing all deviations in detail to clearly indicate the necessity or desirability for the change.

K. Miscellaneous Supports:

1. Furnish and install all necessary angles, beams, channels, hanger rods or other supports for equipment and piping furnished under this Contract requiring support or suspension from building structure.

L. Continuity of Service:

1. Uninterrupted electrical service shall be maintained during the entire time required for complete installation of the work proposed in the Drawings and in the specifications.

2. Temporary equipment, cable, emergency generators, and whatever else is necessary shall be provided as required to maintain electrical service to all facilities. Temporary service facilities, if required at any time, shall not be disconnected or removed until new services are placed in proper operation.

3. If any service or system must be interrupted, the Contractor shall request permission in writing stating the date and time the service will be interrupted, and the areas affected. This request shall be made in sufficient time for proper arrangements to be made. Written permission shall be obtained from the Owner before interrupting electrical service to any facility.

M. Clean Up:

1. Upon completion of all work under electrical specifications, furnish labor, materials and incidentals to accomplish the following: remove all dirt, foreign materials, stains, fingerprints, etc. from all electrical equipment

enclosures, panelboards, and system equipment, and leave the electrical work in such a condition that no cleaning will be required by the Owner. The complete system shall be subject to inspection and approval by the Owner.

3.02 ELECTRICAL COORDINATION AND ARC FLASH STUDY

A. General:

1. A short-circuit, component protection, flash hazard analysis, and selective coordination study shall be made for the entire electrical distribution system, beginning at utility connections and ending at the largest feeder from each motor control center or panel but in no case will study terminate before AIC values are below 10,000 amps.

2. The company performing the study shall attend one (1) meeting with the Owner and the Engineer to review the study requirements prior to performing the study. This meeting shall be held at the pump station.

B. References:

1. The coordination study shall be completed in accordance with the latest edition of IEEE Standard 242 – Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems.

2. The flash hazard analysis shall be completed in accordance with the latest editions of NFPA 70E – Standard for Electrical Safety Requirements for Employee Workplaces and IEEE Standard 1584 - Guide for Performing Arc-Flash Hazard Calculations.

C. The short circuit study shall consist of the following:

1. Momentary and interrupting values of short circuit shall be calculated for three-phase bolted faults at each bus having a protective device. Fault current calculations shall consider the contribution of all significant synchronous and/or induction motors. Motors less than 15 hp at one location shall be represented as a lump sum, and motors 15 hp and larger shall be represented individually. Motor horsepower's shall be obtained from the Contract Drawings, including applicable Addenda, by the firm performing the fault study.

2. Questions regarding the starting, running and construction characteristics of individual motors shall be coordinated directly with the associated equipment manufacturer by the firm performing the fault study.

3. Motor subtransient reactances shall be used for the calculation of momentary fault current values. A final tabulation of short circuit

calculations shall include X to R ratios, asymmetry factors, short circuit kVA and symmetrical fault current values for each bus. In addition to this tabulation, provide a tabulation showing protective device interrupting capacity versus available fault current.

4. Recommendations which may be required in order to insure safe fault current interruption shall also form a part of the final report.

D. The coordination study shall consist of the following:

1. All protective devices contained in the scope of work shall be set to provide the best possible coordination and protection. The coordination study shall include log-log plots of phase overcurrent and ground overcurrent protection devices on K & E time-current characteristic paper. Complete plots of these devices will be accurately plotted through their operating range. A sketch shall be included on each plot sheet showing device identification.

2. Attempts will be made to obtain complete coordination on every portion of the system. Appropriate maximum fault levels, transformer inrush currents, conductor insulation withstand curves and transformer withstand points shall be plotted on each coordination plot sheet to assure adequate component protection and maximum system reliability.

3. Each current transformer shall be checked for saturation to insure that they accurately translate all fault currents which may be available on the system. A complete and thorough discussion of each coordination curve sheet shall be prepared. This discussion will describe the areas where coordination is effective, as well as any instances where a lack of coordination exists. All protective relay settings, fuse sizes and low-voltage circuit breaker settings will be tabulated.

4. Recommendations for new equipment or conductor changes which may be necessary to improve protection and/or coordination will also be contained in a section of the completed coordination study.

E. Arc Flash Hazard Analysis:

1. The study shall include a flash hazard analysis for the electrical distribution equipment. The analysis shall determine the flash protection boundary, incident energy, and required level of personal protective equipment (PPE) for workers at the electrical distribution equipment. The flash protection boundary and incident energy shall be determined based upon a working distance of 18 inches. The electrical distribution equipment shall be field marked with this information in accordance with codes and standards.

2. The arc flash labels shall be furnished and installed by the Contractor.

F. A complete set of coordination curves, starting with the main outdoor switchgear devices protecting the service down through and including all on-site service, feeder, sub-feeder, and secondary main and branch circuit devices, shall be provided.

G. The final selection and setting of overcurrent devices shall be based on this coordination study. Study Contractor to coordinate with settings for overcurrent devices in conjunction with the switchgear manufacturer.

H. The Study Contractor shall coordinate ground fault protection.

I. Submissions and approval of this study are required prior to final approval of shop drawings.

J. Motor starting voltage profiles for all large motors shall be provided.

K. The Contractor shall make all settings as recommended by the coordination study.

L. A factory representative for the switchgear shall be present when the Contractor adjusts, tests and calibrates devices as required in the field after the installation is complete. The number of days required to do this work shall be the manufacturer's responsibility and shall be included in the bid.

M. Points of non-coordination shall be brought to the attention of the Engineer, along with recommendations by Contractor and manufacturers involved.

N. This study shall be made by an independent electrical testing company. Acceptable testing companies are Square D, Eaton, or equal.

O. The final study, along with the SKM Power tools Project file (.PRJ), shall be submitted to the Owner on a CD.

END OF SECTION

SECTION 16050

BASIC MATERIALS AND METHODS

PART 1 - GENERAL

1.01 DESCRIPTION

A. Work Included:

1. All items of labor, materials and equipment, not specified in details on Drawings but necessary for complete installation and proper operation of work described or implied, shall be furnished and installed.

1.02 QUALITY ASSURANCE

A. Regulations, Standards and Publications:

ANSI	American National Standards Institute, Inc.
ASTM	American Society for Testing and Materials
BOCA	Building Officials and Code Administrators
IEEE	Institute of Electrical and Electronic Engineers
IPCEA	Insulated Power Cable Engineers Association
NEC	National Electrical Code of National Fire Protection Association
NEMA	National Electrical Manufacturers Association
NESC	National Electrical Safety Code
UL	Underwriters' Laboratories

B. Qualification of Manufacturers:

1. Various materials specified herein shall be as supplied by manufacturers listed under PRODUCTS.

C. Quality Control:

1. All equipment shall be new and limited to products regularly produced and recommended for service ratings in accordance with engineering data or other comprehensive literature made available and in effect at time of bidding. In all cases where device, or devices, or part of equipment is herein referred to in singular, reference shall apply to as many items as required to complete installation.

1.03 SUBMITTALS

A. Shop Drawings:

1. Shop drawings shall be complete in all respects and shall indicate all dimensions, installation methods, size, weight, capacity, ratings, integral controls and types of materials, elevations, and sections.

2. All shop drawing submittals shall clearly indicate, using arrows and/or highlighting on all copies, which item(s) are being submitted and that each item being submitted is in compliance with all requirements on the drawings and in these specifications. All pertinent specification and drawing requirements shall be indicated on the manufacturer's drawings.

3. Submit manufacturer's latest publications for the following items:

a. Conduit and Fittings
b. Wire
c. Instrumentation Cable
d. Outlet Boxes
e. Junction Boxes
f. Pull Boxes
g. Convenience Receptacles
h. Local Control Switches
i. Disconnect Switches
j. Emergency Stop Push Button Stations
k. Uni-Strut
l. Conduit Link Seals
m. Conduit Labels

PART 2 - PRODUCTS

2.01 MATERIALS

A. Conduit:

1. PVC conduit in duct banks shall be Schedule 40. Direct buried PVC conduit shall be Schedule 80. PVC conduit shall be suitable for installation underground.

2. Rigid steel conduit shall be mild steel piping, zinc coated, and of sufficient weight and toughness to withstand cracking and peeling during bending. Galvanizing to be a coating of zinc of uniform thickness applied by either electrolytic or hot metal dip process.

3. Rigid aluminum conduit shall be 6063-T1 aluminum alloy and shall comply with Federal Specification WW-C-540C.

4. Each piece of rigid conduit to be straight, free from blisters and defects, cut square and taper reamed, finished in 10' lengths and threaded at each end. Couplings shall be supplied at one end and a protective sleeve for the other end. All threads shall be clearly cut. Each length of conduit shall bear Underwriters' Label.

5. PVC coated galvanized rigid steel conduit shall have a permanent plastic coating factory applied to a minimum thickness of 40 mils and a urethane internal coating. PVC coated conduit shall be Plasti-Bond Red H2OT as manufactured by Robroy Industries, Ocal Blue as manufactured by the Occidental Coating Company or Perma-Cote Supreme as manufactured by Perma-Cote Industries.

6. Flexible metallic conduit shall conform to Articles 350 and 351 of the NEC and shall be UL listed. All flexible metallic conduit shall have nonmetallic screw-in type connectors and couplings. All flexible conduit shall be liquid-tight type. Flexible conduit in wet locations and chemical feed areas shall be non-metallic.

7. Minimum size of rigid conduit shall be 3/4". Minimum size of flexible conduit shall be 1/2”.

B. Wire:

1. Wire inside the pump station shall be Type THHN/THWN. Underground wiring shall be Type XHHW. All wiring shall be stranded copper with 600 volt insulation. Aluminum wire will not be acceptable.

2. Wire shall be 90°C, suitable for wet or dry locations.

C. Instrumentation Cable:

1. Instrumentation cable for analog signal wiring shall be #18 AWG stranded, twisted shielded pairs with tinned copper conductors, 300 volt polyethylene insulation, a continuous foil shield with 100% coverage, a tinned copper drain wire, and PVC jacket.

2. The instrumentation cable shall be Beldon #8760, or approved equal.

D. Cast Fittings:

1. Cast fittings for steel conduit shall be made of rust resisting alloy of iron or steel. An iron fitting shall be cast malleable iron thoroughly coated with metallic zinc or cadmium inside and outside after all machine work is completed.

2. Cast fittings for aluminum conduit shall be made of aluminum.

3. Each cast fitting shall be provided with heavy threaded hubs to fit the conduit used. A cast fitting shall be used on all exposed conduit runs except at impractical locations where factory ells may be used.

4. All cast fittings used for PVC coated conduit shall be PVC coated and shall be Form 8 with encapsulated screws.

5. All fittings in wet locations shall be gasketed.

E. Outlet Boxes:

1. Each outlet box shall be sized in accordance with current editions of all Federal, State and local codes.

2. All outlet boxes shall have mounting lugs or ears for mounting wiring devices and covers. Each outlet box shall be equipped with an appropriate cover.

3. Outlet boxes shall be cast type of same construction as cast fittings described above.

F. Junction Boxes:

1. Junction boxes shall be cast type, and shall be of same construction as cast fittings, unless noted otherwise on the Drawings.

2. Junction boxes identified on the Drawings as NEMA 4X aluminum shall be constructed of Type 5052 H-32 aluminum, and shall have gasketed shoe box type covers with stainless steel screws.

3. Label all junction boxes with an engraved nameplate fastened to the junction box. Nameplate shall be black with 1/4” white lettering.

G. Pull Boxes:

1. Pull boxes identified on the Drawings as NEMA 4X aluminum shall be constructed of Type 5052 H-32 aluminum, and shall have gasketed shoe box type covers with stainless steel screws.

2. Pull boxes identified on the Drawings as fiberglass shall be Hoffman, or equal.

3. Label all pull boxes with an engraved nameplate fastened to the pull box. Nameplate shall be black with 1/4” white lettering.

H. 20 Ampere, 120 Volt, Single Receptacles, NEMA 5-20R:

1. Single receptacles shall be corrosion resistant, 20 ampere, 3 wire, U-ground to meet Federal Specification WC-596. Receptacle color shall be yellow.

2. Single receptacles shall be Arrow Hart #5361-CR, Hubbell #53CM61, Leviton #5361-CR, or approved equal.

I. 20 Ampere, 120 Volt, Duplex Receptacles, NEMA 5-20R:

1. Duplex receptacles shall be 3 wire, U-ground, to meet Federal Specification WC-596. Receptacle color shall be ivory.

2. Receptacles shall be Arrow Hart #5362, Bryant #5362, Hubbell #5362, Leviton #5362, Pass &Seymour #5362, or approved equal.

J. 20 Ampere, 120 Volt, Duplex Receptacles, NEMA 5-20R (G.F.I. Type):

1. All receptacles noted as G.F.I. receptacles shall be 20 Amp ground fault circuit interrupter receptacles. Receptacles shall be the "Standard" End-of-Line" type, which protects itself only. "Feed-Thru" installation will not be permitted. Devices shall be Class A, UL listed.

2. Provide a weatherproof cover for G.F.I. receptacles where indicated on the Drawings. Cover shall be self-closing and UL listed.

K. Switches:

1. Local control switches, other than those mounted on a panelboard, shall be 20 ampere, 120-277 volt, AC, meeting Federal Specification WS-896E. Switch color shall be ivory.

2. Switches shall be single pole, double pole, three-way, four-way or type as noted. Switches shall be Arrow Hart #1221, Bryant #4901, Hubbell #1221, Leviton #1221, Pass & Seymour #20AC, or approved equal.

L. Wall Plates:

1. Local control switches, receptacles and similar wiring devices shall be provided with stainless steel wall plates with beveled edges. Plates shall be same manufacturer as wiring device used.

2. At locations where FS condulets are used for switches or receptacle outlets, an FS condulet plate shall be used. Plates shall have beveled or rounded edges and shall fit flush with all sides of the FS condulet.

M. Disconnect Switches:

1. Disconnect switches shall be non-fusible, size and NEMA enclosure as indicated on the Drawings, quick-make, quick-break, heavy-duty. Provide a ground lug in each disconnect switch.

2. NEMA 4X disconnect switches shall be 316 stainless steel, unless noted otherwise.

3. Label all disconnect switches with an engraved nameplate fastened to the disconnect switch.

4. Disconnect switches shall be Square D, Eaton, or approved equal.

N. Emergency Stop Push Button Stations:

1. Emergency stop push button stations shall consist of a 30.5 mm heavy-duty, non-illuminated, push-pull type with red mushroom head mounted in a corrosion resistant NEMA 4X stainless steel enclosure. Push buttons shall be maintained contact type with double-break silver contacts. Provide a red automotive sized legend plate for each push button with white marking.

2. The emergency stop push button stations shall be Allen-Bradley Bulletin 800H, NEMA Type 4X, or approved equal.

O. Uni-strut:

1. Uni-strut shall be used to support conduit and electrical equipment. All uni-strut shall be 316 stainless steel, unless noted otherwise on the Drawings.

P. Conduit Link Seals:

1. Conduit link seals shall be installed in all core-drilled holes for sealing around the conduit. All link seal bolts shall be stainless steel.

Q. Conduit Labels:

1. Conduit labels shall be PVC sleeves that wrap around conduit. Labels shall indicate the voltage of the wiring inside the conduit.

R. Fire Resistant Foam Sealant:

1. All penetrations through floors and walls shall be sealed with Nelson Firestop Products CLK, Cat. #AA492, silicon based sealant, or approved equal.

2. All wall or floor penetration openings shall be as small as possible.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Conduit:

1. All direct buried conduits shall be PVC coated galvanized rigid steel, unless noted otherwise on Drawings.

2. All conduits for power wiring embedded in concrete slabs shall be PVC. Where conduits turn up out of the slab, they shall be PVC coated galvanized rigid steel. All conduits embedded in slabs for instrumentation wiring and motor feeders from VFDs shall be PVC coated rigid steel.

3. All conduits for motor feeders from VFDs shall be PVC coated galvanized rigid steel.

4. All exterior exposed conduits shall be rigid aluminum, unless noted otherwise on the Drawings.

5. All exposed conduits in buildings shall be rigid aluminum, unless noted otherwise on the Drawings.

6. All wiring shall be run in conduit.

7. Install conduit so wires may be removed and replaced at a later date.

8. Short runs of flexible metallic conduit with separate ground wire shall be used for connection of motors and instrumentation. Flexible conduit in chemical areas shall be non-metallic. Approximately 18" runs of flexible metallic conduit shall be used for connection of all HVAC equipment. No rigid connection to HVAC equipment will be permitted.

9. Running threads will not be permitted. Use an approved threaded coupling or a suitable union where required. Setscrew couplings will not be permitted.

10. Space supports for conduit as per the NEC. Support conduit by one-hole malleable iron pipe straps or beam clamps. Where it is impractical to use beam clamps and where conduit is installed on building surfaces, use back straps and approved fastening devices with malleable iron pipe straps. All straps and clamps for PVC coated conduit shall be permanently PVC coated by same manufacturer as conduit.

11. Where it is necessary to cross building expansion joints, or expansion joints in piping, provide conduit runs with suitable expansion fittings.

12. All conduit penetrations into electrical equipment enclosures shall be made using conduit hubs. PVC coated rigid steel conduit systems shall use PVC coated conduit hubs.

13. Bend conduit only by use of an approved pipe bending machine or hickey so the conduit will always retain its cylindrical shape. PVC coated conduit shall be bent and threaded only with tools manufactured for that purpose.

14. If the PVC coating on conduit and fittings is damaged during installation, the damaged conduit or fitting shall be replaced in its entirety by the contractor. Repairing damaged conduit with touch-up paint will not be acceptable.

15. Install metallic electrical warning tape above all underground duct banks and conduit. Tape shall be 6" wide with red background and black letters. Letters shall read "CAUTION ELECTRICAL LINE BURIED BELOW". Install tape 6" below finished grade.

16. Label all exposed conduits at each end of the conduit run.

B. Outlet Boxes:

1. An outlet box shall be furnished and installed at each outlet, firmly in place, and set true and square.

2. All outlet boxes shall be supported from the building structure, independent of the entering conduit. All unused knockouts must remain closed.

C. Wiring:

1. The voltage drop at the end of any circuit shall not exceed 3% of the normal line voltage under full load. No wires smaller than #12 AWG shall be used for branch circuits; pilot and control circuits shall not be smaller than #14 AWG.

2. Care shall be exercised in pulling wire into conduit so as not to injure insulation. Use pulling compound as required.

3. Conductors shall be continuous from source to end point with no splices.

4. Balance circuits across the phase wires of the branch and distribution panels. Run separate neutral wires for all circuits.

5. Switches shall not be connected to the neutral conductor.

6. Power and control wiring shall be run in separate conduits. AC and DC circuits shall be run in separate conduits.

7. All wiring shall conform to the following color code:

480 Volt, 3 Phase:	Brown, Orange, Yellow - Phase Wires Gray - Neutral Wire
208 Volt, 3 Phase:	Black, Red, Blue - Phase Wires White - Neutral Wire
208 Volt, 1 Phase:	Black, Red - Phase Wires
120 Volt, 1 Phase:	Black - Phase Wire White - Neutral Wire
Control Wires:	120V AC - Red 24V dc - Blue
Ground Wires:	Green

8. AC control wires energized from a source external to the control panel power source shall be yellow.

9. All control wiring shall be identified at each end with a legible permanent coded wire-marking sleeve. Sleeves shall be heat-shrink white PVC tubing with machine printed black marking, as manufactured by Brady Markings shall be in accordance with the wire numbers and terminal numbers shown on the control panel wiring diagrams.

D. Splices:

1. Make all splices using solderless connectors. Use wire nut connectors composed of expandable spring steel shell and PVC insulator for size #14 through #8. Temperature rating shall be 105°C.

2. For size #6 and larger, use bolted-type tinned copper pressure connectors, either the straight coupling type or the split bolt type. All connectors #6 and larger shall be wrapped with UL approved liner-less rubber splicing tape rated to 69 KV and vinyl plastic electrical tape to the same thickness as the insulation of the wire. Electrical tape shall be Scotch 33+, or equal.

E. Lugs:

1. All lugs used with copper wire and cable shall be tinned copper. Aluminum will not be accepted.

F. Panels:

1. Furnish a typed list identifying all circuits and insert in frames provided inside of panel doors.

G. Mounting Heights:

1. Mounting heights and exact locations of all equipment to be verified by the Engineer before roughing in.

2. Unless otherwise instructed, outlets shall be located as follows:

a. Local Lighting Control Switches: Locate all outlets for single or gang switches 3'-4" above finished floor on strike side of door. If this location places the switch group partly in tile or other finishes, the outlet shall be lowered or raised to place the plate entirely on a flat surface.

b. Duplex Receptacles: 36" above finished floor.

c. Disconnect Switches: 5'-0" above finished floor to top of switch, unless noted otherwise on Drawings.

