

Andover Purchasing / CDM Smith Inc.
36 Bartlett Street
Andover, MA 01810

ADDENDUM NO. 3
(3 Pages plus 6 Attachments)
Date Issued: October 30, 2017

TO: All Bidders of Record

RE: Town of Andover, Massachusetts
Department of Public Works
Contract No. 008/10-17/301
Addendum No. 3

Location of Bid Opening: Andover Central Purchasing
36 Bartlett Street
Andover, MA 01810

Receipt of General Bids: November 8, 2017 (*unchanged from Addendum No. 2*)
12:00 pm (noon)

This Addendum shall be part of the Contract Documents for the above referenced project as provided in the Instruction to Bidders. Acknowledge receipt of this Addendum by inserting its number and date in the space provided on page 00300-1 of the Bid Form. Failure to do so may subject the bidder to disqualification.

This addendum consists of three pages and six attachments (A-F).

This addendum includes revisions to the scope of work for the Base Bid and Additive Alternate No. 1; revisions to Section 01176 and Section 16020; an updated Section 11214 Vertical Turbine Pumps; and the additions of Section 09901 Surface Preparation and Shop Priming, Section 09902 Painting, and Section 15072 Ductile Iron Pipe and Fittings.

PLEASE CONTACT TOM WATKINS AT THE ANDOVER TOWN OFFICES WITH ANY TECHNICAL QUESTIONS AT: twatkins@andoverma.gov

CHANGES TO THE SPECIFICATIONS:

Table of Contents

- A. REPLACE Table of Contents, in its entirety, with the new Table of Contents attached to this addendum in Attachment A.

Per the Table of Contents, within DIVISION 1 – GENERAL REQUIREMENTS:

Section 01010 – Summary of Work

- A. REPLACE Section 01010 Summary of Work, in its entirety, with the new Section 01010 attached to this addendum in Attachment B.

Section 01176 – Medium Voltage Induction Motors

- A. In Section 01176, on page 01176-6 within Paragraph 2.01 B.4, after “System configuration:” DELETE “Two Speed, Two Winding Delta” and INSERT in place thereof “Solid grounded WYE”.

Per the *REVISED* Table of Contents, within DIVISION 9 – FINISHES:

Section 09901 – Surface Preparation and Shop Prime Painting

- A. In accordance with the revised Table of Contents, INSERT the new Section 09901 attached to this addendum in Attachment C.

Section 09902 – Painting

- A. In accordance with the revised Table of Contents, INSERT the new Section 09902 attached to this addendum in Attachment D.

Per the Table of Contents, within DIVISION 11 – EQUIPMENT:

Section 11214 – Vertical Turbine Pumps

- A. REPLACE Section 11214 Vertical Turbine Pumps, in its entirety, with the new Section 11214 attached to this addendum in Attachment E.

Per the *REVISED* Table of Contents, within DIVISION 15 – MECHANICAL:

Section 15072 – Ductile Iron Pipe and Fittings

- 1. In accordance with the revised Table of Contents, INSERT the new Section 15072 attached to this addendum in Attachment F.

Per the Table of Contents, within DIVISION 16 – ELECTRICAL:

Section 16020 – Electrical

- A. In Section 16020, on page 16020-1 after existing Paragraph 1.01C, INSERT a new paragraph labeled “D” as shown below.

“D. Refer to Section 01010 for description of base bid and bid alternates.”

- B. In Section 16020, on page 16020-3 after existing Paragraph 1.07C.2.h, INSERT a new paragraph labeled “i” as shown below.

“i. Inspection and testing of autotransformers.”

CHANGES TO THE DRAWINGS:

1. SHEET M-1 – DEMOLITION AND IMPROVEMENTS PLAN AND SECTION

- A. On the left-hand side of sheet, Demolition SECTION 1 DEMOLITION (TYP FOR 3)
 - i. At the top of the demolition section view directly to the right of the existing pump motor, INSERT a note as shown below.

“Contractor shall be responsible for removing and replacing fittings and pipe as required to mate existing piping with new pump discharge head”.

- B. On the right-hand side of sheet, Improvements SECTION 1 IMPROVEMENTS (TYP FOR 3)
 - i. At the top of the improvement section view directly to the right of the new pump motor, INSERT a note as shown below.

“Contractor shall be responsible for furnishing and installing fittings and pipe, as required, to mate existing piping with new pump discharge head”.