END OF SECTION

SECTION 16060

GROUNDING SYSTEM

PART 1 - GENERAL

1.01 DESCRIPTION

A. Work Included:

1. Furnish all labor and materials required to complete all work necessary for an electric service and branch distribution grounding system. System shall include but not be limited to all grounding electrodes, ring conductors, connectors, and miscellaneous accessories such as bonding lugs, bushings and jumpers in accordance with the current edition of the National Electrical Code and as specified herein.

2. In addition to grounding/bonding connections required to comply with NEC provisions, a grounding ring system shall be installed as indicated herein or on the Drawings. This system is intended to provide bonding between all process and structural components and the electrical distribution system grounding. The description "process piping" where included herein shall be understood to mean all metallic piping systems where they occur on the site. Other process and structural components shall be grounded as specifically described herein to provide a complete system with all metallic components at the site bonded together.

1.02 QUALITY ASSURANCE

A. Regulations, Standards and Publications:

ANSI American National Standards Institute, Inc.
ASTM American Society for Testing and Materials
IEEE Institute of Electrical and Electronic Engineers
NEC National Electrical Code of National Fire Protection Association
UL Underwriters' Laboratories

1.03 SUBMITTALS

A. Shop Drawings:

1. Submit in accordance with General Requirements. Shop drawings shall be complete in all respects and shall indicate all dimensions, installation methods, size, weight, capacity, ratings and types of materials.

2. All shop drawing submittals shall clearly indicate, using arrows and/or highlighting on all copies, which item(s) are being submitted and that each

item being submitted is in compliance with all requirements on the Drawings and in these Specifications. All pertinent Specification and Drawing requirements shall be indicated on the manufacturer's drawings. Submit shop drawings on the following:

a. Grounding Electrodes
b. Grounding Conductors
c. Grounding Conductor Connectors
d. Conduit Grounding Bushings
e. Conduit Grounding Jumpers
f. Exothermic Weld Process and Components
g. Grounding System Resistance Test Equipment
h. Grounding System Test Point Sleeves

B. Literature:

1. Submit manufacturer's latest publications for each item.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Grounding Electrodes:

1. Grounding electrodes shall be 10'-0" long, 3/4" diameter copper clad steel. Exterior shall be electrolytic copper metallically bonded to a round one-piece carbon steel rod. The electrodes shall be fabricated so as to prevent mushrooming of rod head during driving, or a steel-driving stud, manufactured for such a purpose, shall be used.

2. Electrodes shall conform to the requirements of UL Specification No. 467 (ANSI C-33.8-1972).

3. Electrodes shall be Blackburn, Carolina, or approved equal.

B. Ground Conductors:

1. Electric service ground conductor shall be sized in accordance with NEC Article 250-66 and shall be connected to the associated building/structure grounding ring as well as all other equipment and building components required by the NEC.

2. The grounding rings shall be annealed temper, stranded, bare, copper, uncoated type. Individual members of stranded conductor shall meet the requirements of ASTM B3, and the overall fabrication shall meet the requirements of ASTM B8 for stranded conductors.

3. Size of grounding ring conductors shall be #4/0 AWG.

4. All connections between the grounding ring and the individual equipment or building/structure components called for to be grounded herein shall be made using #2/0 AWG copper cable of the same type as the grounding rings.

C. Grounding Jumpers:

1. UL listed jumpers shall be provided on all metallic conduit expansion fittings whether or not the circuit is provided with a separate ground conductor. Jumpers shall be braided, tinned copper, factory connected as a single assembly to two galvanized steel U-bolts. OZ Gedney Type "BJ" (for steel conduit), or approved equal.

D. Grounding Bus:

1. All power distribution equipment, motor control centers, panelboards, terminal boxes, transformers, etc. shall be furnished with a factory installed grounding bus or termination point.

E. Electrical Conduit Grounding Bushings:

1. Conduit connectors shall be insulated bushing type for grounding and bonding. Fitting shall have ground lug terminal as well as a bonding setscrew in the circumference of the bushing. Appleton "G1B" series, OZ Gedney "BLG" series, Steel City "BG" series, or approved equal.

F. Exothermic Weld Connections:

1. All underground grounding system connections shall be exothermically welded, including all cable connections to grounding electrodes (rods), concrete reinforcing and any other utilities required to be grounded but are not accessible from above grade.

2. The welding process shall use a mixture of copper oxide and aluminum packaged according to connection type in plastic tubes. The packages shall be nonexplosive and shall not be subject to spontaneous ignition.

3. All welding materials used shall be Cadweld as manufactured by Erico Products, Inc. or equal and shall meet or exceed the requirements of IEEE Standards 80 and 837 and as listed in MIL 419.

G. Exposed Mechanical Type Grounding System Connectors:

1. The following equipment, structural and nonstructural components at the site shall be connected with a #2/0 AWG, soft-drawn, stranded, tinned copper, bare grounding conductor with the described materials or fitting to

the associated building or structure grounding ring. (These items are in addition to the electrical distribution grounding requirements described elsewhere herein.) In addition to the component and fitting manufacturers listed herein and on the Standard Details, fittings and components manufactured by Burndy, OZ Gedney, Dossert, Teledyne/Penn-Union, or approved equal:

a. Electrical Switchgear and Substation

b. Motor Control Center

c. Emergency Generators

d. Process Piping:

1) 1/2" to 1-1/2" - OZ Gedney Type "ABG"
2) 1-1/4" to 12" - OZ Gedney Type "G" bronze heavy-duty ground clamps with Type "GWB" dead end terminal hub
3) Larger than 12" - OZ Gedney Type "XL" single hole lug mounted to a single process pipe flange bolt.

e. Concrete slab reinforcing steel

f. Handrail

2. Components used for grounding conductor connections shall be as indicated herein or on the Drawings.

H. Grounding Conductor Connection Lugs:

1. Grounding conductor connection lugs shall be aluminum for all connections to aluminum materials. Grounding conductor connection lugs for connections to all other materials shall be copper. All aluminum-to-copper connections shall be made according to the lug manufacturer's recommendations using an appropriate cleaning and oxidation prevention compound, Penetrox A-13, or approved equal.

PART 3 - EXECUTION

3.01 INSTALLATION

A. General:

1. Grounding system shall comply with the current edition of the National Electrical Code, the current edition of the National Electrical Safety Code and as specified herein.

2. Flexible conduit to motors shall not be used as a ground conductor.

3. All ground conductors shall be copper and sized according to the requirements of the NEC, Table 250-66 and Table 250-122 as applicable.

4. All conduits shall be furnished with a separate ground conductor. Conduits shall not be used as a ground conductor.

5. All metallic electrical conduits shall be bonded to the equipment ground terminal, ground wire or ground bus using an insulated ground bushing and jumpers sized as required by the NEC. Bond shall be provided at all conduit terminations.

6. Flexible jumpers (bonding straps) shall be installed where conduit expansion fittings occur.

7. Ground conductors shall be green, insulated stranded type where installed in conduit.

8. Grounding ring and all associated conductors shall be soft drawn, stranded copper, size 4/0, bare type.

9. Unless otherwise indicated on the drawings or in the specifications, all copper-to-copper or copper-to-steel splices and terminations for ground ring and connections to the ground ring shall be made by controlled exothermic reaction welding process, using the appropriate fittings for the process employed. Steel shall be ground or filed, and copper conductors shall be cleaned, to ensure all surfaces are clean, dry and free from oxide before welding process is performed.

10. System ground ring and top of ground electrodes shall be direct buried to a minimum depth of 24" and a maximum depth of 30". Electrodes shall be driven straight down, perpendicular to the finished grade.

11. Ground electrodes in the ground ring shall be installed at no less than 10' intervals nor greater than 20' intervals.

12. The term "grounding ring" shall be understood to mean a copper conductor, as specified of this Section, buried and connected to grounding electrodes (driven rods) at + 15'-0" intervals, to completely encircle the associated building or structure. Splices in and connections to the copper conductor and grounding electrodes shall be made using an exothermic weld process, as described in this Section.

13. All metallic water piping systems shall be connected to the building's associated ground ring at two locations. Where flow meters, valves, flexible piping or any type of nonmetallic connection occur in a piping system, a bonding jumper shall be installed around the device to ensure ground

continuity. Jumpers installed under other portions of these specifications, such as reference grounds for process flow meters, etc., shall not be used to replace or be considered as grounding system jumpers.

14. Rebar in concrete structures shall be connected to the grounding ring at two locations for each structure.

15. The ground ring shall be furnished with a test point. The test point shall consist of a 6" diameter, Schedule 40 PVC conduit brought flush with finished grade and extending down to 4" below point on ground rod where ring conductor is attached. The PVC shall be notched as required to prevent stress on the ground ring conductor if the PVC conduit is pushed downward from grade for any reason. Provide threaded end cap on top of PVC conduit. The cap shall be labeled "GROUND TEST POINT".

16. Testing of actual ground resistance shall be made by the Contractor before any finish landscaping is accomplished. Testing shall not be performed until after all underground connections are made and buried and after all structural steel has been connected to the ground ring. Test shall be made at the ground ring using a megger type ground tester and the "fall of potential" test method. Maximum resistance at the test point shall be 5 ohms unless otherwise noted. Where measured values exceed the above figures, the Contractor shall install additional electrodes at no additional cost to the Owner until further tests indicate the ground resistance has been reduced to the specified limit.

END OF SECTION

SECTION 16210

ELECTRIC SERVICE

PART 1 - GENERAL

1.01 DESCRIPTION

A. Work Included:

1. Furnish all labor and materials to remove the primary electric service to the existing pump station transformer and install a new temporary primary electric service to the transformer prior to the construction of the new pump station.

2. Furnish all labor and materials to remove the electric service to the existing pump station and install a complete new electric service to the new pump station including transformer pad, conduit, wiring, termination, metering, and all equipment and labor required, as shown on Drawings, and specified herein.

3. Service characteristics for the new electric service are 277/480V, 3 phase, 4 wire, wye connected. Power company is Potomac Edison. Design Request (DR) Number for this project is 765131070.

4. All power company coordination is the responsibility of the Contractor.

1.02 QUALITY ASSURANCE

A. Contact power company for specific instructions regarding service requirements before beginning work. Complete system must meet with power company approval, and shall meet all power company requirements

B. Power company contact is Garrett Hixon. Phone number is 301-271-5907.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Transformer Pad:

1. Transformer pad shall be a pre-cast concrete pad, furnished and installed in accordance with the requirements of the power company.

B. Primary Service Conduit for Temporary Service:

1. Primary service conduit for the temporary service shall be PVC Schedule 40, direct buried.

C. Primary Service Conduits for New Service:

1. Primary service conduits for the new service shall be PVC Schedule 40, encased in a concrete duct bank for straight runs of conduit. At bends, the conduit shall be PVC coated galvanized rigid steel.

D. Secondary Service Conduits:

1. Secondary service conduits shall be PVC Schedule 40, encased in a concrete duct bank for straight runs of conduit. At bends, the conduit shall be PVC coated galvanized rigid steel.

PART 3 - EXECUTION

3.01 INSTALLATION OF TEMPORARY ELECTRIC SERVICE

A. Temporary Service:

1. Disconnect and remove the primary electric service to the existing pump station transformer and re-feed the transformer with a temporary electric service from a new service pole.

B. Temporary Service Conduit:

1. The temporary service conduit shall start at the new electric service pole and run underground to the existing pad mounted transformer. The temporary service conduit shall be furnished and installed by the Contractor.

3.02 REMOVAL OF EXISTING ELECTRIC SERVICE

A. General:

1. The Contractor shall remove the existing pad mounted power company transformer, transformer pad, and the secondary electric service to the existing pump station after the new pump station is on-line.

2. Coordinate the removal of the existing pad mounted transformer with the power company.

3.03 INSTALLATION OF NEW ELECTRIC SERVICE

A. General:

1. The Contractor shall install a complete new electric service to new pump station, including a new pad mounted transformer, transformer pad, and underground primary and secondary electric service as shown on the Drawings and specified herein.

2. Coordinate all service installation requirements with the power company.

B. Transformer Pad:

1. Install a pre-cast transformer pad for the new power company transformer. The pad shall be installed in accordance with the power company requirements and as shown on the Drawings.

C. Primary Service Conduits:

1. Primary service conduits shall start at the electric service pole and run underground to the pad mounted transformer. Primary service conduits shall be furnished and installed by the Contractor in a concrete duct bank.

D. Secondary Service Conduits:

1. Secondary service conduits shall start at the pad mounted transformer and run underground to MCC-C located in the Pump Station. Secondary service conduits shall be furnished and installed by the Contractor in a concrete duct bank.

E. Primary Service Conductors:

1. Primary service conductors shall be furnished and installed by the power company in the primary service conduits.

F. Secondary Service Conductors:

1. Secondary service conductors shall be furnished and installed by the Contractor in the secondary service conduits.

G. Electric Metering:

1. The electric metering shall be furnished by the power company on the pad mounted transformer.

H. Costs:

1. All power company costs for the installation of the temporary electric service, the installation of the new electric service, and the removal of the existing electric service will be paid by the Owner. The Contractor shall be responsible for all other costs associated with the installation of the new electric service, and the removal of the existing electric service.

END OF SECTION

SECTION 16230

EMERGENCY GENERATOR SYSTEM

PART 1 - GENERAL

1.01 DESCRIPTION

A. Work Included:

1. Furnish a complete natural gas emergency generator system including generator, prime mover, muffler, exhaust system, cranking battery, battery charger, control panel, water jacket heater, generator mounted circuit breaker, Level 2 sound attenuated weatherproof enclosure, and all other necessary material required to complete the system.

B. Generator Requirements:

1. The emergency generator shall be rated for continuous standby service at 200 KW, 250 KVA, 60 Hz, 0.8 power factor, 277/480 volts, 3 phase, 4 wire.

2. The generator must meet the most current EPA emission requirements for this size generator at the time of manufacture.

1.02 QUALITY ASSURANCE

A. Standards: The engine generator set, and all accessories, shall meet the requirements of:

MIL-STD	705 B
NEC	National Electrical Code
NEMA	National Electrical Manufacturer's Association
NFPA	National Fire Protection Association (Pamphlets 30, 31, 37, 110)
UL	Underwriters' Laboratory

B. Quality Control:

1. All components of the emergency generator system shall be new and of the most current and proven design.

2. The complete system shall be of a type, which has been in satisfactory service for at least one year under automatic emergency system conditions.

3. This generator set system shall be assembled, tested and shipped by one supplier so that there is one source of supply and responsibility.

4. The Supplier shall be a factory trained and certified manufacturer's representative and shall maintain a complete service facility. The service facility shall be capable of making delivery to the generator set site all generator set parts within 48 hours of placing the order. The Supplier shall employ a manufacturer trained and certified technician on a full time basis at the service facility capable of making repairs and responding to service calls within 24 hours of notice. Certified proof of this requirement shall be available from the Supplier.

C. Testing:

1. Prototype tests performed on a generator set of the same size and type, required by these specifications, shall be submitted and approved with the shop drawings, required below. The test procedures and results shall be certified by an independent testing laboratory. The tests shall be performed in accordance with NFPA 110 and shall document the following:

   a. Maximum power level
   b. Maximum motor starting capacity
   c. Voltage dip
   d. Fuel consumption
   e. Engine-generator cooling air flow
   f. Governor response time
   g. Alternator temperature rise per NEMA MG1-22.40
   h. Harmonic analysis and voltage Wave Form Deviation per MIL-STD-705 B, method 601.4
   i. Three (3) phase short circuit test for mechanical and electrical strength

2. Factory tests of the generator set to be supplied shall be conducted in accordance with procedures certified by an independent testing laboratory. The manufacturer shall successfully test the generator set to be supplied, document items 1 a-i above and submit the test results for approval before shipping the generator set to the job site. A two-hour load bank test shall be performed and the results submitted before shipping the generator set.

D. Acceptance Tests:

1. Acceptance testing of the installed generator set shall be conducted by a factory-trained representative of the generator set manufacturer. An authorized representative of the Owner shall witness the acceptance tests. The test results shall be submitted to and approved by the Owner

before the generator set is accepted. The Supplier shall furnish all testing equipment, materials, etc., including fuel needed to demonstrate the set is in compliance with the specification. Any deficiencies brought to the attention of the Supplier shall be corrected and, if warranted or requested by the Owner, the test shall be re-performed prior to acceptance. Final O&M Manuals shall be submitted before the acceptance tests commence.

2. The acceptance tests shall be performed during an eight-hour field test during which the manufacturer's representative shall demonstrate that the system performs in complete compliance with the specifications. As a minimum, a load bank test, performed in accordance with NFPA 110 section 5-13.2. The load tests shall use dry type load banks specifically utilized for this purpose. The load bank will be capable of definite and precise incremental loading and shall not be dependent on the generator control instrumentation to read voltage and amperage of each phase. The test instrumentation will serve as a check of the generator set meters. Load bank testing shall be performed for a period of four (4) hours at the full rated load of the generator. Salt-water brine tank load banks are not acceptable for this purpose and are disallowed and will not be utilized for this test.

E. Warranty:

1. The emergency generator shall be furnished with a 5-year warranty.

1.03 SUBMITTALS

A. Shop Drawings:

1. Shop drawings shall be complete in all respects and shall indicate all dimensions, installation methods, size, weight, capacity, ratings, integral controls and types of materials, elevations, and sections. Shop drawings shall include manufacturer's literature and complete information including the following:

a. Engine generator system plan, elevation and dimensional drawings clearly indicating all aspects of the system including points for each of the inter-connections required.

b. Engine generator/exciter control cubicle layout and component descriptions.

c. Gas piping schematic and fuel line connection information.

d. Fuel consumption rate curve at various loads, ventilation and combustion CFM requirements.

e. Exhaust muffler and vibration isolator.

f. Schematic ladder and control wiring diagrams for the generator system.

g. Printed literature and brochures describing the system including all sizing requirements and components specified.

h. The weight of the engine, generator and complete system.

i. Points of measurement and maximum vibration readings (measured as velocity) for the installed system recommended by the manufacturer.

j. Battery, battery rack and battery charger literature and description.

k. Sound attenuated weatherproof housing.

l. The specified standby KW of the generator shall be for continuous electrical service during interruption of the normal utility power source and this shall be certified to this effect by the manufacturer for the actual unit supplied.

m. Factory prototype test results performed on a unit of this size and type documenting items (a) through (I) listed in 1.02 C above.

B. Operation and Maintenance Manuals:

1. Submit required number of copies of an operation and maintenance manual for the complete emergency generator system. The manual shall be submitted in 3-ring loose-leaf binders, and shall be complete, neat, orderly and indexed. The manual shall include, at the least, all data bearing on the specific generator system necessary for maintenance, operation, parts repair and replacement including all accessories and electrical controls, fire-code safety and operator safety measures, and lubrication schedule. A copy of the approved shop drawings shall be included in the manual. Manual shall be submitted and approved before system will be accepted.

C. Installation Certificate:

1. A factory technician shall inspect the installed generator system and certify in writing to the installer that it is installed in accordance with the manufacturer's recommendations before the system is initially started. The technician shall be present for the initial start-up and make recommendations to resolve any defects experienced. A copy of the

installation certificate must be submitted to the Owner before the generator set is conditionally accepted.

1.04 MANUFACTURER

A. The manufacturer of the generator set shall be Cummins Onan, Caterpillar, Kohler, or approved equal.

PART 2 - PRODUCTS

2.01 GENERATOR EQUIPMENT

A. Engine:

1. The engine shall be the water-cooled in-line or V-type, natural gas. It shall meet specifications when operating on natural gas. The engine shall be equipped with filters for fuel, lube oil, intake air, lube oil cooler, fuel transfer pump, fuel priming pump, one foot of flexible fuel line between engine and rigid supply, and gear-driven water pump.

2. The engine shall be controlled by an electronic governor. The governor shall maintain isochronous frequency regulation from no load to full load.

3. The engine shall be equipped with automatic safety controls, which will shut down the engine in the event of low oil pressure, high water temperature, overspeed and overcrank.

4. The engine shall be remote starting with a 2 wire, solenoid shift electric starter.

B. Generator:

1. The generator shall be a three phase, single-bearing, synchronous-type built to NEMA standards, rated for continuous standby at service. Class F insulation shall be used on the stator and rotor, and both shall be further protected with 100% epoxy impregnation and an overcoat of resilient insulating material on end coils to reduce possible fungus and/or abrasion deterioration. The generator shall incorporate a resettable thermal protector for exciter/regulator protection against extended low power factor loads. The generator shall be capable of accepting full nameplate load in one step.

2. A generator-mounted, volts-per-hertz type exciter/regulator shall be provided to match the characteristics of the generator and engine. Voltage regulation shall be ±1% from no load to full rated load. Voltage level adjustment shall be a minimum of ±5%. The solid-state regulator

module shall be shock-mounted and epoxy-encapsulated for protection against vibration and atmospheric deterioration. Voltage dip due to motor starting current shall not exceed 20% under the maximum load conditions.

3. A permanent magnet generator (PMG) shall provide excitation power to the automatic voltage regulator for immunity from voltage distortion caused by non-linear SCR controlled loads on the generator. The PMG shall sustain main field excitation power for optimum motor starting and to sustain short circuit current for selective operation and coordination of system over current devices.

4. The alternator shall be 105°C rise at standby rating.

C. Cooling System:

1. The engine shall be furnished with a cooling system having sufficient capacity for cooling the engine when the generator set is delivering full rated load at an ambient temperature of 125°F.

2. The engine cooling system shall be filled with a solution of 50% ethylene glycol. Cooling system shall be pretreated by supplier for inhibition of internal corrosion.

3. The engine shall be equipped with a radiator having a blower type fan. The radiator shall have a duct adapter flange, and shall be equipped with a fan guard and core guards.

D. Starting System:

1. The engine shall be equipped with a DC electric starting system of sufficient capacity to crank the engine at a speed, which will allow full natural gas starting of the engine. The motor voltage shall be as recommended by the engine manufacturer.

2. Fully automatic generator start/stop controls shall be provided in the generator control panel to start the generator automatically from a contact in the automatic transfer switch.

3. When the engine starts, the starting control shall automatically disconnect the cranking controls. The cranking disconnect means shall be electrically self-regulating to prevent re-cranking for a definite time after source voltage has reduced to a low value. If engine fails to start, or any safety device operates while engine is running, engine shall be stopped immediately and starting control locked out, requiring manual resetting.

4. Controls shall provide shutdown for low oil pressure, high water temperature, overspeed and overcrank. Controls shall include a 10-second cranking cycle limited to 3-5 attempts before lockout.

5. The automatic engine starting control shall incorporate industrial control type elements throughout, which must operate at 80% battery voltage. Relays shall be equipped with silver-gold contacts of the wiping type and shall have adequate pressure to insure reliable performance at battery voltage.

6. Batteries:

   a. A lead/acid storage battery set of the heavy-duty starting type shall be provided. Battery voltage shall be compatible with the starting system. The battery set shall be rated for a minimum of 172 hours and shall be of sufficient capacity to provide for 1½ minutes total cranking time without recharging. It shall be sized for the cold cranking amps as recommended by the battery manufacturer. A wood bottom, fiberglass treated, battery rack and necessary cables and clamps shall be provided. The battery rack shall be isolated from the engine to protect it from excessive vibration, and shall be readily accessible for service and/or removal.

7. Battery Charger:

   a. A 10-amp current limiting battery charger shall be furnished to automatically recharge the batteries. The charger shall include overload protection, silicon diode-full wave rectifiers, voltage surge suppressors, DC ammeter, and AC over current protection. AC input voltages shall be the same as the generator output voltage.

   b. The battery charger shall be mounted inside the generator housing.

E. Jacket Water Heater:

1. Provide an engine mounted thermostatically controlled water heater to maintain the engine jacket water temperature at 100°F. Heater shall be sized as recommended by the manufacturer.

2. The heater for the generator shall operate on 208 volts, 1 phase.

F. Exhaust System:

1. Provide a critical type exhaust silencer, including stainless steel flexible exhaust fitting, properly sized according to the manufacturer's

recommendation. Exhaust pipe size shall be sufficient to ensure that exhaust backpressure does not exceed the maximum limitations specified by the generator set manufacturer. The silencer shall be manufactured by Maxim, or equal.

2. Provide taps for drainage with petcock drain valves, drip cap, rain cap, wall thimble and accessories.

3. The exhaust silencer shall be installed inside the generator housing.

4. The exhaust piping and muffler shall be insulated with insulating blankets.

G. Engine Generator Set Mounting:

1. The engine generator shall be mounted in perfect alignment on an all welded preformed structural steel I-beam or C channel skid type sub-base which shall provide for attachment of all specified engine and generator accessories.

2. Provide spring-type vibration isolators for mounting between the engine generator set mounting rails and the concrete slab. The size and quantity of isolators shall be as recommended by the manufacturer.

H. Generator Control Panel:

1. Provide a generator-mounted NEMA 12 control panel. The control panel shall be mounted on the generator terminal box and shall be vibration isolated. The generator control panel shall contain, but not be limited to, the following equipment:

   a. Digital AC Voltmeter
   b. Digital AC Ammeter
   c. Digital AC Frequency Meter
   d. Ammeter - Voltmeter Phase Selector Switch
   e. Automatic Starting Controls
   f. Voltage Level Adjustment Potentiometer
   g. Run-stop-remote switch and remote start-stop terminals
   h. Alarm lights for low oil pressure, low engine temperature, high water temperature, overspeed, and overcrank
   i. Engine Temperature and Pressure Gauges
   j. DC Charging Volts and Ampere Gauges
   k. Running Time Meter
   l. Dry Contacts for run indication, not in auto, and common alarm wired to terminal strips
   m. Panel illumination lights and switch

I. Generator Circuit Breaker:

1. A main line molded case 3-pole circuit breaker shall be installed as a load circuit interrupting and protection device. It shall operate both manually as an isolation switch and automatically during overload and short circuit conditions.

2. The trip unit for each pole shall have elements providing inverse time delay during overload conditions and instantaneous magnetic tripping for short circuit protection. The circuit breaker shall meet standards established by Underwriters' Laboratories, National Electrical Manufacturer's Association, and National Electrical Code.

3. The circuit breaker shall be mounted in a NEMA 12 type enclosure, adjacent to the generator control panel.

J. Sound Attenuated Enclosure:

1. Provide a weatherproof, sound attenuated 16 gauge aluminum enclosure for the generator. The enclosure shall be drip-proof to prevent water from entering enclosure and shall be provided with heavy-duty “lockable” latches to ensure tamper-proof security and safety. Sound shield shall be provided with lifting eyes for ease of installation.

2. The enclosure shall have solid access doors with door handles keyed alike. Doors shall have 3-point latches, stainless steel butt hinges, stainless steel door holders, and rain gutters above doors.

3. The enclosure shall have an advanced sound-attenuation design. The noise at 7 meters shall be 72 dBA or less, at full load.

4. Provide a 20 amp 120 volt, weatherproof, G.F.I. receptacle on the generator enclosure.

K. Painting:

1. The complete generator set shall be painted with the manufacturer's standard prime and finish paint system. Observed nicks, damage, rust, etc. to the paint system of the installed generator set shall be prepared, primed and finish coated in the field prior to conditional acceptance.

PART 3 - FIELD SERVICES

3.01 TECHNICAL SERVICES

A. The manufacturer of the emergency generator shall furnish a qualified technician, whose qualifications are acceptable to the Owner, to provide the following services:

1. Inspection of the installation of the emergency generator system

2. Start-up

3. Performance testing

4. Operating adjustments

5. Instruction of Owner's personnel

6. Assistance at final inspection

B. These services shall include not less than four (4) 8-hour workdays on-site comprising a minimum of four trips.

END OF SECTION

SECTION 16500

LIGHTING FIXTURES

PART 1 - GENERAL

1.01 DESCRIPTION

A. Work Included:

1. Furnish all labor and materials for a complete lighting fixture installation as indicated on the Drawings and specified herein.

2. Fixtures of size and type specified herein shall be supplied, installed and connected as indicated on the Drawings. Provide accessories for each fixture as required for a complete installation.

3. Furnish and install lamps in each fixture.

1.02 QUALITY ASSURANCE

A. Regulations, Standards and Publications:

1. Fixtures shall be U.L. listed.

2. All fixtures shall meet all Federal, State and local required criteria.

3. All light fixtures shall be mounted in accordance with manufacturer's recommendations.

4. The installation must comply with the amended National Electrical Code of the National Fire Protection Association.

B. Qualification:

1. Provide manufacturer specified for each light fixture type. Substitutes will not be accepted without approval prior to the bid.

2. When more than one name of manufacturer of fixture is listed in these specifications, the first manufacturer and number determine the style and quality.

1.03 SUBMITTALS

A. Shop Drawings:

1. Submit manufacturer's latest publication of each fixture; including LED information, construction details, light distribution details and/or coefficients.

PART 2 - PRODUCTS

2.01 MATERIALS

A. LED Drivers:

1. LED light driver shall be of high efficiency.

2. LED light driver shall allow continued operation of all other LEDs in the event of an LED failure.

B. Light Fixture Schedule:

1. CA: Ceiling mounted, 120 volt, high efficiency LED, nominal 8" x 4', totally enclosed gasketed fixture suitable for wet locations. Fixture shall be provided with an electronic driver. Fixture shall produce a minimum of 6,000 initial lumens and have a color temperature of less than or equal to 4000K. Housing shall be one-piece high impact plastic to provide durability and corrosion resistance. The lens shall be one-piece low profile, frosted acrylic, resistant to damage. Fixture shall have plastic latches to apply positive, uniform pressure on the gaskets to seal against dust and moisture. Provide gasketed conduit hubs. Fixture shall be Holophane #EMS-L48-6000LM-LPAFL-MD-MVOLT-40K-WLFEND, Lithonia #FEM-L48-6000LM-LPAFL-MD-MVOLT-40K-80CRI-WLFEND2, or approved equal.

2. SA: Same as Light Fixture Type CA, except pendant mounted.

3. WA: Wall mounted, 120 volt, high efficiency LED fixture. The fixture shall produce a minimum of 8000 initial lumens and have a color temperature of 4000K. The fixture housing shall be constructed of die-cast copper-free aluminum with a bronze powder coated finish. Fixture shall have a tempered glass lens. Fixture shall have a button style photoelectric cell. Fixture shall be Holophane #W4GLED-30C1000-40K-T3M-MVOLT-SPD-PE-BZSDP, or approved equal.

4. WB: Same as Light Fixture Type WA, except without photoelectric cell.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Installation:

1. Contractor shall furnish supports for light fixtures. Light fixtures shall be supported with formed channels, angles, rods, clamps, washers, etc. of sufficient size and strength to support weight of fixtures from the building overhead structural members, independently from the ceiling system.

2. The fixture manufacturer's catalog numbers describing the various types of fixtures shall be used as a guide only and do not include all the required accessories or hardware that may be required for a complete installation. The Contractor shall be responsible for furnishing, at no additional cost to the Owner, all required accessories and hardware for a complete installation.

3. All inoperable lamps shall be replaced with new lamps during the course of construction, up to and including the date of final acceptance by the Owner and Engineer.

END OF SECTION

SECTION 16530

BATTERY EMERGENCY LIGHTING FIXTURES

PART 1 - GENERAL

1.01 DESCRIPTION

A. Work Included:

1. Furnish, install and connect a complete system of conduits, conductors, unit type battery emergency lighting fixtures and all other materials and equipment necessary for the installation of an emergency lighting system.

1.02 QUALITY ASSURANCE

A. Regulations, Standards and Publications:

FM Factory Mutual Engineering Corp.
NEC National Electrical Code of National Fire Protection Association
UL Underwriters' Laboratories

B. Qualification:

1. The complete system shall be of a type, which has been in satisfactory service for at least one year under automatic emergency lighting conditions.

2. Provide manufacturer specified for each fixture type. Substitutes will not be accepted without approval prior to the bid.

3. When more than one name of manufacturer of fixture is listed in these specifications, the first manufacturer and number determine the style and quality.

1.03 SUBMITTALS

A. Shop Drawings:

1. Submit manufacturer's latest publication of the following:

a. Battery Unit
b. Fixed Heads
c. Remote Heads
d. Combination Battery Emergency/Exit Fixtures
e. Battery Exit Fixtures

PART 2 - PRODUCTS

2.01 MATERIALS

A. Battery Units:

1. EA/EAR: Battery emergency light fixtures shall have a nonmetallic housing. Fixture shall be provided with a test switch, status indicator and a rechargeable Nickel Cadmium battery. The battery shall provide 90 minutes of emergency illumination. Fixture shall operate on 120 volts and shall be furnished with two 2-watt LED lighting heads. Fixture shall be Holophane #DM30-WL-LED, Crouse-Hinds #N2LPS12222, or approved equal. Battery emergency remote heads shall be Holophane ELA-QM-T-L0309 or Crouse-Hinds #N2RF1222, or approved equal.

B. Combination Battery Emergency/Exit Fixtures:

1. EB: Combination exit fixture/battery emergency light fixtures shall be back mounted, single faced with red (confirm color with local code) high intensity LED lamps and sealed nickel cadmium battery. The fixture housing shall be white polycarbonate. The exit fixtures shall operate on 120 VAC power. Fixture shall be Holophane Magellan #QM-LED-R-HO-SD, Sure-Lites #LPX7DHNCl, or approved equal.

C. Exit Fixtures:

1. EC: Exit fixtures shall be back mounted, single faced with red high intensity LED lamps and a sealed nickel cadmium battery. The fixture housing shall be white polycarbonate. The exit fixtures shall operate on 120 VAC power and shall be Holophane Magellan #QM-R-HORO, Sure-Lites #LPX7, or approved equal.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Battery Unit:

1. Battery units shall be firmly fastened to walls. Mounting height to be determined in field.

B. Wiring:

1. Wiring on low voltage side of unit shall be no smaller than #10.

2. Connect battery emergency lighting units and exit fixtures to lighting circuit for area being protected ahead of all local control switches.

END OF SECTION

SECTION 17010

PUMP CONTROL SYSTEM GENERAL REQUIREMENTS

PART 1 - GENERAL

1.01 DESCRIPTION

A. Work Included:

1. The Contractor shall obtain the services of a subcontractor who shall provide a complete integrated Pump Control System (PCS) consisting of a motor control center, variable frequency drives, control panels, instrumentation, and programmable controller system hardware and software, as shown on the Pump Control System Drawings and as specified in Division 17. This subcontractor will hereafter be referred to as the Pump Control System Supplier. The System Supplier shall have total responsibility for the design, programming, testing, start-up and commissioning of the Pump Control System.

2. The Pump Control System Supplier shall be one of the following System Integrators. No other suppliers will be accepted without approval prior to the bid:

Micro-Tech Designs, Inc.
4312 Black Rock Rd.
Suite 1
Hampstead, MD 21074
410-239-2885
Contact: Mark Duvall

S-L Controls, Inc.
2140 Renard Court
Annapolis, MD 21401
410-841-6810
Contact: Steve Vinceguerra

Optimum Controls Corp.
1301 Rosemount Blvd.
Reading, PA 19604
610-375-0990
Contact: Jim Brunell

Trijay Systems, Inc.
10 Maple Avenue
Line Lexington, PA 18932
215-997-5833
Contact: Jim Arevalo

Allied Control Services, Inc.
611 Garfield Ave.
West Point, PA 19486
(215) 699-2955
Contact: Paul Mamzic

1.02 QUALITY ASSURANCE

A. Regulations, Standards and Publications:

ANSI	American National Standards Institute
IEEE	Institute of Electrical and Electronic Engineers
ISA	International Society of Automation
NEC	National Electrical Code
NEMA	National Electrical Manufacturers Association
UL	Underwriters' Laboratories, Inc.

B. Quality Control:

1. All components of the Pump Control System shall be new and of the most current and proven design. All components shall be suitable for the intended application and shall be installed and wired in strict accordance with the manufacturer's requirements. The System Supplier shall provide all necessary transformers, power supplies, fusing, and grounding required to meet the manufacturer's requirements.

2. The complete system must comply with all Federal, State, Municipal, or other authority's laws, rules, or regulations.

3. All motor control centers, variable frequency drives, and control panels, and their components and materials, shall bear the label of the Underwriters' Laboratory. All control panels shall be UL listed as a complete assembly.

C. Equipment Manufacturers:

1. The Pump Control System Supplier shall base his bid on providing the manufacturers specified under Division 17 for all equipment furnished for the System. No substitutes will be allowed.

1.03 SUBMITTALS

A. Shop Drawings:

1. Submit required number of detailed shop drawings for all equipment being provided for the Pump Control System. Shop drawings shall be submitted within 90 days of the date of Notice to Proceed.

2. Shop drawings shall be submitted in 3-ring loose-leaf binders and shall be complete, neat, orderly, and indexed. Separate shop drawing submittals shall be made for each of the following:

a. Motor Control Center

b. Variable Frequency Drives

c. Control Panels

d. Instrumentation

e. Programmable Controller System Hardware and Software

f. PLC Program

g. Factory Acceptance Test Plan

h. Loop Check-out Sheets

3. Refer to specification sections for specific shop drawing requirements.

4. The System Supplier shall submit a complete set of engineered drawings for the Motor Control Center, Variable Frequency Drives, Control Panels, and Programmable Controller system hardware. These engineered drawings shall be similar to the Contract PCS Drawings, and shall be done by the System Supplier using AUTOCAD. The drawing size shall be 11"x17". These drawings shall include, but not be limited to, the following:

   a. Motor Control Center elevation showing all unit locations, door mounted devices and dimensions.

   b. A chart for the Motor Control Center indicating nameplate engraving, starter size and type, circuit breaker size and type, transformer size, special controls, motor horsepower, and overload heater size, for each Motor Control Center unit.

   c. Three line wiring diagrams for each motor control center unit showing power and control wiring, unit devices, terminal numbers, and interconnecting wiring.

   d. Variable Frequency Drive elevation showing all door mounted devices and dimensions.

   e. Wiring diagrams for each variable frequency drive showing power and control wiring, unit devices, terminal numbers, and interconnecting wiring.

   f. Control panel elevation, details, front and back panel layout, and wiring diagrams showing terminal numbers and interconnecting wiring. The control panel layout drawings shall include dimensions for the location of all panel-mounted devices.

   g. Programmable controller system block diagram, power wiring diagrams and I/O wiring diagrams showing terminal numbers and

interconnecting wiring. The I/O wiring diagrams shall include the PLC address for each input and output.

B. Installation, Operation and Maintenance Manuals:

1. Submit required number of copies of installation, operation and maintenance manuals for all equipment being provided for the Pump Control System.

2. Installation, operation and maintenance manuals shall be submitted in 3-ring loose-leaf binders, and shall be complete, neat, orderly and indexed. Separate binders shall be submitted for each of the following:

a. Motor Control Center
b. Variable Frequency Drives
c. Control Panels
d. Instrumentation
e. Programmable Controller System Hardware and Software

PART 2 - PRODUCTS

2.01 SEE SPECIFIC SECTIONS FOR PRODUCTS

PART 3 - EXECUTION

3.01 COORDINATION

A. The Pump Control System Supplier shall attend an initial coordination meeting with the Engineer, the Contractor, and the Owner to review the scope of the project and the project schedule.

3.02 FACTORY ACCEPTANCE TEST

A. The System Supplier shall conduct a factory acceptance test for the Pump Control System prior to shipment of the equipment. The factory test shall be conducted at the supplier's facility and shall demonstrate the control system was designed and performs in accordance with the Specifications and Drawings.

B. The System Supplier shall provide all necessary equipment and hardware required to conduct the factory test.

C. The factory acceptance test shall demonstrate the proper operation of all system hardware and software, and all PLC and HMI control logic described in the Description of Operation. The factory test shall demonstrate the operation of all HMI graphic displays. The factory test shall be witnessed by the Engineer and the Owner.

D. Submit an itemized test procedure and schedule for the factory acceptance test to the Engineer for his review prior to the actual test.

3.03 RECORD DRAWINGS

A. Submit required number of as-built drawings for the Pump Control System prior to the delivery of any equipment to the site. Provide an as-built drawing in the control panel.

B. Following start-up and commissioning of the system, the System Supplier shall make all necessary changes to the as-built drawings and re-submit required number of final as-built drawings. A final as-built drawing shall also be provided in the control panel.

3.04 SYSTEM INSTALLATION, START-UP AND COMMISSIONING

A. System Installation:

1. The System Supplier shall provide on-site supervision and advice to the installing contractor to insure the system is installed in accordance with the specifications and the manufacturer's requirements.

2. All field wiring to the equipment furnished by the System Supplier shall be performed under the electrical work unless noted otherwise on the Drawings.

B. Loop Check-out:

1. The System Supplier shall perform loop check-out for each loop to verify that the wiring, programming and documentation for the loop are correct. The loop check-out shall check each input from its origination point back to the PLC and each output from the PLC to its destination point. The loop shall be verified at the PLC and the operator interface terminal.

2. Loop check-out sheets shall be provided by the System Supplier which shall be used for the record sign-off for each loop. The loop check-out sheets shall be submitted to the Engineer at least 30 days prior to loop check-out.

3. The System Supplier shall provide a minimum of two people on site for the duration of the loop check-out.

C. System Start-Up:

1. Start-up the control system by energizing the system equipment and testing the operation of all hardware, software, pump control logic, and all customized software programs.

2. All start-up and testing shall be scheduled, performed in an orderly sequence, and conducted in the presence of and to the satisfaction of the Engineer and the Owner.

D. System Commissioning:

1. Calibrate all instrumentation, and place the complete pump control system into operation. The commissioning of the system shall include the overall calibration and tuning of all control loops and sequences to provide stable control of the pumps. The validity of all inputs and outputs for the system shall be checked and verified during the system commissioning.

2. The System Supplier shall provide a minimum of two people on-site for the length of time necessary for system start-up and commissioning.