ATTACHMENTS

- A. Table of Contents (2 pages)
- B. Section 01010 – Summary of Work (3 pages)
- C. Section 09901 – Surface Preparation and Shop Prime Painting (3 pages)
- D. Section 09902 – Painting (10 pages)
- E. Section 11214 – Vertical Turbine Pumps (17 pages)
- F. Section 15072 – Ductile Iron Pipe and Fittings (7 pages)

END OF ADDENDUM NO. 3

Attachment A
Table of Contents
(2 pages)

TOWN OF ANDOVER, MASSACHUSETTS
 ANDOVER WATER TREATMENT PLANT
 BANCROFT PUMP REPLACEMENT
 TOWN BID NO. 008/10-17/301

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 ANDOVER WATER TREATMENT PLANT
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D	Drawings (M-1, E-1, E-2, and E-3)
E	Bid Form (2 Copies)

Attachment B

Section 01010 – Summary of Work

(3 pages)

SECTION 01010
SUMMARY OF WORK

PART 1 GENERAL

1.01 LOCATION OF WORK

- A. The work of this Contract is located in the Town of Andover, Massachusetts as shown on the location map on the Drawings.
- B. The existing Bancroft pumps are located at the Andover Water Treatment Plant and transfer treated water from the clearwell to the Bancroft storage tank in the Central Service Zone.

1.02 SCOPE OF WORK

- A. The Work includes furnishing all labor, materials, equipment, and incidentals required to provide two new vertical turbine pumps, two new two-speed medium voltage induction motors and two new discharge heads as specified herein. The two new pumps, motors, and discharge heads will replace two existing two-speed vertical turbine pumps and motors.
- B. **Additive Alternate No. 1 shall be as described in Paragraph 1.03 herein.**
- C. Each pump shall be rated as specified in Section 11214 and shall be driven by a two-speed 4,160V 384/600 HP motor. Refer to Section 01176, Section 11214, and to the Drawings.
- D. The work shall also include the following items of work.
 - 1. Remove and dispose of existing pump bowl assemblies, discharge tees, motors and associated piping as shown on the Drawings.
 - 2. Remove existing 4,160V conductors from MCC to motors and electrical work associated with removing existing motors. Existing motor starters shall remain and are to be used with new motors.
 - 3. Remove and dispose of existing concrete pad and soleplate for existing pump mounting.
 - 4. Furnish and install new pump soleplate for pump and discharge head mounting, if required.
 - 5. Furnish and install new pumps, discharge tees, motors and associated piping as shown on the Drawings.
 - 6. Contractor is responsible for mating discharge head with existing piping as show in the drawings. Contractor may remove and replace ductile iron fittings, as approved by the Engineer, to mate new and existing discharge piping.
 - 7. Clean, prime and paint existing equipment, including, but not limited to, discharge heads and existing motors as determined by the Owner or Engineer.

8. Furnish and install new 4,160V electrical conductors from existing MCC to new motor and any other electrical work in the Specifications.
9. Perform electrical and instrumentation work as required in the Specifications to return pumps to service.
10. All work described in Section 01170.

1.03 ALTERNATE NO. 1

- A. The Owner may elect to increase the scope of work by selecting Alternate No. 1. Alternate No. 1 requires that the Contractor provide a third pump, motor, and discharge head including all electrical and other related work be added to the scope of Work.

1.04 ABBREVIATIONS AND REFERENCES

AASHTO	-	The American Association of State Highway and Transportation Officials
ACI	-	American Concrete Institute
AISI	-	American Iron and Steel Institute
ANSI	-	American National Standards Institute
ASCE	-	American Society of Civil Engineers
ASME	-	American Society of Mechanical Engineers
ASTM	-	ASTM International
AWPA	-	American Wood Preservers Association
AWS	-	American Welding Society
AWWA	-	American Water Works Association
DIPRA	-	Ductile Iron Pipe Research Association
Fed. Spec.	-	Federal Specifications
NCPI	-	National Clay Pipe Institute
NEWWA	-	New England Water Works Associations
OSHA	-	Occupational Safety and Health Administration
SSPC	-	Steel Structures Painting Council

Where reference is made to a specification by one of the above-mentioned or other associations, it is understood that the latest revisions thereof shall apply.