3.05 FINAL ACCEPTANCE TEST

A. Following the commissioning of the Pump Control System, and the issuance of the Certificate of Substantial Completion to the Contractor by the Engineer, a final acceptance test shall be conducted for a period of 30 consecutive days. This test shall be scheduled with the Owner and the Engineer and shall not begin until the System Supplier receives written approval to start. During that time period, the system shall operate satisfactorily and in compliance with the Specifications. The System Supplier shall promptly correct any problems that occur during the acceptance test.

B. Following the successful completion of the final acceptance test, a certificate of final acceptance will be issued to the System Supplier.

3.06 EXPANSION OF SYSTEM I/O

A. The System Supplier shall include in his cost for this Contract the addition of 10 I/O points to the system as directed by the Engineer. These additional I/O points will originate from the spare I/O. The Supplier's allowance shall include all costs to add these points to the system including wiring, drawing changes, PLC programming, field verification and testing.

3.07 ADDITIONAL SOFTWARE CONFIGURATION AND PROGRAMMING

A. The System Supplier shall include in their cost for this Contract 80 additional manhours of on-site time for software configuration and programming. This time shall be utilized for changes and/or additions that may be required after the commissioning of the system. The Supplier's cost for these additional manhours shall include software documentation changes, and updates to the O&M Manuals. The additional programming and configuration shall be performed during start-up and during the one-year warranty period.

3.08 TRAINING

A. During the Final Acceptance Test, the System Supplier shall arrange for the instruction and training of the Owner at the pump station site in the operational procedures of the system. At the end of this period, the Owner shall have, as determined by the Engineer, sufficient knowledge to operate the system. This training shall be for six people for eight (8) hours. Training shall be conducted on two separate days with four (4) hours of training being performed each day.

B. This training shall be in addition to the training specified in the other Division 17 sections.

END OF SECTION

SECTION 17100

MOTOR CONTROL CENTER

PART 1 - GENERAL

1.01 DESCRIPTION

A. Work Included:

1. Furnish and install a motor control center in the pump station as shown on the Drawings.

2. The motor control center shall include required number of vertical sections, main breaker, automatic transfer switch, power monitor, surge protective device, circuit breakers, combination type motor starters, panelboard, panelboard transformer, variable frequency drives, control transformers, relays, selector switches, push buttons, pilot lights, and special controls as shown on the Drawings and specified herein.

3. See Section 17110 for the variable frequency drives.

B. Special Requirements:

1. The Motor Control Center shall be provided by the Pump Control System Supplier.

1.02 QUALITY ASSURANCE

A. Regulations, Standards and Publications:

ANSI	American National Standards Institute
NEC	National Electrical Code
NEMA	National Electrical Manufacturers Association
UL	Underwriters' Laboratories, Inc.

B. Quality Control:

1. The motor control centers shall be new and limited to products regularly produced and recommended for service ratings in accordance with engineering data or other comprehensive literature. In all cases where device, or devices, or part of equipment is herein referred to in singular, reference shall apply to as many items as required to complete installation.

2. All internal conductors are to be of sufficient cross-sectional area copper to carry the rated ampere load and not exceed the maximum heat rise above ambient temperature specified by UL and NEMA.

1.03 SUBMITTALS

A. Shop Drawings:

1. Submit in accordance with the General Requirements. Shop drawings shall be complete in all respects and shall indicate all dimensions, installation methods, size, weight, capacity, ratings, integral controls and types of materials, elevations, and sections. Shop drawings shall include manufacturer's literature and complete information on the following:

a. Freestanding Vertical Sections
b. Main Circuit Breaker
c. Automatic Transfer Switch
d. Power Monitor
e. Surge Protective Device
f. Thermal-Magnetic Type Circuit Breakers
g. Motor Circuit Protector Type Circuit Breakers
h. Magnetic Across-the-Line Motor Starters
i. Panelboard Transformer
j. Panelboard
k. Control Transformers
l. Relays
m. Selector Switches
n. Push Buttons
o. Pilot Lights
p. Elapsed Time Meters
q. Special Controls
r. Engineered Control Diagrams and Connection Diagrams
s. Nameplate Schedules

1.04 MANUFACTURER

A. The motor control center shall be Allen-Bradley Centerline 2100, Square D Model 6, or approved equal.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Motor Control Center Structure and Configuration:

1. The Motor Control Centers shall be NEMA Type 1, gasketed. Wiring shall be NEMA Class 1, Type B. The motor control center shall have a main breaker to feed the horizontal bus. Provide lugs of adequate size to terminate incoming cables. The motor control center shall be furnished with a ground bus, and a neutral bus as indicated on the Drawings.

2. The motor control center shall be rated at 480 volts, 3 phase, 4 wire, 60 Hz and shall be braced to withstand a short circuit current of 65,000 rms symmetrical amperes.

3. Motor starter units shall be combination type with a molded case circuit breaker. Control voltage for units shall be 120 volts.

4. The motor control center shall consist of vertical sections bolted together to form a rigid, freestanding assembly.

5. Vertical sections shall be formed of 13 gauge hot rolled steel with uniform blemish-free surfaces. Top and bottom structural parts shall be 10 gauge. End closing plates shall be 12 gauge, and unit parts and doors shall be 14 gauge. Base channels shall be provided constructed of rugged steel to easily withstand the stress of transit and moving the control center into position. Bolt holes in the base channels shall be provided in all sections for the purpose of bolting the control center to the floor. Steel removable lifting angles shall be provided on the top of the sections for convenience in handling the control center.

6. Each section, to comply with standards of NEMA, shall be approximately 90" high excluding lifting angles and base channels. It shall be 20" deep by 20" to 35" wide, as indicated on the Drawings.

7. End sections shall have end-closing plates, which can be removed for the addition of future sections. The top plate shall be of a removable one-piece construction for added convenience in cutting conduit holes. Removable blank plates flanged on all 4 sides and having captive screws shall cover all unused unit spaces.

B. Main Circuit Breaker:

1. Main circuit breaker shall be solid state electronic trip, individually mounted and identified, and shall be 100% rated. Main circuit breaker shall have quick-make, quick-break mechanism and shall visually indicate whether the breaker is closed, open or tripped.

2. The main breaker shall have sufficient interrupting capacity to properly close against and interrupt instantaneously, without damage, the maximum short circuit current available at the breaker. Minimum interrupting capacity shall be 65,000 amperes symmetrical at 480 volts.

3. The main breaker shall have adjustable long time, short time, and instantaneous trip settings.

C. Automatic Transfer Switch:

1. Furnish a 600 amp, 480 volt, 3-pole, 4-wire automatic transfer switch in the MCC for utility and generator service. The transfer switch shall be suitable for continuous operation and shall consist of a double throw power transfer mechanism and a microprocessor controller. Provide lugs in the MCC for the transfer switch wiring.

2. The transfer switch shall be arranged to close a contact for remote starting of the emergency generator, after a time delay of 0-6 seconds, after power failure or drop in any phase voltage to 70 percent of line voltage. During the delay period, the load circuits shall not be disconnected from the normal service lines.

3. When the generator is delivering not less than 95 percent of rated voltage and frequency, the load circuits shall be transferred. Retransfer to normal service shall be automatic when full line voltage and phase are restored after a time delay of 0 to 5 minutes, set for 3 minutes. Provisions shall also be made for manual transfer to the generator. After transfer to normal source, the generator shall continue to run for 5 minutes (adjustable 0 to 25 minutes) unloaded, shall shut down and shall be ready to start upon the next failure of the normal source or for manual start-up. If the generator should fail while carrying the load, retransfer to the normal source after a short delay shall be made upon restoration of the normal power. The pick-up and drop-out settings of the phase voltage-sensing relays shall be completely adjustable in the field from 70 percent to 100 percent pick-up and drop-out.

4. The transfer switch shall be double-throw switch operated by a single coil mechanism momentarily and electrically. Operating current for transfer shall be obtained from the source to which the load is to be transferred. Failure of any coil or disarrangement of any parts shall not permit a neutral position. The switch shall be positively locked mechanically on either source without the use of hooks, latches, semi-permanent magnets, or contacts. All contacts and coils shall be readily accessible for replacement from the front of the panel without major disassembly of associated parts.

5. The transfer switch shall be equipped with a test button, and auxiliary contacts as required to show that the switch is in the normal or emergency position. Provide pilot lights on the MCC door to indicate the switch position.

6. Auxiliary contacts shall be provided for remote indication of the transfer switch position. These contacts shall be wired to a terminal block in the transfer switch for wiring to the PLC System.

7. The transfer switch shall have a load test switch to simulate normal power failure.

8. The transfer switch shall be furnished with an in-phase monitor.

9. Provide a 7-day solid-state exercise clock to set the day, time and duration of the generator exercise period. Furnish a selector switch to enable the generator to be exercised with or without load.

10. Minimum withstand and closing ratings shall be in accordance with UL 1008.

11. The automatic transfer switch shall be ASCO 7000 Series, or approved equal.

12. The automatic transfer switch shall be furnished with all software, programs and cables necessary for maintenance and adjustment of the transfer switch.

D. Power Monitor:

1. Provide a power monitor in MCC-C to provide complete electrical metering. The power monitor shall be microprocessor based and shall be furnished complete with current transformers. The power monitor shall be Allen-Bradley PM 5000, or approved equal.

2. The power monitor shall be furnished with an alarm contact for remote indication of a power failure. This contact shall be wired to terminals in the MCC cubicle for wiring to the plant PLC System.

E. Surge Protective Device:

1. A surge protective device shall be furnished in MCC-C. The surge suppressor shall be UL 1449 Second Edition Listed (1998). Unit shall protect all modes (L-L, L-N, L-G, N-G) applicable. Unit shall have 240kA of surge capacity per phase with a let-thru voltage of less than 1500V L-L and 700V L-G. A disconnecting means shall be provided ahead of the surge suppressor so the unit can be serviced without de-energizing the service.

2. Surge suppressor shall have AC tracking filter with EMI/RFI filtering. Each module shall be fused individually, thermally protected, and have LED indication.

3. The surge suppressor shall be furnished with a dry alarm contact to indicate a failure of any module. The alarm contact shall be wired to terminals in the MCC cubicle for wiring to the plant PLC System.

4. Surge protective device shall be provided and installed by MCC manufacturer. Surge suppressor shall be APT Transient Eliminator XGA Series, or approved equal.

F. Horizontal Wireways:

1. Adequate conduit entrance space and wire entry room shall be provided at both the top and bottom of each section. The bottom horizontal wireway shall be 12" and the top horizontal wireway shall be 6" and both shall extend through the length and depth of the control center section with openings between sections. Covers over these wireways shall be equipped with captive type screws to prevent loss of hardware during installation. These wireways shall be isolated from the bus bars.

G. Vertical Wireways:

1. A vertical wire trough located on the right-hand side of each standard section and having a cross-sectional area of not less than 28 sq.in. shall extend from the top horizontal wire trough to the bottom horizontal wire trough for the purpose of routing user's motor and control wires to the control units. The wire trough shall be isolated from the bus bars to guard against accidental contact. A separately hinged door having captive type screws shall cover the vertical wire trough for safe and easy access to wiring without disturbing control units.

2. Wire ties shall be furnished in the vertical wire trough to group and securely hold wires in place for a neat, orderly installation.

3. Where wire access ports between unit spaces and vertical wire trough are open, shutters shall be provided to prevent items, such as a fish tape, from accidentally entering the unit space. Snap-in wire grommets shall be provided in wire access ports for size 2 units and smaller for isolation and added protection of small wires. For larger units, snap-in wire guards shall be provided for added protection of larger wires.

H. Vertical Sections:

1. Each vertical section shall be divided into compartments, each containing a combination starter or other control assembly as indicated on the Drawings. Power shall be provided to these compartments from the main bus by bus bars extending the full height of the unit. Sections shall also be provided with horizontal spaces at the top and at the bottom, which shall

line up with adjacent section to form horizontal wiring raceways along the entire length of the control center.

I. Compartments:

1. Compartments shall be built in interchangeable combinations of modular heights. A full vertical section shall contain six equal NEMA size l modular compartments exclusive of top and bottom wiring spaces. Starter compartments shall not be less than 12" high. Only l/2 and integral multiples of the basic module will be allowed. Compartments for NEMA size 4 and smaller starters shall be draw out type.

2. Guide rails shall be provided in the structure for supporting and aligning a unit during its removal or replacement. Draw out units shall have pressure type, line disconnecting stabs of high strength alloy and shall be held in place by means of quick acting, captive machine screw fasteners arranged so the units can be removed or remounted readily without access to the rear of the structure. Each compartment whether draw out or stationary, shall be enclosed and effectively baffled to isolate any fault which may occur and shall be covered by an individual door fixed to the structure with a continuous full length piano hinge or two (three for doors over 36" high) semi-concealed, heavy-duty, pin type hinges. Doors shall be secured with captive, quick acting machine screw fasteners and shall be arranged to completely cover all live parts whether the draw out unit is present or not.

J. Bus Bars:

1. Main horizontal bus bars rated as indicated on Drawings but not less than 600 amperes shall be provided at the top or center of the control center and extend its entire length, except when cut and supplied with splice bars to divide the control center for ease in handling or when section is indicated on Drawings to be furnished without bus.

2. Horizontal bus bars of copper shall be mounted edge-to-edge to provide greater mechanical strength.

3. Vertical copper bus bars shall be rated not less than 300 amperes for adequate current carrying capacity in a variety of plug-in applications.

4. Horizontal and vertical bus bars shall be electrolytically tin plated copper. Connections between horizontal and vertical busses shall be joined by bolts, conical spring washers for constant pressure joints and self-clinching nuts to allow joint maintenance from the front.

5. High strength glass reinforced alkyd insulators shall be used as bus supports and as unit plug-in insulators. Bus and plug-in insulators shall be red to indicate the proximity of energized bus parts.

6. The temperature rise, above ambient temperature outside the enclosure, of bus bars and connections shall not exceed 50°C and that of connections to insulated cable shall not exceed 45°C when operated continuously at rated current. Buswork, wiring and equipment shall be rated to withstand short circuits of 65,000 rms symmetrical amperes at 480 volts or as noted on the Drawings.

7. A copper ground lug shall be provided in each incoming line vertical section capable of accepting a #8 to 250 MCM cable. A horizontal and vertical copper ground bus shall be provided in each section of the motor control center. Horizontal ground bus shall run continuously throughout the control center except where splits are necessary for ease of shipment and handling; in which case, splice bars shall be provided. Ground bus shall be tin plated copper and have a cross-sectional area of equal to 28% of the main horizontal bus cross-sectional area. Horizontal ground bus shall be located at the bottom of the motor control center.

K. Bus Barriers:

1. Insulated horizontal and vertical bus barriers shall be furnished to reduce the hazard of accidental contact. These barriers shall have a red color to indicate proximity to energized busses. Vertical bus barriers shall have interlocking front and back pieces to give added protection on all sides and shall segregate the phases from each other. Small, separate openings in the vertical bus barriers shall permit unit plug-in contacts to pass through and engage the vertical bus bars.

2. Bottom bus covers shall be provided below the vertical bus to protect the ends of this bus from contact with fish tapes or other items entering the bottom of the enclosure. Unused plug-in openings shall have plastic snap-in closing plates.

L. Unit Plug-In:

1. Unit plug-in contacts shall be provided for size l through size 5 motor starters and for branch circuit breakers.

2. The plug-in connection shall be 2-point connection for each phase designed to tighten during heavy current surge. The plug-in fingers shall be tin plated to yield a low resistance connection and shall be backed by spring steel clips to provide high-pressure connection points. Contact fingers shall be mounted in their support so these fingers become floating and self-aligning to allow solid seating onto the vertical bus bars.

M. Unit Doors:

1. Each unit shall have a door securely mounted with hinges, which allow the door to swing open a minimum of 112 degrees. Unit doors shall be fastened to the stationary structure so they can be closed to cover the unit space when the units have been temporarily removed. Unit doors shall be held closed with captive type screws, which engage self-aligning cage nuts. These screws shall provide at least 2 threads of engagement to help hold unit doors closed under fault conditions. Removable door panels held captive type screws shall be provided on starter unit doors for mounting push buttons, selector switches or pilot lights. Blank door panels capable of accepting future push button devices shall be furnished when push button devices are not originally specified for starter units. Starter units shall have an external low profile overload reset button.

2. Pilot devices and instruments, including push buttons, reset buttons, and indicating lights, shall be flush mounted in the compartment doors. Equipment shall not be mounted on the rear of draw out units. All equipment within the unit shall be arranged to provide ample electrical clearances and easy access for maintenance. Draw out combination starter unit of a given type and size shall be made interchangeable. Only those items, which are common to all starters, shall be mounted in the unit.

3. Where a spare unit is indicated on the Drawings, it shall be a complete combination starter of the type and size shown.

N. Unit Support Pan:

1. Each plug-in unit shall be supported and guided by a tilt and lift-out removable pan so unit rearrangement is easily accomplished. For easy unit installation and rearrangement, transfer of this unit support pan from one location to another shall be accomplished without the use of tools after the unit and door have been removed.

O. Unit Saddles:

1. Each plug-in unit shall have a sheet steel saddle designed to physically isolate the unit from the bus compartment and adjacent units. Saddles shall be equipped with captive, self-aligning mounting screws, which hold the unit securely in place during shipment and maintain the unit and structure at the same potential. Handholds shall be provided on each plug-in unit to facilitate unit removal.

P. Disconnect Operator:

1. A flange mounted operator handle shall be supplied for each switch or breaker. To prevent false circuit indication, this mechanism shall be

engaged with the switch or breaker at all times regardless of unit door position. The operator handle shall have a conventional up-down motion with the down position as "OFF." It shall be possible to lock this handle in the "OFF" position with up to three 3/8" diameter shackle padlocks. The operator handle shall be color coded to display red in the "ON" position and black in the "OFF" position.

2. The operator handle shall be interlocked with the unit door so the disconnect cannot be switched to the "ON" position unless the unit door is closed. It shall be possible to defeat this interlock by a deliberate act of an electrician should he desire to observe the operation of the operator handle assembly. This interlock shall also prevent opening the unit door, unless the disconnect is in the "OFF" position. A defeater for this action shall also be provided in the event an electrician must gain access to the unit without interrupting the service.

Q. Starter Units:

1. Starter units shall be completely draw out Type B, sizes as indicated on the Drawings, so units may be withdrawn without disconnecting any wiring. Units over three space units high may be bolt-in type. A positive guidance system shall be provided to assure proper alignment of wedge-shaped power stabs in dead-front openings in vertical power bus. The screw racking mechanism shall serve as a mechanical advantage to the operator during unit insertion or removal. Stab-in power terminals shall be of a type that will increase contact pressure on short circuits.

2. All starter units shall be rated to withstand short circuits of 65,000 rms symmetrical amperes at 480 volts or as noted on the Drawings.

R. Thermal Magnetic Type Circuit Breakers:

1. Thermal magnetic circuit breakers shall have quick-make, quick-break mechanisms and shall visually indicate whether the breaker is closed, open or tripped.

2. All breakers shall have sufficient interrupting capacity to properly close against and interrupt instantaneously, without damage, the maximum short circuit current available at the breaker. Minimum interrupting capacity of breakers shall be 65,000 amps rms symmetrical at 480 volts.

3. Provide auxiliary contacts on the circuit breakers where indicated on the Drawings.

S. Motor Circuit Protector Type Circuit Breakers:

1. Motor circuit protector type circuit breakers shall be used for all branch circuit breakers for motor circuits. Breakers shall be instantaneous trip, magnetic only type.

2. Each breaker shall be furnished with a single magnetic trip adjustment, which simultaneously sets the magnetic trip level of all poles. Adjustment shall be continuous throughout the trip range. Minimum interrupting capacity of breakers shall be 65,000 amps rms symmetrical at 480 volts.

3. Provide auxiliary contacts on the circuit breakers where indicated on the Drawings.

T. AC Magnetic Starters - Line Voltage Type:

1. Motor starters shall be across-the-line magnetic type, rated in accordance with NEMA standards, sizes and horsepower ratings. Starter sizes shall be as indicated on the Drawings.

2. Across-the-line magnetic starters shall be equipped with double-break, silver alloy contacts. All contacts shall be replaceable without removing power wiring or removing starter from panel.

3. Coils shall be of molded construction and shall operate on 120 volts AC. All coils shall be replaceable from the front without removing the starter from the panel.

4. Overload relays shall be solid state electronic type.

U. Electrical Interlocks:

1. All starters shall be furnished with electrical interlocks as shown on the Drawings plus one spare normally open and one spare normally closed contact. Arrangements shall be convertible from normally open to normally closed.

V. Panelboard Transformer:

1. Provide a lighting transformer in MCC-C as shown on the drawings. The rating shown on the drawings shall be the minimum acceptable rating.

2. The insulation shall be 180°C insulation with 80°C rise.

3. Provide a circuit breaker with thermal magnetic trip for primary protection.

4. Provide a secondary fuse protection for the transformer. The primary circuit breaker compartment and transformer compartment shall be interlocked together and factory wired together.

W. Panelboard:

1. Provide a panelboard in MCC-C as shown on the Drawings.

2. The panelboard shall be rated for 14kA interrupting capacity.

3. Provide bolt-on branch breakers for the panelboard.

X. Control Transformers:

1. Provide a control transformer for each motor starter control circuit as indicated on the Drawings. Control transformers shall be 480 volts to 120 volts and shall have primary and secondary fusing. The primary fuses shall be Class "CC".

2. The control transformers shall be sized as required for the load being powered, plus 50VA spare capacity.

Y. Relays:

1. Relays shall be heavy-duty general-purpose type with 10 amp contacts. Relays shall have pin type terminals, which plug-in to a socket, mounted to the inside of the MCC bucket. Contact configuration shall be 3PDT.

2. Relay coils shall operate on 120 volts AC, unless indicated otherwise on the Drawings. Relays shall have an indicator light to indicate the relay coil is energized.

Z. Selector Switches:

1. Selector switches shall be non-illuminated. Switches shall be 30mm, heavy-duty, oil tight. Switches shall have double-break silver contacts. All switches shall be maintained contact type unless otherwise indicated on Drawings.

2. Provide auxiliary contact blocks as indicated on the Drawings.

AA. Push Buttons:

1. Push buttons shall be non-illuminated. They shall be 30mm, heavy-duty, oil tight. Contacts rated for 10 amps minimum. Push buttons shall be momentary contact type unless noted otherwise on the Drawings.

BB. Pilot Lights:

1. Pilot lights shall be LED, push to test, transformer type. They shall be 30mm, heavy-duty, oil tight. Voltage rating shall be 120 volts. Color caps shall be green for "run", and red for "alarm".

CC. Elapsed Time Meters:

1. Elapsed time meters shall be time totalizer, non-resettable. They shall have a synchronous motor, which shall drive a set of digit readout wheels to indicate the total time the unit is energized. Readout shall be five-digit including 1/10 digit. Range shall be 0 to 9999.9 hours. Voltage rating shall be 120 volts.

2. Elapsed time meters shall be ENM Company Series T50, or approved equal.

DD. Legend Plates:

1. Provide an engraved legend plate for each pilot device. Engraving shall be as indicated on the Drawings.

EE. Identification:

1. A control center identification number nameplate describing section catalog numbers and characteristics shall be fastened on the vertical wire trough door of every section. Each control center unit shall have its own identification number nameplate giving unit catalog number fastened to the unit saddle near the upper left-hand corner. These nameplates shall also have suitable references to factory records for efficient communication with supplier.

2. Each control center unit shall also have an engraved Bakelite nameplate fastened to the outside of each unit door. Nameplates shall be black with white engraving.

FF. Wiring:

1. The motor control center shall be wired in accordance with NEMA class and type previously specified and shall be furnished to be interconnected with a programmable controller system.

2. All 120 VAC control wiring shall be red. All wiring in each MCC cubicle shall be labeled.

3. Quick separating, pull apart terminals shall be mounted on lift-out brackets in the units. All terminals shall be labeled.

GG. Finish:

1. All painted parts shall undergo a phosphatizing pre-painting treatment for rust resistance and good paint bond. All painting shall be with enamel, which shall be baked for a durable, hard finish. Unit saddles shall be painted white for easy interior visibility. Removable push button plates, flange mounted operator handles and trim plates, and top horizontal wire trough cover plates shall be painted a contrasting charcoal gray. Other painted parts shall be painted ANSI-49 medium light gray.

2. All unpainted parts shall be plated for resistance to corrosion.

2.02 SPARE PARTS

A. Provide the following spare parts for the motor control center:

1. One (1) Relay for each type utilized

2. Six (6) Fuses for each type and size utilized

B. Spare parts shall be packaged individually in boxes that are clearly labeled with part name and manufacturer's part/stock number.

PART 3 - EXECUTION

3.01 FIELD SERVICES

A. Main Breaker Adjustment and Testing:

1. Contractor shall adjust the settings for the main breaker in accordance with the coordination study.

2. Contractor shall have a factory-authorized representative present with required test equipment to test the ground fault protection device and explain operation in the presence of the Owner and also submit results of test in writing.

B. Start-up and Testing:

1. Test the operation of each motor starter and all MCC controls.

2. Test the operation of the power failure and SPD alarm contacts.

3. Test the operation of the automatic transfer switch with the emergency generator.

4. All start-up and testing shall be performed in the presence of the Owner and the Engineer.

C. Training:

1. Provide two (2) hours of training on the motor control center. Training shall include theory of operation, maintenance and troubleshooting procedures.

END OF SECTION

SECTION 17110

VARIABLE FREQUENCY DRIVES

PART 1 - GENERAL

1.01 DESCRIPTION

A. Work Included:

1. Furnish and install variable frequency AC drives as shown on the Drawings and specified herein.

2. The variable frequency drives shall be mounted in the motor control center as shown on the Drawings.

B. Special Requirements:

1. The variable frequency drives shall be furnished by the Pump Control System Supplier, who shall be responsible for coordinating the drive start/stop and speed controls.

1.02 QUALITY ASSURANCE

A. Regulations, Standards and Publications:

ANSI	American National Standards Institute
NEC	National Electrical Code
NEMA	National Electrical Manufacturers Association
UL	Underwriters Laboratories, Inc.

1. The drives shall be built to applicable NEMA standards and be suitable for use as a component to meet NEC requirements. Drives shall be listed by Underwriters Laboratories (UL).

B. Quality Control:

1. All variable frequency drives shall be new and limited to products regularly produced and recommended for service ratings in accordance with engineering data or other comprehensive literature. In all cases where device, or devices, or part of equipment is herein referred to in singular, reference shall apply to as many items as required to complete installation.

2. All incoming material shall be inspected and/or tested for conformance to quality assurance specifications. All chips (CMOS, TTL, LINEAR, etc.) shall be functionally tested.

3. All subassemblies shall be inspected and/or tested for conformance to vendor's engineering and quality assurance specifications.

4. All drives shall be burned-in at the factory, cycling load to simulate no load/full load and exercise drive power components.

1.03 SUBMITTALS

A. Shop Drawings:

1. Submit in accordance with the requirements of Section 17010. Shop drawings shall be complete in all respects and shall indicate all dimensions, installation methods, size, weight, capacity, ratings, integral controls, elevations, and sections. Shop drawings shall include manufacturer's literature and complete information on the following:

a. Variable Frequency Drives
b. Line Reactors
c. Wiring Diagrams

2. The panel layout drawings and VFD wiring diagrams shall be customized for this project. Standard drawings will not be accepted.

1.04 MANUFACTURER

A. The Variable Frequency Drives shall be Allen-Bradley PowerFlex 753, Square D Altivar 61, or approved equal.

1.05 WARRANTY

A. Each Variable Frequency Drive shall be furnished with a 2-year warranty, which shall commence on the date of start-up by a factory authorized VFD service representative.

PART 2 - PRODUCTS

2.01 VARIABLE FREQUENCY DRIVES

A. General:

1. The variable frequency drives shall convert a fixed frequency, three phase input power to an adjustable AC frequency and voltage source for controlling the speed of a standard, NEMA Design B, AC induction motor.

2. The drives shall be fully digital, microprocessor controlled and shall incorporate a diode bridge rectifier and a transistorized inverter section. IGBT type power transistor modules shall be utilized in the inverter section

to invert a fixed DC bus voltage to a symmetrical three-phase pulse-width modulated (PWM) output voltage.

3. The drives shall accept incoming 480 VAC, 60 Hz line power, and shall not be affected by voltage fluctuations of ±10% or frequency fluctuations of ±2%. The drive shall include phase-to-phase and phase-to-ground protection, and transient voltage surge protection.

4. Each variable frequency drive shall be designed to operate a 460 volt, 3 phase AC induction motor in an ambient temperature of 32 to 104°F. The drive output amp rating shall exceed the motor nameplate FLA rating. Refer to drawings for motor horsepower and specs for motor RPMs.

B. Drive Enclosure:

1. The variable frequency drives shall be mounted in motor control centers as shown on the Drawings. Provide ventilation fans and louvers as required to dissipate the heat generated by the drive.

C. Drive Operating Characteristics:

1. The drive operation shall be fully digital with microprocessor control of frequency, voltage and current. All drive set-up operations and adjustment shall be digital and stored in a non-volatile memory (EEPROM).

2. To control the rate of change of output frequency for a step change in input reference, the drive shall have two independently adjustable acceleration and deceleration rates.

3. The drive shall have a foldback current limiting circuit. During acceleration, the circuit shall automatically reduce the acceleration rate to a slower rate should the load inertia cause excessive currents.

4. The drive shall have a selectable deceleration voltage limiting circuit. The circuit shall extend the set deceleration ramp should the bus voltage approach high limits due to regeneration.

5. The drive output frequency shall be adjustable from 0-60 Hz.

6. The drive shall have a fully programmable volts per hertz ratio.

7. The drive shall maintain set frequency to within 0.6 Hz during power line fluctuations.

8. The drive speed reference signal shall be a 4-20mA analog output from the PLC or a signal received from the VFD keypad module.

9. The drive shall be capable of maintaining 100% of rated output current continuously, and shall be capable of delivering 110% of rated output current for up to one minute.

10. The drive shall be capable of restoring motor operation after a 0.5 second line loss without shutting down on a fault.

11. The drive input circuitry shall not generate line notches or large voltage transients on the incoming line.

12. The drive shall present a displacement power factor of 0.95 or better to the AC line at any speed or load.

13. The drive efficiency at rated load and frequency shall be 96% or better.

D. Drive Controls:

1. Each variable frequency drive shall be furnished with start/stop controls and speed controls as indicated on the Drawings and in the Description of Operation.

E. VFD Keypad Module:

1. A keypad module shall be mounted on the MCC door for digital set-up of the drive, drive parameter review and drive fault annunciation. The module shall have an LCD display and a digital speed pot for local control of the drive speed.

F. Drive Protection and Diagnostics:

1. Each variable frequency drive shall incorporate internal diagnostic and fault sensing circuits as an integral part of the drive. The following drive protection functions shall be monitored:

   a. Momentary Overload Protection - Adjustable from 20 to 115% of Drive Rating
   b. Motor Overload Protection
   c. Undervoltage Sensing
   d. Overvoltage Sensing
   e. Phase Protection
   f. Drive Overtemperature
   g. Ground Fault Detection

2. Each of the above fault conditions shall be annunciated on the digital display panel and shall shut down the drive.

2.02 DRIVE CONTROL COMPONENTS

A. Line Reactors:

1. Provide line reactors for each VFD to eliminate nuisance overvoltage tripping and to reduce harmonic distortion. The line reactors shall be iron core, Class H insulation, 115ºC rise, copper wound, and shall have an impedance as indicated on the Drawings. The line reactors shall be sized for the motor horsepower and shall be manufactured by TCI, MTE, or approved equal.

B. Control Wiring:

1. All 120 VAC control wiring shall be red. All 24vdc wiring shall be blue. All wiring in the VFD shall be labeled.

C. Control Terminal Block:

1. Provide a control terminal block in the MCC cubicle to terminate all control wiring from the field. All terminals shall be labeled with machine printed labels.

2.03 SPARE PARTS

A. Provide the following spare parts for the variable frequency drives provided:

1. Six (6) Fuses for each size and type utilized

2. One (1) variable frequency drive

3. Two (2) ventilation fans for each size provided

4. Four (4) sets of fan filters for each size utilized

B. Spare parts shall be packaged individually in boxes that are clearly labeled with part name and manufacturer's part number.

PART 3 - EXECUTION

3.01 FIELD SERVICES

A. Start-up and Testing:

1. Provide the services of a manufacturer's representative to start-up, adjust and test each variable frequency drive. Demonstrate start/stop control, fault diagnostics and variation of motor speeds in response to both the manual and automatic variable speed controls.

2. All start-up and testing shall be performed in the presence of the Owner and the Engineer.

B. Training:

1. Provide four (4) hours of on-site training for the Owner on the variable frequency drives.

2. Training shall be specific for the VFDs provided and shall include theory of operation, VFD keypad programming, and maintenance and troubleshooting procedures. All training shall be performed by a qualified training specialist from the VFD manufacturer.

END OF SECTION

SECTION 17200

PUMP STATION CONTROL PANEL

PART 1 - GENERAL

1.01 DESCRIPTION

A. Work Included:

1. Furnish and install a Pump Station Control Panel for the Pump Control System as shown on the Drawings.

2. The control panel shall be provided by the Pump Control System Supplier and shall be complete and include all components and wiring as shown on the Drawings and specified herein.

1.02 QUALITY ASSURANCE

A. Regulations and Standards:

ANSI	American National Standards Institute
IEEE	Institute of Electrical and Electronic Engineers
NEC	National Electrical Code
NEMA	National Electrical Manufacturers Association
UL	Underwriters' Laboratories

B. The control panel components shall be of the most current and proven design. Specifications and Drawings call attention to certain features but do not purport to cover all details entering into the design of the control panel. The components provided by the System Supplier shall be compatible with the functions required and shall form a complete working system.

C. The control panel shall be UL listed as a complete assembly in accordance with UL-508.

1.03 SUBMITTALS

A. Shop Drawings:

1. Submit shop drawings on the control panel in accordance with the requirements of Section 17010. Shop drawings shall be complete in all respects and shall include a complete bill of material, catalog information, descriptive literature of all components, wiring diagrams, and panel layout drawings showing dimensions to all devices.

PART 2 - PRODUCTS

2.01 CONTROL PANEL COMPONENTS

A. Control Panel Enclosure:

1. The control panel enclosure shall be designed and sized in accordance with the requirements of the Drawings and as specified herein. Control panel enclosures shall be manufactured by Hoffman, Saginaw, or approved equal.

2. Steel control panel enclosures shall be NEMA 12, constructed of 10 gauge steel with continuously welded seams. Panel shall have piano type hinged, overlapping doors with neoprene gasket. Enclosure doors shall be equipped with a heavy-duty 3-point latching mechanism operated by a padlocking handle. Following fabrication, the control panel shall be degreased, cleaned and treated with a phosphatizing process, then primed and painted inside and out with an industrial grade enamel. The inside of the control panel shall be painted white. The exterior color shall be gray.

3. The control panel components shall be properly identified with an engraved nameplate mounted on the inside of the panel. All components not mounted on the front of the panel shall be mounted to a subpanel. All wiring shall be installed in a neat, workmanlike manner and shall be grouped, bundled, supported and routed horizontally and vertically to provide a neat appearance. All wires leaving the panel shall be terminated at the terminal strips inside the enclosure. Terminals and wires shall be identified in accordance with the Supplier's panel wiring diagrams.

4. Provide a copper grounding plate inside the control panel for terminating all ground wires.

5. Provide a plastic data pocket in the control panel.

B. Enclosure Light Fixtures:

1. Provide a LED light fixture in the control panel to illuminate the enclosure. The light fixture shall have a low profile design with a non-yellowing lens cover and a door-activated switch. The light fixture shall be Hoffman, or approved equal.

C. Control Circuit Breakers:

1. Control circuit breakers shall be quick-make, quick-break thermal magnetic molded case type, individually mounted and identified. Circuit breakers shall be Allen-Bradley Bulletin 1492-CB, Eaton, or approved equal.

D. Surge Protection Device:

1. Provide a 120 volt, 1 phase transient voltage surge suppressor in the control panel to protect the panel components from damage which may occur from transient over voltages caused by lightning or surges on the incoming power line.

2. The surge protective device shall have a pluggable surge protection module, an indication light to indicate if the unit has failed, and a normally closed alarm contact, which shall be wired to the PLC System.

3. Surge suppressor shall be Phoenix Contact PLT-SEC-T3-120-FM, or approved equal.

E. Uninterruptible Power Supplies (UPS):

1. Provide a UPS in the control panel to power the equipment in the panel. The UPS shall provide lightning and surge protection, spike attenuation, galvanic isolation, noise isolation, and a regulated 120 volt, 1-phase power supply. The power output shall be continuous with no interruptions.

2. The UPS shall be sized by the System Supplier based on the maximum power requirements of the control panel and for a minimum run time of 10 minutes. The UPS shall be furnished with two (2) alarm contacts to indicate when the UPS is operating on battery power and when the UPS battery needs replaced.

3. The UPS shall be APC Smart-UPS, or approved equal.

F. 24 Volt DC Power Supplies:

1. 24 volt DC power supplies shall be mounted in the control panel to supply 24 volt DC power for the analog output modules, Ethernet switches, and for the 2-wire instrumentation.

2. The power supplies shall be wired in parallel with a redundancy module. The power supplies shall be sized as required for the load being powered.

3. Each power supply shall be furnished with a normally open contact that closes when the power supply is operating and the DC power is ok. This contact shall be wired to the PLC System.

4. The 24 volt DC power supplies shall be Phoenix Contact Quint4 with a Quint-Oring redundancy module, or approved equal.

G. Selector Switches:

1. Selector switches shall be 30.5mm, heavy-duty, non-illuminated. Switches shall have double-break silver contacts. Switches shall be maintained contact type unless otherwise indicated on the Drawings. Provide auxiliary contact blocks on switches where indicated on the Drawings or in the Description of Operation.

2. Provide a black legend plate for each switch with white engraving as indicated on the Drawings.

3. Selector switches shall be Allen-Bradley Bulletin 800H, NEMA Type 4X, or equal by Square D, or approved equal.

H. Push Buttons:

1. Push buttons shall be 30.5mm, heavy-duty, non-illuminated. Push buttons shall have double-break silver contacts. Push buttons shall be momentary contact type and shall be color-coded as indicated on the Drawings. Stop push buttons shall have extended heads. All other push buttons shall have flush heads.

2. Provide a black legend plate for each push button with white engraving as indicated on the Drawings.

3. Push buttons shall be Allen-Bradley Bulletin 800H, NEMA Type 4X, bootless type, or equal by Square D, or approved equal.

I. Pilot Lights:

1. Pilot lights shall be 30.5mm, heavy-duty, push to test, transformer type with LED lamps. Voltage rating shall be 120 volts. Lens color shall be as indicated on the Drawings.

2. Provide a black legend plate for each pilot light with white engraving as indicated on the Drawings.

3. Pilot lights shall be Allen-Bradley Bulletin 800H, NEMA Type 4X, or equal by Square D, or approved equal.

J. Relays:

1. Relays shall be heavy-duty general-purpose type with 10 amp contacts. Relays shall have terminals, which plug-in to a socket, mounted to the inside of the panel enclosure. Terminals for relays shall be pin type. Contact configuration shall be 3PDT.

2. Relay coils shall operate on 120 volts AC, or 24vdc as indicated on the Drawings. Relays shall have an indicator light to indicate the relay coil is energized. Relays shall be Eaton #D7PF2AA (120VAC) and #D7PF2AT1 (24vdc). Provide relays with additional poles where required to provide the number of contacts indicated on the Drawings.

K. TVSS Devices for Analog Signal Wiring:

1. Provide a transient voltage surge suppressor (TVSS) on all analog signal wiring that originates from outside of the pump station to protect the analog signal wiring from surges and transient voltages. The TVSS device shall have of a pluggable surge protection module, and shall be furnished with a status indicator for visual indication that the unit is functioning.

2. The TVSS devices shall be Phoenix Contact PLUGTRAB PT for analog signal wiring, or approved equal.

L. Intrinsically Safe Barriers:

1. Provide intrinsically safe barriers for analog signal wiring originating from a Class 1, Division 1, Group D area. The intrinsically safe barriers shall be furnished with surge protection.

2. The intrinsically safe barriers shall be Pepperl+Fuchs, or approved equal.

M. Fuses:

1. All fuses shall be sized as required for the circuit they are protecting. Fuses shall be Bussmann, touch-safe type, or approved equal.

N. Terminal Blocks:

1. Terminal blocks shall be provided in the control panel for terminating field wiring. All terminal blocks shall be single level type, rated for 600 volts AC.

2. Terminal blocks shall be identified with a permanent machine printed marking in accordance with the terminal numbers shown on the panel wiring diagrams.

3. Terminal blocks for 24vdc inputs shall be blue.

4. Provide 20% spare terminal blocks in each control panel.

5. Terminal blocks shall be Phoenix Contact, or approved equal.

O. Wiring:

1. All wiring shall be stranded copper. Control wiring shall be 16 gauge, 600 volt, Type MTW. Power wiring shall be 600 volt, Type MTW, sized as required.

2. All analog signal wiring shall be 18 gauge twisted shielded pairs with foil shield and drain wire, with 300 volt, 90°C insulation. Drain wires shall be grounded at one end only.

3. All wiring and terminal strips shall be isolated by voltage levels to the greatest extent possible.

4. All wiring shall conform to the following color code:

a) 120 volt, 1 phase: Black, White
b) 24 vdc: Blue
c) 120 VAC Control Wires: Red
d) Intrinsically Safe Wiring: Purple
e) Ground Wires: Green

5. 120 VAC control wires energized from a source external to the control panel power source shall be yellow.

6. All control wiring shall be tagged at each end with a legible permanent coded wire-marking sleeve. Sleeves shall be white PVC tubing with machine printed black marking. Markings shall be in accordance with the wire numbers shown on the control wiring diagrams, and shall match terminal strip numbers.