1.05 CONTRACTOR'S USE OF PREMISES

- A. Contractor shall limit the use of the premises for his/her Work and for storage to allow for:
 1. Owner occupancy
- B. Coordinate use of premises with Owner.
- C. Contractor shall assume full responsibility for security of all his/her and his/her subcontractor's materials and equipment stored on the site.
- D. If directed by the Owner, move any stored items which interfere with operations of Owner or other contractors.

- E. Obtain and pay for use of additional storage or work areas if needed to perform the Work.

1.06 OWNER OCCUPANCY

- A. Owner will occupy premises during performance of the work for the conduct of his/her normal operations. Coordinate all construction operations with Owner to minimize conflict and to facilitate Owner usage.
 - 1. Operation and maintenance of existing water pumps and equipment in the vicinity of the proposed work.

END OF SECTION

Attachment C

Section 09901

Surface Preparation and Shop Prime Painting

(3 pages)

SECTION 09901
SURFACE PREPARATION AND SHOP PRIME PAINTING

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required for the surface preparation and application of shop primers on ferrous metals, excluding stainless steels, as specified herein.

1.02 RELATED WORK

- A. Finish painting is included in Section 09902.

1.03 SUBMITTALS

- A. Submit, in accordance with Section 01300, shop drawings, manufacturer's specifications and data on the proposed primers and detailed surface preparation, application procedures and dry mil thicknesses.
- B. Submit representative physical samples of the proposed primers, if required by the Engineer.

1.04 REFERENCE STANDARDS

- A. The Society for Protective Coatings (SSPC)
 - 1. SSPC-SP 6/NACE No. 3 - Joint Surface Preparation Standard SSPC-SP 6/NACE No. 3: Commercial Blast Cleaning
 - 2. SSPC-SP 10/NACE No. 2 - Joint Surface Preparation Standard SSPC-SP 10/NACE No. 2: Near-White Blast Cleaning.
- B. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Submerged Surfaces - Shop primer for ferrous metals which will be in contact with water being treated, either submerged or which are subject to splash action or which are specified to be considered submerged service shall be shop primed with the following:
 - 1. Shop Prime Coat: (Zinc Micaceous Iron Oxide Polyurethane Aromatic Shop Primer)
 - a. TNEMEC: Series 1 Omnithane
 - b. Carboline: Carboguard 561
 - c. Sherwin-Williams Company (The): Corothane I Zinc Primer 1K Mio-Zinc.
 - d. PPG PMC Durathane MCZ 97-679 Series or PPG PMC Amerlock 400.
 - e. Or equal.

- B. Non-Submerged Surfaces: Shop primer for ferrous metals which will not be in contact with water being treated, not submerged and not subject to splash action shall be shop primed with the following:
1. Shop Prime Coat: (Zinc Micaceous Iron Oxide Polyurethane Aromatic Shop Primer)
 - a. TNEMEC: Series 1 Omnithane
 - b. Carboline: Carboguard 561
 - c. Sherwin-Williams Company (The): Corothane I Zinc Primer 1K Mio-Zinc.
 - d. PPG PMC Durathane MCZ 97-679 Series or PPG PMC Amercoat 68HS
 - e. Or equal.
- C. Submerged Surfaces:
1. Shop Prime Coat for Ductile Iron Pipe: (Epoxy, Polyamidoamine Shop Primer)
 - a. TNEMEC: Series N140 Pota-Pox-Plus
 - b. Carboline: Carboguard 561
 - c. Sherwin-Williams Company (The): Macropoxy 846 NSF Winter Grade Epoxy Mill White
 - d. PPG PMC Aquapon HB Potable Water Epoxy Coating 95-132 Series or PPG PMC Amerlock 2 Epoxy.
 - e. Or equal.
 2. Shop Prime Coat for Ferrous Metal Surfaces: (Zinc Micaceous Iron Oxide Polyurethane Aromatic Shop Primer)
 - a. TNEMEC: Series 1 Omnithane
 - b. Carboline: Carboguard 561
 - c. Sherwin-Williams Company (The): Corothane I Zinc Primer 1K Mio-Zinc.
 - d. PPG PMC Durathane MCZ 97-679 Series
 - e. Or equal.
- D. Non-Primed Surfaces - Gears, bearings surfaces and other similar surfaces obviously not to be painted shall be given a heavy shop coat of grease or other suitable rust-resistant coating. This coating shall be maintained as necessary to prevent corrosion during all periods of storage and erection and shall be satisfactory to the Engineer up to the time of the final acceptance test.
- E. Compatibility of Coating Systems - Shop priming shall be done with primers that are guaranteed by the manufacturer to be compatible with their corresponding primers and finish coats specified in Section 09902 for use in the field and which are recommended for use together.