P. Nameplates:

1. Provide laminated phenolic nameplates on the front of each control panel. Nameplates shall be black with white engraved letters. Engraving shall be as indicated on the Drawings. Minimum size of engraving shall be 1/4".

2.02 SPARE PARTS

A. Provide the following spare parts for the control panels:

1. One (1) 24 volt DC power supply for each size utilized

2. Two (2) general purpose relays for each type utilized

3. One (1) surge protection device

4. One (1) TVSS device for analog signal wiring

5. Six (6) fuses for each type and size utilized

B. Spare parts shall be packaged individually in boxes that are clearly labeled with part name and manufacturer's part/stock number.

PART 3 - EXECUTION

3.01 FIELD SERVICES

A. Start-up and Testing:

1. Test the operation of each control panel and all controls.

2. Start-up each control panel and place the control panel into operation.

3. All start-up and testing shall be performed in the presence of the Owner and the Engineer.

END OF SECTION

SECTION 17300

INSTRUMENTATION

PART 1 - GENERAL

1.01 DESCRIPTION

A. Work Included:

1. Furnish and install instrumentation and provide services as specified herein or as indicated on the Drawings. Instrumentation shall be provided by the Pump Control System Supplier.

1.02 QUALITY ASSURANCE

A. Regulations and Standards:

ANSI	American National Standards Institute
IEEE	Institute of Electrical and Electronic Engineers
ISA	International Society of Automation
NEC	National Electrical Code
NEMA	National Electrical Manufacturers Association
UL	Underwriters' Laboratories

B. All instrumentation equipment supplied shall be of the most current and proven design. Specifications and drawings call attention to certain features but do not purport to cover all details entering into the design of the instrumentation equipment. The equipment provided by the System Supplier shall be compatible with the functions required for the Process Control System.

C. All necessary fuses and cables required for instrumentation equipment shall be provided with the equipment.

1.03 SUBMITTALS

A. Shop Drawings:

1. Submit shop drawings on all instrumentation in accordance with the requirements of Section 17010. Shop drawings shall be complete in all respects and shall indicate all dimensions, installation methods, size, weight, capacity, ratings, integral controls and types of materials, elevations, and sections. Submittals shall include a complete bill of material, catalog information, descriptive literature of all components and wiring diagrams.

PART 2 - PRODUCTS

2.01 INSTRUMENTATION

A. Submersible Level Transducer:

1. The wet well submersible level transducer shall be an industrial submersible pressure transducer, submerged in the wet well to sense the sewage level in the wet well. The transducer shall be furnished with an integral signal cable with a molded cable seal.

2. The transducer shall have a weatherproof housing constructed of 316 stainless steel. The transducer shall have a 2.75" sensing area and an integral diaphragm protector.

3. The transducer shall be designed for installation in a Class 1, Division 1, Groups C and D hazardous location.

4. The transducer cable shall be a polyethylene jacketed shielded cable. Length of cable shall be as required for transducer installation. Provide a stainless steel cable hanger to support the cable.

5. The pressure transducer shall be a 2-wire device with dc power being provided from the Pump Station Control Panel. The transducer shall output a 4-20mA dc signal, which is proportional to the wet well level.

6. The level transducer shall be factory calibrated for the range indicated on the schedule below. Provide an aneroid bellows for the transducer.

7. The transducer shall operate in a temperature range of -20°C to +60°C.

8. The accuracy shall be ±0.25% of the full-scale range.

9. The transducer shall be furnished with lightning protection at the transducer and in the Pump Station Control Panel.

10. The wet well level transducer shall be KPSI Series 750, or approved equal.

SCHEDULE OF SUBMERSIBLE LEVEL TRANSDUCERS

Range	Location	Service
0-12 Feet	Wet Well	Wet Well Level

B. Magnetic Flow Meter:

1. Magnetic flow meter shall be of the low frequency and short form characterized coil design. The characterized field principle of electro-magnetic induction shall produce a positive DC pulsed signal directly and linearly proportional to the flow rate.

2. The metering tube shall be constructed of Type 304 stainless steel. The meter body shall be carbon steel. The flow meter shall have a flanged body to fit between ANSI Class 150 pipe flanges. The flow meter shall have a polyurethane liner and Type 316 stainless steel electrodes. Liners and electrodes shall be suitable for potable water. Provide all required mounting hardware, stainless steel grounding rings and grounding straps for the installation of the magnetic flow meter.

3. The coils, which generate the field, shall be inside the pipe wall and shall be encapsulated in epoxy resin and encased behind the meter lining material. The ratio of flow velocity to reference voltage signals generated shall be compatible with the readout instrument without the necessity of circuit modifications. The meter shall have an average power consumption of 60 watts. Accuracy of the meter shall be ±0.5% of rate.

4. The meter housing shall be splash-proof and weather resistant design. The meter shall be capable of accidental submergence in up to 30 feet of water for up to 48 hours without damage to the electronics.

5. Complete zero stability shall be inherent characteristic of the meter system. This shall eliminate the requirement for valving downstream of the meter for creating a full pipe zero flow condition for calibration purposes. Meter systems requiring field zero adjustment will not be acceptable.

6. The magnetic flow meters shall be factory calibrated on an approved test stand with certified accuracy traceable to NIST, compliant with the ISO 17025 standard, and third party accreditation by a national verification agency such as A2LA. Calibration curves shall be submitted for each flow meter for 3 points within the specified flow range.

7. The flow meter shall have a remote mounted microprocessor based, NEMA 4X flow transmitter. The flow transmitter shall have an LCD display to indicate the flow rate. The transmitter shall convert the meter's DC pulsed signal to a linear 4-20mA dc signal which is proportional to the flow rate.

8. The flow transmitter shall operate on a 120 volt AC, 60 Hz power source and shall have RFI protection. Provide signal cable to connect the flow transmitter to the flow meter. Length of cable shall be as required for the installation (See Electrical Drawings).

9. The Magnetic Flow Meter shall be Endress & Hauser Proline Promag W400, or approved equal.

SCHEDULE OF MAGNETIC FLOW METERS

Size	Flow Range	Location	Service
14"	0 – 4,000 GPM	Flow Meter Vault	Pump Station Discharge Flow

C. Float Switches:

1. Each float switch shall consist of a single pole, weighted, mercury switch in a smooth chemical resistant polypropylene casing with integral 2-wire cable. The float switch shall be permanently molded to the signal cable at the factory.

2. Float switch cable shall be 2/C #18 AWG. Length of cable shall be as indicated on schedule below.

3. The wet well float switches shall be normally open, and the flooding float switches shall be normally closed. The float switches shall actuate 1" above and below horizontal.

4. Float switch contacts for the wet well float switches shall operate with an intrinsically safe relay. Float switch contacts for the flooding float switches shall operate on 24vdc power.

5. Provide a 316 stainless steel mounting bracket with rubber grommet for each float switch.

6. The float switches shall be Anchor Scientific Roto-Float, Conery, or approved equal.

SCHEDULE OF FLOAT SWITCHES

Qty.	Type	Cable Length	Mounting Bracket	Service
1	S	30 feet	WMS	Wet Well High Level
1	S	30 feet	WMS	Wet Well Lead Pump Start
1	S	30 feet	WMS	Wet Well Lag Pump Start

1	S	30 feet	WMS	Wet Well Pump Off
1	S	30 feet	WMS	Wet Well Low Level
1	S	20 feet	WMS	Pump Room Flooding
1	S	20 feet	WMS	Pump Station Flow Meter Vault Flooding

D. Magnetic Door Switches:

1. Door switches shall consist of an industrial wide gap surface mounted SPDT magnetic contact switch. The contact shall be a hermetically sealed reed switch in ABS plastic case with matching actuating magnet.

2. The door switch contact shall be closed when the door is closed and shall open when the door is opened.

3. See Electrical Drawings for locations of the door switches.

4. The door switches shall operate on 24 volts DC, and shall be Sentrol Model No. 1045, or approved equal.

E. Automatic Telephone Dialer:

1. The automatic telephone dialer shall be a 16-channel, solid state electronic, field programmable type with 6 hour 12vdc battery back-up.

2. Unit shall be programmable to dial up to nine 10-digit telephone numbers and shall be capable of dialing either local or long-distance calls.

3. Unit shall operate properly throughout a temperature range of 20°F to 130°F with a relative humidity of 0% to 95%.

4. Power requirements shall be 120 volt, 1 phase.

5. Unit shall operate over a standard private telephone line furnished by the telephone company.

6. Capacity for monitoring up to 16 different alarm conditions shall be furnished. Alarms shall be transmitted separately using code numbers in conjunction with the station identification. When any of the eight alarm conditions exist at the station, the dialer shall automatically call the programmed telephone numbers continuously until one of the numbers

answers. At that time, the dialer, through computer type synthesized voice, shall deliver a message indicating location of alarm and which alarm code number exists. After the answering party has received the dialer's message, they shall be required to dial specific code numbers on the receiving telephone to acknowledge the alarm condition. After acknowledgment, the dialer shall automatically go into a delay mode (field programmable from 1 to 99 hours) to allow time for the alarm condition to be corrected. If the alarm condition has not been corrected (or disabled using the selector switch provided on the alarm panel), the automatic dialer shall start the dialing sequence again. If a different alarm condition occurs during the delay mode, the dialer shall ignore the delay set point and automatically dial the programmed numbers and communicate the new alarm condition. After acknowledgment, the same sequence may be repeated for up to a total of eight different alarm conditions.

7. Dialer shall be capable of being interrogated at any time by calling the dialer from any location. When interrogated, the unit shall inform the caller of any and all existing alarm conditions or give a "normal" or "station clear" announcement.

8. Alarm messages shall be repeated six times when dialer's call is answered and repeated three times when dialer is interrogated.

9. Unit shall be field or factory programmed with voice vocabulary to announce the location of and description of the alarm condition.

10. All alarms interfaced with automatic dialer shall be able to be manually disabled, with the exception of "power failure". A "power failure" alarm will start the automatic dialing sequence every time it occurs and must be acknowledged each time.

11. Unit shall be furnished with a delayed fault recognition feature to eliminate false alarms due to slow response times of valves, etc. Time delay shall be adjustable from 0-60 seconds.

12. Unit shall be furnished with a fault "lock-in" feature that continues the calling sequence until the fault is acknowledged, even if fault clears itself before call sequence is answered.

13. The dialer shall be furnished with a surge suppressor for the AC power and telephone lines.

14. The automatic telephone dialer shall be RACO Verbatim, Cattron, or approved equal.

2.02 INSTRUMENT NAMEPLATES

A. Provide a laminated phenolic nameplate for each instrument. The nameplates shall be black with white engraved letters, and they shall be mounted on the front of each instrument or instrument enclosure, or where applicable attached to the instrument with a plastic wire tie. An instrument nameplate schedule shall be submitted to the Engineer for approval prior to performing any engraving.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install the instrumentation in accordance with the manufacturer's instructions.

B. Issue an installation certificate to the Owner and the Engineer for each instrument certifying that the instrument has been installed in accordance with the manufacturer's recommendations.

3.02 CALIBRATION

A. Calibrate all instrumentation provided. All calibration shall be performed in the presence of the Owner and the Engineer. The calibration of each instrument shall be performed after the instrument installation certificate has been issued.

B. Provide a calibration certificate to the Owner and the Engineer for each instrument certifying that the instrument has been calibrated and is ready to be placed into service. The calibration certificate shall indicate the calibrated range or setpoint for each instrument.

3.03 TRAINING

A. Provide four (4) hours of training for the Owner on the instrumentation provided. Training shall include theory of operation, maintenance requirements, calibration methods and function of instrument in the Pump Control System.

END OF SECTION

SECTION 17400

PROGRAMMABLE CONTROLLER SYSTEM

PART 1 - GENERAL

1.01 DESCRIPTION

A. Work Included:

1. Furnish all labor and materials required for a complete programmable controller system consisting of a programmable controller, I/O modules, operator interface terminal, industrial Ethernet switch, power supplies, power and communication cables, software packages, and all other associated equipment as specified herein and as indicated on the Drawings.

B. System Configuration:

1. The system shall be configured as shown on the Pump Control System Drawings and as described in the Description of Operation.

1.02 QUALITY ASSURANCE

A. Regulations, Standards and Publications:

ANSI	American National Standards Institute
IEEE	Institute of Electrical and Electronic Engineers
NEC	National Electrical Code
NEMA	National Electrical Manufacturers Association

B. Quality Control:

1. All equipment and software supplied shall be of the most current and proven design. The Specifications and Drawings call attention to certain features but do not purport to cover all details entering into the design of the programmable controller system. The completed system and the equipment provided shall be compatible with the functions required and shall be a complete working system.

C. Manufacturer:

1. For continuity with the existing PLC system, the programmable controller system shall be manufactured by Allen-Bradley. All model numbers shown on the Drawings are Allen-Bradley numbers.

1.03 SUBMITTALS

A. Shop Drawings:

1. Submit shop drawings on each of the items listed below in accordance with the requirements of Section 17010. Shop drawings shall be complete in all respects, and shall include a complete bill of material, catalog information, descriptive literature of all components, and applicable wiring diagrams.

a. Programmable Controller
b. Input and Output Modules
c. Operator Interface Terminals
d. Ethernet Switches
e. Power and Communication Cables
f. Programming Software

1.04 MEETINGS

A. Initial Coordination Meeting:

1. The System Supplier shall attend and participate in an initial meeting with the Engineer and the Owner to discuss the PLC control logic, and the layout, color conventions, and control strategies for the operator interface screens.

B. Operator Interface Review Meetings:

1. The System Supplier shall attend and participate in one (1) review meeting with the Owner and the Engineer to review the operator interface graphic screens.

PART 2 - PRODUCTS

2.01 SYSTEM HARDWARE

A. Programmable Controller:

1. Provide an Allen-Bradley CompactLogix 5069-L330ER programmable controller in the Control Panel as indicated on the Drawings. The programmable controller shall be mounted with input and output (I/O) modules as indicated on the Drawings.

2. The programmable controller shall be furnished with an Allen-Bradley flash memory card. The PLC program shall be stored on the flash memory card.

B. Operator Interface Terminal:

1. An operator interface terminal shall be flush mounted in the Pump Station Control Panel to display process values, alarm messages and graphic displays, and to provide an interface for the operator to change process setpoints.

2. The operator interface shall have a TFT color touch screen with a NEMA 4X rating. Size shall be as indicated on the Drawings.

3. The operator interface shall be networked to the programmable controller via Ethernet. The operator interface shall be furnished with enough memory to meet the requirements of the Description of Operation plus 20 percent spare memory.

4. The operator interface shall operate on 24 vdc power.

5. The operator interface terminals shall be Allen-Bradley PanelView Plus 7 Performance Model.

6. The operator interface terminal shall be furnished with Factory Talk View Studio for Machine Edition and RSLinx software.

C. Ethernet Switch:

1. Provide a managed industrial Ethernet switch in the Pump Station Control Panel to network the PLC and operator interface terminal.

2. The Ethernet switch shall be furnished with the number of copper ports required for the system. Provide a minimum of two (2) spare copper ports on the switch.

3. The Ethernet switch shall be a stand-alone unit operating on 24vdc power.

4. The Ethernet switch shall be Stratix, N-tron, Moxa, or approved equal.

2.02 COMMUNICATIONS CABLES

A. Ethernet Cable:

1. Provide Cat 6 Ethernet cable to network the PLC and the operator interface terminal as shown on the Drawings. The System Supplier shall furnish all cables required for the Ethernet network. The Ethernet cables shall be blue.

2.03 PROGRAMMING SOFTWARE

A. Programmable Controller Programming and Documentation Software:

1. Provide a windows-based programming and documentation software package for programming the Allen-Bradley programmable controllers using a personal computer as a programming terminal. This software package shall be used to program the programmable controllers.

2. The programming and documentation software shall be latest version of Rockwell Software RSLogix 5000, Professional Edition.

3. The programming software, and all licenses, shall be turned over to the Owner at the completion of the project.

B. Operator Interface Terminal Programming Software:

1. Provide a Windows based programming and development software package to program the operator interface terminals using a personal computer. This software package shall be used to program the operator interface terminal.

2. The programming and development software shall be the latest version of RSView Studio for Machine Edition.

3. The programming software, and all licenses, shall be turned over to the Owner at the completion of the project.

2.04 SPARE PARTS

A. Provide the following spare parts for the programmable controller system:

1. One (1) CompactLogix Programmable Controller

2. One (1) 24vdc Input Modules

3. One (1) 24vdc Output Modules

4. One (1) Analog Input Module

5. One (1) Analog Output Module

6. Six (6) fuses for each type and size utilized

B. Spare parts shall be packaged individually in boxes that are clearly labeled with part name and manufacturer's part/stock number.

PART 3 - EXECUTION

3.01 SOFTWARE PROGRAMMING

A. PLC Programming:

1. Program the PLC to meet the requirements of the Description of Operation.

2. All programming shall be annotated and documented with rung numbers, descriptive comments and I/O identification comments. The beginning of each major sub-system shall be identified in the PLC program.

3. A copy of the PLC program shall be furnished to the Owner on CD, and on a hard copy print-out.

B. Operator Interface Programming:

1. General:

a. Program the operator interface terminal to meet the requirements of the Description of Operation. All programming and graphic screen development shall be performed as required for a complete and operational system.

2. Graphic Displays:

a. Dynamic graphic displays shall be programmed in the operator interface for the process equipment and its associated control strategies. The graphic displays shall be interactive with live data from the programmable controller.

b. The graphic displays shall include all digital and analog points being monitored by the PLC system.

c. The graphic displays shall indicate the auto/manual status, run status and alarms for all system equipment.

d. The graphic displays shall allow the operator to set and adjust all process setpoints, and timer settings for control of the system equipment.

e. The configuration of each graphic screen shall be reviewed with and approved by the Owner and the Engineer.

3. Alarms:

a. All alarms for the system shall be displayed on the alarm display screen on the operator interface.

4. Monitoring of Process Variables:

a. All process variables being monitored by the system shall be displayed by the operator interface.

3.02 TESTING

A. Field Testing:

1. Test the operation of each PLC I/O point after the PLC System is installed.

2. Analog points shall be tested using a signal generator. Each point shall be tested at 0, 25, 50, 75 and 100% of its full scale range.

3. Test the operation of each graphic screen programmed in the operator interface terminals to verify the digital and analog points display correctly on the screen.

4. Test all control strategies to verify that they function correctly.

5. Test all alarms in the system to verify that they display correctly.

6. All testing shall be conducted in the presence of, and to the satisfaction of, the Owner and the Engineer.

3.03 TRAINING

A. On-Site Training:

1. Provide four (4) hours of training for the Owner on the operation of the PLC System and the operator interface terminal.

END OF SECTION

SECTION 17500

DESCRIPTION OF OPERATION

TABLE OF CONTENTS

SECTION 17500

DESCRIPTION OF OPERATION

A. PUMP CONTROL SYSTEM CONFIGURATION

1. General Description

a. A new Pump Control System consisting of a motor control center, variable frequency drives, control panels, instrumentation and a programmable controller system will be provided for the new Creamery Road Pump Station.

2. Motor Control Center

a. A motor control center will be provided for the pump station to house the pump station main breaker, an automatic transfer switch, circuit breakers and motor starters for the pump station equipment. This motor control center will be designated as MCC-C.

3. Variable Frequency Drives

a. Variable frequency drives (VFDs) will be provided in MCC-C for the three (3) Sewage Pumps.

4. Pump Station Control Panel

a. A Pump Station Control Panel will be provided in the Pump Station Electrical Room to house a programmable controller, an operator interface and other associated controls for the pump station equipment.

b. An Allen-Bradley ControlLogix PLC will be provided in the Pump Station Control Panel for automatic control and monitoring of the sewage pump and other pump station equipment. The programmable controller will be designated as PLC-C:

5. Operator Interface Terminals

a. A 12” Allen-Bradley PanelView Plus 7 color touch screen operator interface terminal will be provided on the Pump Station Control Panel. The operator interface will be networked to the PLC via Ethernet.

b. The operator interface terminals shall be programmed to perform the following functions:

(1) Display Graphic Screens of the Pump Station
(2) Display Setpoint Screens
(3) Display Process Variables

(4) Display Alarm Messages
(5) Trend Wet Well Levels
(6) Trend Pump Station Flows

c. Rockwell Software Factory Talk View Studio for Machine Edition software will be installed on each operator interface.

6. Programmable Controller Software

a. Programmable controller programming and documentation software will be provided to enable a personal computer to be utilized to view, edit, program, document and print the logic program contained in the memory of the programmable controller.

B. INFLUENT GRINDER

1. General Description

a. An influent grinder will be provided in the pump station wet well influent channel to grind up material in the influent sewage. The influent grinder will consist of a screen assembly, hydraulic unit with motor and a grinder with hydraulic torque motor.

b. The hydraulic unit will be located on the wet well slab. A disconnect switch will be backboard mounted adjacent to the hydraulic unit to disconnect power to the hydraulic unit motor.

2. Influent Grinder Control Panel

a. An influent grinder control panel will be provided for the influent grinder. The control panel will be wall mounted in the Electrical Room of the pump station. The control panel will power and control the influent grinder and will house the following:

(1) Main Disconnect Switch
(2) Motor Starter
(3) Control Transformer
(4) Off/On Selector Switch
(5) Run Indication Light
(6) Overload Alarm Light
(7) Solid State Controls

b. The influent grinder off/on switch will have an auxiliary normally open contact that will close when the switch is placed in the "on" position. This contact will be wired to PLC-C.

c. The influent grinder motor starter will have two auxiliary contacts that will close when the motor starter is energized. One contact will be wired to the run indication light on the grinder control panel, and the other contact will be wired to PLC-C for run status monitoring by the programmable controller.

3. Programmable Controller PLC-C Inputs

a. Digital Inputs (24 vdc):

	Description	Origination Point
(1)	Influent Grinder Off/On Switch “On” Position	Off/On Switch on Influent Grinder Control Panel

(2)	Influent Grinder Run Status	Motor Starter in Influent Grinder Control Panel
(3)	Influent Grinder Overload	Overload Contact in Influent Grinder Control Panel

4. Description of Operation

a. The influent grinder will be manually controlled by the off/on selector switch located on the grinder control panel. The influent grinder will normally run continuously.

b. PLC-C will provide failure monitoring for the influent grinder as follows:

(1) When the influent grinder off/on switch is placed in the “on” position, a failure timer in the programmable controller will be started. If this timer times out and the influent grinder motor starter is not energized, an “Influent Grinder Failure” alarm message shall be displayed on the operator interface located on the Pump Station Control Panel.

c. The influent grinder control panel will be furnished with solid-state controls to sense an overload condition. If an overload condition caused by a jam occurs, the grinder cutters will reverse their rotation in an attempt to free the jam. If the jam cannot be freed after several reverses, the influent grinder will shut down and an overload alarm circuit will be activated. When this occurs, an overload alarm light on the influent grinder control panel will be lit and an overload alarm contact in the panel will close. This contact will be wired to PLC-C. If an overload occurs, an “Influent Grinder Overload” alarm message shall be displayed on the operator interface.

5. Influent Grinder Alarms

a. The following alarms for the Influent Grinder shall be displayed on the operator interface located on the Pump Station Control Panel:

(1) Influent Grinder Failure
(2) Influent Grinder Overload

b. The influent grinder alarms shall be paralleled in PLC-C to a common alarm output. Whenever an influent grinder alarm occurs, PLC-C will energize an "Influent Grinder Alarm" relay in the Pump Station Control Panel. A normally open contact on this relay will be wired to the automatic telephone dialer for notification of an Influent Grinder alarm.

C. SEWAGE PUMPS

1. General Description

a. Three dry-pit centrifugal sewage pumps will be installed in the pump station to pump the sewage from the wet well to the Town of Emmitsburg WWTP. The three pumps operate in the lead/first lag/second lag mode.

b. An AC variable frequency drive (VFD) will be provided for each sewage pump to vary the pump discharge rate. The VFDs will be located in MCC-C.

c. A submersible level transducer will be installed in the wet well to sense the sewage level in the wet well and provide for automatic control of the pumps. The level transducer will output a 4-20mA analog signal proportional to the wet well level to PLC-C for level monitoring by the programmable controller.

d. Five float switches will be mounted in the wet well for back-up control of the sewage pumps should the transducer fail, or a PLC failure occurs, and for alarm indication. Each float switch will be wired to an intrinsically safe relay located in the Pump Station Control Panel. The float switches will be designated as follows:

(1) Wet Well Low Level
(2) Pump Off
(3) Lead Pump Start
(4) Lag Pump Start
(5) Wet Well High Level

2. Sewage Pump Motor Controls

a. A variable frequency drive will be provided for each of the three sewage pumps. Each drive enclosure will house the following:

(1) Main Disconnect Switch
(2) Line Reactors
(3) Variable Frequency Drive
(4) Control Transformer
(5) H/O/A Selector Switch
(6) VFD Run Relay and Indication Light
(7) VFD Fault Relay and Alarm Light
(8) VFD Fault Reset Push Button
(9) Motor High Temp Relay and Alarm Light
(10) Elapsed Time Meter

b. Each variable frequency drive (VFD) will incorporate the following:

(1) Diode Rectifier to Convert the AC input Voltage to a Fixed DC Voltage.

(2) Transistorized Inverter to Invert the Fixed DC Voltage into a Sine Coded Pulse Width Modulated Output to the Pump Motor.

(3) Control Logic Boards to Control and Monitor Electronic Functions within the VFD.

(4) VFD Keypad Module Mounted on VFD Enclosure.

c. Each pump H/O/A switch will have two auxiliary normally open contacts that will close when the switch is placed in the "auto" position. One contact will be wired to PLC-C and the other contact will be wired to the drive for selecting automatic speed control.

d. Each variable frequency drive will have a run contact that will close when the drive is energized and outputting a frequency to the pump motor. This contact will be wired to a run indication light and a run relay located in the VFD enclosure. The run relay will have three normally open contacts that will close when the relay is energized. One contact will be wired to the elapsed time meter located on the VFD, one will be wired to the VFD ventilation fan, and the other contact will be wired to PLC-C for run status monitoring by the programmable controller.

e. Each variable frequency drive will have a VFD fault contact that closes when a drive fault occurs. This contact is wired to a VFD fault relay in the VFD enclosure and to a VFD fault alarm light on the enclosure. The VFD fault relay will have a normally open contact that will close when the relay is energized. This contact will be wired to PLC-C for VFD fault alarm monitoring by the programmable controller.

f. Each variable frequency drive will output a 4-20mA analog speed signal proportional to the drive speed to PLC-C. The speed of each sewage pump shall be displayed on the operator interface located on the Pump Station Control Panel.

g. An emergency stop push button will be mounted adjacent to each pump to disconnect power to the pump control circuit. The emergency stop buttons will be wired in series with the VFD pump control circuit so that when the emergency stop button is pushed in, power to the VFD control circuit will be removed.

3. Programmable Controller PLC-C Inputs and Outputs

a. The programmable controller inputs and outputs for the Sewage Pumps will be wired to and from PLC-C located in the Pump Station Control Panel.

b. Digital Inputs (24vdc):

	Description	Origination Point
(1)	Sewage Pump No. 1 H/O/A Switch "Auto" Position	H/O/A Switch on Pump VFD
(2)	Sewage Pump No. 1 Running	VFD Run Relay in Pump VFD
(3)	Sewage Pump No. 1 VFD Fault	VFD Fault Relay in Pump VFD
(4)	Sewage Pump No. 1 Motor High Temp	Motor High Temp Relay in Pump VFD
(5)	Sewage Pump No. 1 Casing High Temp	Thermal Switch on Pump Casing
(6)	Sewage Pump No. 2 H/O/A Switch "Auto" Position	H/O/A Switch on Pump VFD
(7)	Sewage Pump No. 2 Running	VFD Run Relay in Pump VFD
(8)	Sewage Pump No. 2 VFD Fault	VFD Fault Relay in Pump VFD
(9)	Sewage Pump No. 2 Motor High Temp	Motor High Temp Relay in Pump VFD
(10)	Sewage Pump No. 2 Casing High Temp	Thermal Switch on Pump Casing
(11)	Sewage Pump No. 3 H/O/A Switch "Auto" Position	H/O/A Switch on Pump VFD
(12)	Sewage Pump No. 3 Running	VFD Run Relay in Pump VFD
(13)	Sewage Pump No. 3 VFD Fault	VFD Fault Relay in Pump VFD

(14)	Sewage Pump No. 3 Motor High Temp	Motor High Temp Relay in Pump VFD
(15)	Sewage Pump No. 3 Casing High Temp	Thermal Switch on Pump Casing
(16)	Wet Well Low Level Float	Intrinsically Safe Relay in Pump Station Control Panel
(17)	Sewage Pumps Off Float	Intrinsically Safe Relay in Pump Station Control Panel
(18)	Lead Sewage Pump Start Float	Intrinsically Safe Relay in Pump Station Control Panel
(19)	Lag Sewage Pump Start Float	Intrinsically Safe Relay in Pump Station Control Panel
(20)	Wet Well High Level Float	Intrinsically Safe Relay in Pump Station Control Panel

c. Digital Outputs (24vdc Relay):

	Description	Destination Point
(1)	Sewage Pump No. 1 Start/Stop	Pump Auto Start/Stop Relay in Pump Station Control Panel
(2)	Sewage Pump No. 2 Start/Stop	Pump Auto Start/Stop Relay in Pump Station Control Panel
(3)	Sewage Pump No. 3 Start/Stop	Pump Auto Start/Stop Relay in Pump Station Control Panel

d. Analog Inputs (4-20mA):

	Description	Origination Point
(1)	Wet Well Level	Submersible Level Transducer in Wet Well
(2)	Sewage Pump No. 1 Speed	Pump VFD
(3)	Sewage Pump No. 2 Speed	Pump VFD
(4)	Sewage Pump No. 3 Speed	Pump VFD

e. Analog Outputs (4-20mA):

	Description	Destination Point
(1)	Sewage Pump No. 1 Speed Reference	Pump VFD
(2)	Sewage Pump No. 2 Speed Reference	Pump VFD
(3)	Sewage Pump No. 3 Speed Reference	Pump VFD

4. Description of Operation

a. The three sewage pumps will be controlled by the individual H/O/A selector switches located on MCC-C. The "hand" and "off" positions of the H/O/A selector switches provide for manual start/stop control of the pumps. When a pump H/O/A switch is in the "hand" position, the pump speed may be manually controlled by the speed increment and decrement keys located on the VFD keypad. When the pump H/O/A switches are in the "auto" position, the sewage pumps will be automatically controlled by PLC-C in response to the pump station wet well level as follows:

(1) Level setpoints will be programmed in PLC-C for the following wet well levels:

(a) Wet Well Low Level
(b) Lead Pump Stop
(c) First Lag Pump Stop

(d) Second Lag Pump Stop
(e) Wet Well Level Setpoint
(f) Lead Pump Start
(g) First Lag Pump Start
(h) Second Lag Pump Start
(i) Wet Well High Level

(2) The level setpoints shall be adjustable via the operator interface located on the Pump Station Control Panel.

(3) A PID level controller will be configured in the programmable controller to control the sewage level in the wet well. The level controller will vary the speed of the sewage pumps as required to match the pump discharge flow rate to the pump station influent flow rate. The desired level to be maintained in the wet well will be programmed in PLC-C as the setpoint for the level controller. The level controller will compare the actual wet well level measured by the wet well level transducer to the setpoint level, and will output a speed reference signal to the pump VFDs to increase or decrease the speed of the pumps as required to maintain the setpoint level.

(4) When the water level in the wet well rises to the elevation of the "lead pump start" level setpoint, PLC-C will start the lead sewage pump. When the lead pump is started, it will run with its speed being varied by the programmable controller to maintain the setpoint level in the wet well. As long as the pump station influent flow rate into the wet well is sufficient to maintain the water level in the wet well above the lead pump stop level, the lead pump will run continuously with its speed varied to match the pump discharge rate to the wet well influent flow rate as the influent flow rate varies from the minimum pumping rate to the maximum capacity of the lead pump. When the water level in the wet well is drawn down to the "lead pump stop" level setpoint, PLC-C will shut down the lead pump.

(5) If the lead sewage pump cannot keep up with the pump station influent flow, the water level in the wet well will rise to the "first lag pump start" level setpoint. When this level is reached, a start delay timer in the programmable controller will be started. When this timer times out, PLC-C will start the first lag pump and will output equivalent speed reference signals to both the lead and first lag pumps so that both pumps match speeds. As long as the water level is above the first lag pump stop level, both pumps will run continuously with the speed of the lead and first lag pumps being varied by PLC-C as required to match the combined pump discharge rates to the pump station influent flow rate. When the water level in the wet well is pumped down to the "first lag pump stop" level setpoint, PLC-C will shut down the first lag pump.

(6) If the lead and first lag sewage pumps cannot keep up with the pump station influent flow, the water level in the wet well will rise to the "second lag pump start" level setpoint. When this level is reached, a start delay timer in the programmable controller will be started. When this timer times out, PLC-C will start the second lag pump and will output equivalent speed reference signals to the lead, first lag, and second lag pumps so that all three pumps match speeds. As long as the water level is above the second lag pump stop level, all three pumps will run continuously with the speed of the lead, first lag, and second lag pumps being varied by PLC-C as required to match the combined pump discharge rates to the pump station influent flow rate. When the water level in the wet well is pumped down to the "second lag pump stop" level setpoint, PLC-C will shut down the second lag pump.

(7) The lead, first lag, and second lag sewage pumps will be assigned via the operator interface located on the Pump Station Control Panel. When “alternate” is selected, the programmable controller will alternate the lead/first lag/second lag status of the sewage pumps after an accumulated run time. The accumulated run time shall be an adjustable value that is entered by the operator via the operator interface.

b. If the water level in the wet well is drawn down to the "wet well low level" setpoint, a timer in the programmable controller will be started. If this timer times out and the low level condition still exists, PLC-C will shut down the sewage pumps. When this occurs, a "Wet Well Low Level" alarm message shall be displayed on the operator interface.

c. If the sewage level in the wet well rises to the elevation of the "wet well high level" setpoint, a timer in the programmable controller will be started. If this timer times out and the high level condition still exists, a "Wet Well High Level" alarm message shall be displayed on the operator interface.

d. If an error is detected with the submersible level transducer signal, a “Level Transducer Failure, Pumps on Float Switch Control” alarm message shall be displayed on the operator interface. When this occurs, the PLC will automatically switch the wet well level control to the float switches. The float switches will remain in control until the alarm condition for the level transducer is corrected. The float switches and PLC-C will provide automatic start/stop control of the pumps as follows:

(1) The “pump off”, “lead pump start”, and “lag pump start” float switches will be wired to individual intrinsically safe relays located in the Pump Station Control Panel. These relays will each have a normally open contact that will be wired to the back-up relay logic in the control panel and a normally open contact that will be wired to PLC-C for pump control.

(2) When the sewage level in the wet well rises to the level of the "lead pump start" float switch, PLC-C will start the lead pump. When the lead pump is

started, it will continue to run until the sewage level in the wet well is drawn down to the level of the "pump off" float switch. When this occurs, PLC-C will shut down the lead pump.

(3) If the sewage level in the wet well rises to the level of the "lag pump start" float switch, PLC-C will start the lag pump. When the lag pump is started, it will continue to run until the sewage level in the wet well is drawn down to the level of the "pump off" float switch. When this occurs, PLC-C will shut down the lag pump.

(4) When the pumps are operating under float switch control, PLC-C will output an adjustable speed reference signal to the pump VFD. This speed reference signal will be entered by the operator via the operator interface.

e. The “wet well low level” float switch will be wired to an intrinsically safe relay located in the Pump Station Control Panel. This relay will have a normally open contact that will be wired to the back-up relay logic in the control panel and a normally open contact that will be wired to PLC-C for wet well low level monitoring. If the water level in the wet well is drawn down to the elevation of the low level float switch, the low level relay will be energized, and PLC-C will shut down the sewage pumps. When this occurs, a “Wet Well Low Level, Detected by Low Level Float” alarm message shall be displayed on the operator interface.

f. The “wet well high level” float switch will be wired to an intrinsically safe relay located in the Pump Station Control Panel. This relay will have one normally closed contact and one normally open contact. The normally closed contact will be wired to the automatic telephone dialer, and the normally open contact will be wired to PLC-C for wet well high level monitoring. If the water level in the wet well rises to the elevation of the high level float switch, the high level relay will be energized, and a “Wet Well High Level, Detected by High Level Float” alarm message shall be displayed on the operator interface.

g. Relays and timers will be provided in the Pump Station Control Panel to enable the sewage pumps to be controlled by the float switches if the programmable controller fails. This relay logic will serve as a back-up to the control logic programmed in the PLC and will be initiated as follows:

(1) A control relay will be wired to an output from the PLC so that it is always energized whenever the programmable controller is operating. A normally closed contact on this relay will be wired in series with the wet well float switch relay logic control of the sewage pumps. If the programmable controller system fails, the relay will be deenergized and the relay contact will close. When this occurs, the wet well float switches will provide automatic start/stop control of the pumps.

h. PLC-C will provide failure monitoring for each sewage pump as follows:

(1) When a pump H/O/A switch is in the "auto" position and the pump gets a signal to start, a failure timer in the programmable controller will be started. If this timer times out and the pump VFD is not running, a "Sewage Pump Failure" alarm message shall be displayed on the operator interface.

i. A normally open drive fault contact is provided in each pump VFD. The VFD fault contact is wired to a VFD fault alarm light and a VFD fault relay in MCC-C. A normally open contact on the VFD fault relay will be wired to PLC-C. If a drive fault occurs, this contact will close and the pump VFD will shut down. When this occurs, a "Sewage Pump VFD Fault" alarm message shall be displayed on the operator interface.

j. Each sewage pump motor will be furnished with a normally closed thermal switch in the motor windings to detect a high motor temperature. The thermal switch will be wired to a motor high temp relay in the pump VFD. This relay has a normally open contact that is wired in series with the pump VFD. This relay will also have two normally closed contacts, one will be wired to a motor high temp alarm light on the VFD, and the other will be wired to PLC-C for motor high temp alarm monitoring by the PLC. When a high motor temperature occurs, the motor high temp relay will be de-energized, and the pump will shut down. When this occurs, a "Sewage Pump Motor High temp" alarm message will be displayed on the operator interface.

k. A high temperature switch will be provided on the casing for each sewage pump. If a high temperature occurs, a timer in PLC-C will be started. If this timer times out and the high temperature condition still exists, PLC-C will shut down the pump and a “Sewage Pump Casing High Temperature alarm message will be displayed on the operator interface.

l. If a sewage pump is taken out of “auto”, or experiences a failure, VFD fault, motor high temperature, or casing high temperature, PLC-C will index the lead/first lag/second lag assignments of the three pumps so that this pump now becomes the second lag pump. The remaining two pumps will become the lead and first lag pumps. The pump that has become the second lag pump will be locked out of the pump sequence until it is placed back in “auto” or its alarm has been cleared.

5. Sewage Pump Alarms

a. The following alarms for the Sewage Pumps shall be displayed on the Pump Station Control Panel operator interface:

(1) Sewage Pump No. 1 Failure
(2) Sewage Pump No. 1 VFD Fault
(3) Sewage Pump No. 1 Motor High Temperature
(4) Sewage Pump No. 1 Casing High Temperature

(5) Sewage Pump No. 2 Failure
(6) Sewage Pump No. 2 VFD Fault
(7) Sewage Pump No. 2 Motor High Temperature
(8) Sewage Pump No. 1 Casing High Temperature
(9) Sewage Pump No. 3 Failure
(10) Sewage Pump No. 3 VFD Fault
(11) Sewage Pump No. 3 Motor High Temp
(12) Sewage Pump No. 3 Casing High Temperature
(13) Wet Well Low Level
(14) Wet Well Low Level, Detected by Low Level Float
(15) Wet Well High Level
(16) Wet Well High Level, Detected by High Level Float
(17) Level Transducer Failure, Pumps on Float Switch Control

b. The Wet Well High Level, Detected by High Level Float alarm shall be output from PLC-C to the automatic telephone dialer for notification of a Wet Well High Level alarm.

c. All other sewage pump alarms shall be paralleled in PLC-C to a common alarm output. Whenever a sewage pump alarm occurs, PLC-C will energize a "Sewage Pumps Common Alarm" relay in the Pump Station Control Panel. A normally open contact on this relay will be wired to the automatic telephone dialer for notification of a Sewage Pump alarm.

D. PUMP STATION FLOW METERING

1. General Description

a. The sewage pumps will discharge to a common header, which is piped to the pump station force main.

b. A 14” magnetic flow meter will be installed in the force main to meter the pump station discharge flow. The flow meter will be located outside the pump station in the Pump Station Discharge Flow Meter Vault.

c. The magnetic flow meter will output a voltage signal proportional to the flow rate to a flow meter transmitter located in the Pump Station Electrical Room. The flow meter transmitter will convert the voltage signal to a 4-20mA analog signal proportional to the flow rate and will output this signal to PLC-C.

d. The pump station flow shall be displayed on the operator interface located on the Pump Station Control Panel.

e. The operator interface shall be programmed to trend, log and totalize the pump station flow.

2. Programmable Controller PLC-C Inputs

a. Analog Inputs (4-20mA):

	Description	Origination Point
(1)	Pump Station Discharge Flow	Pump Station Discharge Flow Meter Transmitter

E. FLOODING SENSORS

1. General Description

a. A flooding sensor consisting of a mercury float switch will be installed at each of the following locations to sense a flooding condition:

(1) Pump Station Pump Room
(2) Pump Station Discharge Flow Meter Vault

2. Programmable Controller PLC-C Inputs

a. The flooding sensors will be wired to PLC-C located in the Pump Station Control Panel.

b. Digital Inputs (24vdc):

	Description	Origination Point
(1)	Pump Room Flooding	Flooding Float Switch in Pump Room
(2)	Pump Station Discharge Flow Meter Vault Flooding	Flooding Float Switch in Meter Vault

3. Description of Operation

a. If flooding occurs in the Pump Station Pump Room and water builds up on the floor to the elevation of the flooding float switch, a "Pump Station Pump Room Flooding" alarm message shall be displayed on the operator interface located on the Pump Station Control Panel.

b. If flooding occurs in the Pump Station Discharge Flow Meter Vault and water builds up on the floor to the elevation of the flooding float switch, a "Pump Station Discharge Flow Meter Vault Flooding" alarm message shall be displayed on the operator interface.