PART 3 EXECUTION

3.01 APPLICATION

A. Surface Preparation and Priming

1. Non-submerged components scheduled for priming, as defined above, shall be blast cleaned in accordance with SSPC-SP 6/NACE No. 3, immediately prior to priming. Submerged components scheduled for priming, as defined above, shall be blast cleaned in accordance with SSPC-SP 10/NACE No. 2, immediately prior to priming. Consult manufacturer regarding required surface profiles.

2. Surfaces shall be dry and free of dust, oil, grease and other foreign material before priming.
3. Shop prime in accordance with approved manufacturer's recommendations.

B. Non-Primed Surfaces

1. Apply approved coating per manufacturer's recommendations.

3.02 FABRICATED ITEMS

- A. All items to be shop primed shall be blast cleaned as specified for applicable service prior to priming. If, in the opinion of the Engineer, any prime coating that has been improperly applied or if material contrary to this Section has been used, that coating shall be removed by abrasive blasting to white metal and reprimed in accordance with this Section.
- B. All shop prime coats shall be of the correct materials and applied in accordance with this Section. Remove prime coats not in accordance with this Section by blast cleaning and apply the specified prime coat at no additional cost to the Owner.
- C. Shop primed surfaces shall be cleaned thoroughly and damaged or bare spots prepared as approved and retouched with the specified primer before the application of successive paint coats in the field.
- D. Shop finish coats, if proposed and allowed, shall be equal in appearance and protection quality to a field applied finish coat. If, in the opinion of the Engineer, a shop finish coat system does not give the appearance and protection quality of other work of similar nature, prepare the surfaces and apply the coat or coats of paint as directed by the Engineer to accomplish the desired appearance and protection quality. Submit to the Engineer substantial evidence that the standard finish is compatible with the specified finish coat.
- E. Properly protect the shop prime and finish coats against damage from weather or any other cause.
- F. Wherever fabricated equipment is required to be blast cleaned, protect all motors, drives, bearings, gears, etc, from the entry of grit. Equipment found to contain grit shall be promptly and thoroughly cleaned.

END OF SECTION

Attachment D
Section 09902 – Painting
(10 pages)

SECTION 09902
PAINTING

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required and install all painting complete as specified herein.
- B. It is the intent of this Section to paint all new exposed structural and miscellaneous steel; mechanical and electrical equipment; operators and posts; pipe, fittings and valves; electrical conduit and appurtenances; and all other work obviously required to be painted unless otherwise specified. Minor items not mentioned in the schedule of work shall be included in the work of this Section where they come within the general intent of this Section as stated herein.
- C. Items noted in other Specification Sections as having factory finish and other factory finished items are obviously not field painted. The Contractor is responsible for having damaged factory finish painted items repaired or, if so ordered, for replacing items. The various Sections are responsible, as stated in each, for preparation and field touch-up of abrasions, welds and damaged primed areas of primed or galvanized components after erection.
- D. The following items will not be painted:
 - 1. Concrete except where specified above and scheduled to be painted and seamless flooring.
 - 2. Stainless steel louvers, doors and frames.
 - 3. Finish hardware.
 - 4. Non-ferrous metals and stainless steel, unless specifically noted otherwise.
 - 5. Factory pre-finished architectural components.
 - 6. Packing glands and other adjustable parts and name plates of mechanical equipment.
 - 7. Parts of buildings not exposed to sight, unless specifically noted otherwise.
 - 8. Maintenance equipment
 - 9. Plumbing fixtures.
 - 10. Mechanical, HVAC, Plumbing and Electrical equipment which has been finished painted in the factory as specified in Divisions 11 and 16.

1.02 RELATED WORK

- A. Shop priming and surface preparation of equipment and piping (except copper piping) are specified in Section 09901 and included in the respective Section with the item to be primed.

1.03 SUBMITTALS

- A. Submit the following in accordance with Section 01300.
- B. Product Data: For each type of product indicated.
- C. Samples: Submit the following for each type of coating system and in each color and gloss of finish coat indicated.
 - 1. Color cards for initial color selections.
 - 2. Three sets of 8-in by 8-in samples, on 1/4-in hardboard, of all colors required for all types of paint. Resubmit until approved.
- D. Product List: For each product indicated. Cross-reference products to coating system and locations of application areas. Use same designations indicated on Drawings and in schedules.
- E. LEED Submittals:
 - 1. Product Data for Credit EQ 4.2: For coatings, including printed statement of VOC content and chemical components.