4. Flooding Sensor Alarms

a. The following alarms for the Flooding Sensors shall be displayed on the operator interface located on the Pump Station Control Panel:

(1) Pump Station Pump Room Flooding
(2) Pump Station Discharge Flow Meter Vault Flooding

b. Whenever a pump room flooding alarm occurs, PLC-C will energize a "Pump Station Pump Room Flooding Alarm" relay in the Pump Station Control Panel. A normally open contact on this relay will be wired to the automatic telephone dialer for notification of a Pump Room Flooding alarm.

c. Whenever a meter vault flooding alarm occurs, PLC-C will energize a "Pump Station Discharge Flow Meter Vault Flooding Alarm" relay in the Pump Station Control Panel. A normally open contact on this relay will be wired to the automatic telephone dialer for notification of a Meter Vault Flooding alarm.

F. PUMP ROOM VENTILATION FANS

1. General Description

a. A supply fan and an exhaust fan will be provided in the Pump Room of the pump station to provide ventilation for the room. The supply fan will be designated as Supply Fan SF-1, and the exhaust fan will be designated as Exhaust Fan EF-2.

b. The supply fan will be installed in the duct work in the Pump Room to supply fresh air to the room. This fan will operate with Exhaust Fan EF-2, which will be wall mounted in the pump room. Supply Fan SF-1 and Exhaust Fan EF-2 will ventilate the pump station Pump Room.

c. Supply Fan SF-1 will have an integral motor operated damper. The damper will be designated as M.O.D.-D1

d. Exhaust Fan EF-2 will have an integral motor operated damper. The damper will be designated as M.O.D.-D2.

2. Supply Fan SF-1 Motor Controls

a. Motor Control Center-C will house the following for Supply Fan SF-1:

(1) Motor Circuit Breaker
(2) Motor Starter
(3) Control Transformer
(4) H/O/A Selector Switch
(5) Start Relay
(6) M.O.D.-D1 Open Relay
(7) Run Indication Light
(8) Elapsed Time Meter

b. The supply fan H/O/A selector switch will have an auxiliary normally open contact that will close when the switch is placed in the "auto" position. This contact will be wired to PLC-C for switch position monitoring by the PLC.

c. The supply fan motor starter will have three auxiliary normally open contacts that will close when the motor starter is energized. One contact will be wired to the run indication light and elapsed time meter on MCC-C, one contact will be wired to the auto control circuit for Exhaust Fan EF-2, and the third contact will be wired to PLC-C for run status monitoring by the PLC.

d. A disconnect switch will be mounted adjacent to the supply fan to disconnect power to the fan motor.

3. Exhaust Fan EF-2 Motor Controls

a. Motor Control Center-C will house the following for Exhaust Fan EF-2:

(1) Motor Circuit Breaker
(2) Motor Starter
(3) Control Transformer
(4) H/O/A Selector Switch
(5) Start Relay
(6) M.O.D.-D2 Open Relay
(7) Run Indication Light
(8) Elapsed Time Meter

b. The exhaust fan motor starter will have an auxiliary normally open contact that will close when the motor starter is energized. This contact will be wired to the run indication light and elapsed time meter on MCC-C.

c. A disconnect switch will be mounted adjacent to the exhaust fan to disconnect power to the fan motor.

4. Programmable Controller PLC-C Inputs and Outputs

a. The programmable controller inputs and outputs for the Pump Room Ventilation Fans will be wired to and from PLC-C located in the Pump Station Control Panel.

b. Digital Inputs (24vdc):

	Description	Origination Point
(1)	Pump Room Supply Fan SF-1 H/O/A Switch "Auto" Position	H/O/A Switch on MCC-C
(2)	Pump Room Supply Fan SF-1 Running	Fan Motor Starter in MCC-C

c. Digital Outputs (24vdc Relay):

	Description	Destination Point
(1)	Pump Room Supply Fan SF-1 Start/Stop	Fan Start/Stop Relay in Pump Station Control Panel

5. Description of Operation

a. Supply Fan SF-1 will be controlled by the H/O/A selector switch located on MCC-C. The "hand" and "off" positions of the H/O/A switch provide for manual start/stop control of the fan. When the fan H/O/A switch is in the "auto" position, the fan will be controlled by a thermostat, manually controlled by the switch located at the top of the stairs to the pump room, or automatically controlled by PLC-C as follows:

(1) A graphic display shall be programmed in the operator interface located on the Pump Station Control Panel, and in the HMI software, for the Pump Room Ventilation Fans. The graphic display shall allow the operator to select either continuous or intermittent operation for Supply Fan SF-1.

(2) If continuous operation is selected, the ventilation fans will be controlled as follows:

(a) PLC-C will send a signal to start Supply Fan SF-1. When this occurs, the start relay will be energized. A normally open contact on the start relay will close, and M.O.D.-D1 will open. When the M.O.D. is fully open, an end of travel limit switch on the M.O.D. will close, and the M.O.D. open relay will be energized. When both the supply fan start relay and the M.O.D. open relay are energized, a normally open contact on each relay will close, and the supply fan will start.

(b) When the supply fan is started, Exhaust Fan EF-2 will receive a signal to start, the exhaust fan start relay will be energized. A normally open contact on the start relay will close, and M.O.D.-D2 will open. When the M.O.D. is fully open, an end of travel limit switch on the M.O.D. will close, and the M.O.D. open relay will be energized. When both the exhaust fan start relay and the M.O.D. open relay are energized, a normally open contact on each relay will close, and the exhaust fan will start. Both fans will run continuously in this mode of operation.

(3) If intermittent operation is selected, the ventilation fans will be controlled as follows:

(a) A repeat cycle timer will be programmed in the programmable controller to periodically start the ventilation fans at preset time intervals for intermittent operation of the fans. When a start time occurs, PLC-C will start the supply fan, and a run duration timer in the programmable controller will be started. When the supply fan is started, Exhaust Fan EF-2 will start. The exhaust fan will continue to run as long as the supply fan is running. When the run duration timer times out, the programmable controller will shut down the supply fan.

(b) The supply fan start time intervals and run duration time shall be adjustable via the operator interface on the Pump Station Control Panel.

b. PLC-C will provide failure monitoring for Supply Fan SF-1 as follows:

(1) When the supply fan H/O/A switch is in the "auto" position and the fan gets a signal to start, a failure timer in the PLC will be started. If this timer times out and the fan is not running, a "Pump Room Supply Fan Failure" alarm message shall be displayed by the operator interface located on the Pump Station Control Panel.

6. Pump Room Ventilation Fans Alarms

a. The following alarms for the Pump Room Ventilation Fans shall be displayed on the operator interface located on the Pump Station Control Panel:

(1) Pump Room Supply Fan SF-1 Failure

G. INTRUSION ALARM MONITORNG

1. General Description

a. A magnetic door switch will be installed on each of the pump station exterior doors to detect when someone enters the station. The door switches will be normally closed and will open when the door is opened.

2. Programmable Controller PLC-C Inputs

a. The door switches will be wired in series to PLC-C located in the Pump Station Control Panel.

b. Digital Inputs (24vdc):

	Description	Origination Point
(1)	Pump Station Intrusion	Pump Station Door Switches

3. Description of Operation

a. Whenever a pump station door is opened, a timer in PLC-C will be started. When this timer times out, the PLC will energize a “Pump Station Intrusion Alarm” relay in the Pump Station Control Panel. A normally open contact on this relay will be wired to the automatic telephone dialer for notification of a Pump Station Intrusion alarm.

b. The intrusion alarm shall be capable of being disabled from the operator interface terminal when the pump station operator enters the station.

H. EMERGENCY GENERATOR

1. General Description

a. A 200 KW natural gas emergency generator will be pad mounted outside the pump station in a weatherproof housing to provide standby power for the pump station loads.

b. An automatic transfer switch will be provided in MCC-C to sense a failure of the normal utility power and transfer the pump station loads to the emergency generator.

2. Programmable Controller PLC-C Inputs

a. The programmable controller inputs for the Emergency Generator will be wired to PLC-C located in the Pump Station Control Panel.

b. Digital Inputs (24vdc):

	Description	Origination Point
(1)	Automatic Transfer Switch Emergency Position	Automatic Transfer Switch in MCC-C
(2)	Emergency Generator Running	Run Relay in Generator Control Panel
(3)	Emergency Generator Common Alarm	Alarm Relay in Generator Control Panel

3. Description of Operation

a. The automatic transfer switch will continuously monitor the incoming power source. When a failure of the utility power source occurs, control logic in the transfer switch will start the emergency generator. When the generator is putting out the required voltage and frequency, the transfer switch will transfer the loads to the generator. When the transfer switch transfers to the emergency position, a normally open contact on the switch will close. This contact will be wired to PLC-C for monitoring of the transfer switch position by the programmable controller.

b. A generator run relay will be provided in the generator control panel. A normally open contact on this relay will be wired to PLC-C for generator run status monitoring by the programmable controller. If the generator is running, an “Emergency Generator Running” alarm shall be displayed on the operator interface located on the Pump Station Control Panel.

c. A common alarm relay will be provided in the generator control panel to indicate a generator alarm. A normally open contact on this relay will be wired to PLC-C. If a generator alarm occurs, an “Emergency Generator Alarm” shall be displayed on the operator interface.

4. Emergency Generator Alarms

a. The following alarms for the Emergency Generator shall be displayed on the operator interface located on the Pump Station Control Panel:

(1) Emergency Generator Running
(2) Emergency Generator Alarm

b. Whenever a generator running alarm occurs, PLC-C will energize an "Emergency Generator Running" relay in the Pump Station Control Panel. A normally open contact on this relay will be wired to the automatic telephone dialer for notification that the generator is running.

c. Whenever a generator alarm occurs, PLC-C will energize an "Emergency Generator Common Alarm" relay in the Pump Station Control Panel. A normally open contact on this relay will be wired to the automatic telephone dialer for notification of a generator alarm.

I. MCC-C POWER MONITORING

1. General Description

a. A microprocessor based digital power monitor will be provided in MCC-C to provide for complete electrical metering and to monitor the incoming power to the MCC.

b. A surge protective device (SPD) will be provided in the MCC to protect the MCC from transient voltages that may occur due to lightning or surges on the incoming power line.

2. Programmable Controller PLC-C Inputs

a. The programmable controller inputs for the MCC Power Monitoring will be wired to PLC-C located in the Pump Station Control Panel.

b. Digital Inputs (24vdc):

	Description	Origination Point
(1)	MCC-C Power Failure	Alarm Contact in MCC Power Monitor
(2)	MCC-C SPD Alarm	Alarm Contact in Surge Protective Device

3. Description of Operation

a. The MCC power monitor will provide monitoring for a phase loss, phase unbalance, phase reversal, overvoltage, or undervoltage condition. The power monitor will be furnished with a normally open alarm contact, which will close when power is present, and there are no alarm conditions. This contact will be wired to PLC-C. If a power failure occurs, this contact will open, and an "MCC-C Power Failure" alarm message shall be displayed on the operator interface located on the Pump Station Control Panel.

b. The surge protective device located in the MCC will be furnished with a normally open alarm contact. This contact will be wired to PLC-C. If a surge alarm occurs, this contact will close, and an "MCC-C Surge Alarm" message shall be displayed on the operator interface.

4. MCC-C Power Monitor Alarms

a. The following alarms for the MCC-C Power Monitoring shall be displayed on the operator interface located on the Pump Station Control Panel, and shall be displayed and logged by the HMI software:

(1) MCC-C Power Failure
(2) MCC-C Surge Alarm

b. The MCC alarms shall be paralleled in PLC-C to a common alarm output. Whenever an MCC alarm occurs, PLC-C will energize an "MCC-C Common Alarm" relay in the Pump Station Control Panel. A normally open contact on this relay will be wired to the automatic telephone dialer for notification of an MCC alarm.

J. CONTROL PANEL POWER MONITORING

1. General Description

a. A power failure relay and a surge protective device (SPD) will be provided in the Pump Station Control Panel to monitor the incoming power to the panel and to protect the PLC from transient voltages that may occur due to lightning or surges on the incoming power line.

2. Programmable Controller PLC-C Inputs

a. The programmable controller inputs for Power Monitoring in the Pump Station Control Panel will be wired to PLC-C located in that panel.

b. Digital Inputs (24vdc):

	Description	Origination Point
(1)	Pump Station Control Panel Power Failure	Power Failure Relay in PLC Panel
(2)	Pump Station Control Panel SPD Failure	Alarm Contact in SPD

3. Description of Operation

a. A power failure relay will be provided in the control panel. The relay will be energized continuously by the main incoming power to the panel. The programmable controller will provide power failure monitoring for the control panel as follows:

(1) A normally closed contact on the power failure relay will be wired to PLC-C. Under normal circumstances, the relay will be energized and this contact will be open. If the main incoming power supply fails, the relay contact will close, and a "Control Panel Power Failure" alarm message shall be displayed on the operator interface located on the Pump Station Control Panel.

b. The surge protective device located in the control panel will be furnished with a normally open alarm contact. This contact will be wired to PLC-C. If an SPD alarm occurs, this contact will close, and a “Control Panel SPD Failure” alarm message shall be displayed on the operator interface located on the control panel.

4. Control Panel Power Monitoring Alarms

a. The following Power Monitoring alarms shall be displayed on the operator interface located on the Pump Station Control Panel:

(1) Pump Station Control Panel Power Failure
(2) Pump Station Control Panel SPD Failure

K. 24VDC POWER SUPPLIES

1. General Description

a. Two 24vdc power supplies will be provided in the Pump Station Control Panel. The 24vdc power supplies will provide power for the Ethernet switch, 24vdc programmable controller inputs, and the 2-wire instruments. The power supplies will be wired in parallel through a redundancy module so that if one power supply fails, the other power supply will continue providing 24vdc power.

2. Programmable Controller PLC-C Inputs

a. The programmable controller inputs for the 24vdc Power Supplies for the Pump Station Control Panel will be wired to PLC-C located in that panel.

b. Digital Inputs (24vdc):

	Description	Origination Point
(1)	Pump Station Control Panel 24vdc Power Supply No. 1 Failure	Alarm Contact in Power Supply
(2)	Pump Station Control Panel 24vdc Power Supply No. 2 Failure	Alarm Contact in Power Supply

3. Description of Operation

a. PLC-C will provide failure monitoring for the 24vdc power supplies in the control panel as follows:

(1) A normally closed contact on each power supply will be wired to the PLC in the panel. When the power supply is operating, this contact will be open. If a power supply fails, this contact will close, a "24vdc Power Supply Failure" alarm message shall be displayed on the operator interface located on the Pump Station Control Panel.

4. 24vdc Power Supply Alarms

a. The following alarms for the 24vdc Power Supplies shall be displayed on the operator interface located on the Pump Station Control Panel:

(1) Pump Station Control Panel 24vdc Power Supply No. 1 Failure
(2) Pump Station Control Panel 24vdc Power Supply No. 2 Failure

L. UNINTERRUPTIBLE POWER SUPPLY

1. General Description

a. An uninterruptible power supply (UPS) will be provided in the Pump Station Control Panel to provide continuous power for the equipment in the control panel.

2. Programmable Controller PLC-C Inputs

a. The programmable controller inputs for the UPS in the Pump Station Control Panel will be wired to PLC-C located in that panel.

b. Digital Inputs (24vdc):

	Description	Origination Point
(1)	UPS on Battery Power	UPS in Pump Station Control Panel
(2)	UPS Replace Battery	UPS in Pump Station Control Panel
(3)	UPS Failure	UPS Failure Relay in Pump Station Control Panel

3. Description of Operation

a. The UPS will be furnished with a normally open contact that will close when the UPS is operating on battery power. This contact will be wired to PLC-C. When normal power fails and the UPS is operating on battery power, a timer in the programmable controller will be started. If this timer times out and the UPS is still on battery power, a "UPS on Battery Power" alarm message shall be displayed on the operator interface located on the Pump Station Control Panel.

b. The UPS will be furnished with a normally open contact that will close when the UPS battery needs replaced. This contact will be wired to PLC-C. If the battery needs replaced, a timer in the programmable controller will be started. If this timer times out and the UPS battery still needs replaced, a "UPS Replace Battery" alarm message shall be displayed on the operator interface located on the control panel.

c. A UPS failure relay will be provided for the UPS in the control panel. This relay will be energized continuously by the UPS. The programmable controller will provide failure monitoring for the UPS as follows:

(1) A normally closed contact on the UPS failure relay will be wired to PLC-C. When the UPS in the control panel is operating, the relay will be energized, and this contact will be open. If the UPS fails, the relay contact will close, a "UPS Failure" alarm message shall be displayed on the operator interface located on the control panel.

d. The UPS failure relay will have two normally open contacts and two normally closed contacts in addition to the normally closed contact being utilized for failure monitoring of the UPS. The UPS will be wired through two normally open relay contacts, and the 120 VAC power will be wired through two normally closed relay contacts. If the UPS fails, the UPS failure relay will be de-energized and the 120 VAC power will power the control panel.

4. Uninterruptible Power Supply Alarms

a. The following alarms for the Uninterruptible Power Supplies shall be displayed on the operator interface located on the Pump Station Control Panel:

(1) Pump Station Control Panel UPS on Battery Power
(2) Pump Station Control Panel UPS Replace Battery
(3) Pump Station Control Panel UPS Failure

M. PLC FAILURE MONITORING

1. General Description

a. The HMI software shall monitor the status of PLC-C, located in the Pump Station Control Panel.

2. Description of Operation

a. The HMI software will monitor the status of an internal failure bit for PLC-C. If the PLC fails, the status of the failure bit will change, and a PLC failure alarm shall be displayed by the HMI software.

3. PLC Failure Monitoring Alarms

a. The following alarms for the PLC Failure Monitoring shall be displayed and logged by the HMI software:

(1) PLC-C Failure

b. Whenever a PLC failure alarm occurs, PLC-C will energize a “PLC Failure” relay in the Pump Station Control Panel. A normally open contact on this relay will be wired to the automatic telephone dialer for notification of a PLC Failure alarm.

N. OPERATOR INTERFACE TERMINAL

1. General Description

a. An operator interface terminal will be provided on the Pump Station Control Panel to display graphic displays and alarm messages for the system.

2. Description of Operation

a. Whenever an alarm occurs, a corresponding alarm message will be displayed on the operator interface as previously described in the Description of Operation.

b. An alarm message will remain in the system until its corresponding alarm is cleared. The operator shall be able to acknowledge and clear the alarms from the operator interface.

O. AUTOMATIC TELEPHONE DIALER

1. General Description

a. A 16-channel automatic telephone dialer will be wall mounted in the Pump Station Electrical Room to provide continuous monitoring of the pump station alarms. When an alarm occurs, the dialer will call a series of pre-programmed telephone numbers until one of the numbers answers. When the dialer is answered, it will deliver a message by means of a computer type synthesized voice indicating the alarm that exists.

2. Programmable Controller PLC-C Outputs

a. The programmable controller outputs for the Automatic Telephone Dialer will be output from PLC-C located in the Pump Station Control Panel.

b. Digital Outputs (24vdc Relay):

	Description	Destination Point
(1)	PLC Failure Channel No. 2	Failure Relay in Pump Station Control Panel
(2)	Influent Grinder Alarm Channel No. 3	Alarm Relay in Pump Station Control Panel
(3)	Sewage Pumps Common Alarm Channel No. 4	Alarm Relay in Pump Station Control Panel
(4)	Pump Room Flooding Alarm Channel No. 5	Alarm Relay in Pump Station Control Panel
(5)	Discharge Flow Meter Vault Flooding Alarm Channel No. 6	Alarm Relay in Pump Station Control Panel
(6)	Emergency Generator Running Channel No. 7	Run Relay in Pump Station Control Panel

(7)	Emergency Generator Common Alarm Channel No. 8	Alarm Relay in Pump Station Control Panel
(8)	Pump Station Intrusion Channel No. 9	Alarm Relay in Pump Station Control Panel

3. Description of Operation

a. The wet well high level, detected by float alarm will be wired to Channel No. 1 of the automatic dialer.

b. The pump station alarms shall be programmed to 7 common alarm outputs in PLC-C. The alarm outputs will be wired to Channel Nos. 2-9 of the automatic dialer for remote indication of a pump station alarm.

c. A one minute time delay shall be programmed in PLC-C for each common alarm output to allow the pump station operator time to acknowledge the alarm before the dialer initiates its calling sequence.

END OF SECTION