1.04 REFERENCE STANDARDS

- A. Steel Structures Painting Council (SSPC)
 - 1. SSPC SP-1 - Surface Preparation Specification No. 1 Solvent Cleaning.
 - 2. SSPC SP-2 - Surface Preparation Specification No. 2 Hand Tool Cleaning.
- B. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.
 - 1. Maintain containers in clean condition, free of foreign materials and residue.
 - 2. Remove rags and waste from storage areas daily.

1.06 PROJECT CONDITIONS

- A. Apply coatings only when temperature of surfaces to be coated and surrounding air temperatures are between 50 and 95 deg F.
- B. Do not apply coatings in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Provide products by one of the following:
 - 1. Tnemec, Inc.(TN);
 - 2. The Sherwin Williams Company (SW)
 - 3. PPG Architectural Finishes, Inc. (PPG)
 - 4. PPG Architectural Finishes, Inc. Ameron (AME)
 - 5. Or equal.

2.02 MATERIALS

- A. Material Compatibility:
 - 1. Provide materials for use within each coating system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
 - 2. Provide products of same manufacturer for each coat in a coating system.
- B. All painting materials shall be delivered to the work site in unbroken packages, bearing the manufacturer's brand and name. They shall be used without adulteration and mixed, thinned and applied in strict accordance with manufacturer's directions for the applicable materials and surface and with the Engineer's approval before using.
- C. Shop priming shall be done with primers that are guaranteed by the manufacturer to be compatible with the finish paints to be used. Refer to Section 09901 for special primers.
- D. Work areas will be designated by the Engineer for storage and mixing of all painting materials. Materials shall be in full compliance with the requirements of pertinent codes and fire regulations. Proper containers outside of the buildings shall be provided and used for painting wastes and no plumbing fixture shall be used for this purpose.
- E. Colors: As selected by Engineer from manufacturer's full range.

2.03 COLOR FOR PIPES AND EQUIPMENT

- A. All pipes and equipment shall be painted with final coat color selected by the Engineer and shall be treated as an integral part of the Contract.
- B. All hanger saddles and pipe support floor stands shall be painted the same color and with the same paint as the pipe it supports. Hanger rods and hanger rod connections to building structure shall be painted to match the color of the wall or ceiling to which it is attached.

2.04 LETTERING OF TITLES

- A. The name of the materials in each pipeline and alongside this an arrow indicating the direction of flow of fluids, shall be indicated on each pipe system. Titles shall not be located more than 26 linear feet apart and shall also appear directly adjacent to each side of any wall the pipeline breaches, adjacent to each side of the valve regulator, flowcheck, strainer cleanout and all pieces of equipment.
- B. Titles shall identify the contents by complete name at least once in each space through which it passes and thereafter by generally recognized abbreviations, letters or numerals as approved. Identification title locations shall be determined by the Engineer but in general they shall be placed where the view is unobstructed and on the two lower quarters of pipe or covering where they are overhead. Title should be clearly visible from operating positions especially those adjacent to control valves.
- C. Numbers and letters shall be die-cut from 3.5 mil vinyl film and pre-spaced on carrier tape. Adhesive and finish surface shall be protected with one piece removable liners. Color shall be white or black as approved depending on substrate color.
- D. Letter size shall be as indicated in the following table:

OUTSIDE DIAMETER OF PIPE OR COVERING	SIZE OF LEGEND LETTERS
3/4-in to 1-1/4-in	1/2-in
1-1/2-in to 2-in	3/4-in
2-1/2-in to 6-in	1-1/2-in
8-in to 10-in	2-1/2-in
Over 10-in	3-in

- E. The system for preparation and application of letters shall be Type B a.s.i/2 by ASI Sign Systems; Architectural Graphics Inc. or equal. Letter type shall be Optima Bold, upper case. Grid 2 spacing shall be employed. Arrow shall match as approved, letter type and size. The instructions of the manufacturer shall be followed in respect to storage, surface preparation and applications of letters.

2.05 TITLES FOR EQUIPMENT

- A. Titles shall be provided in vinyl film as specified above on all equipment using 1-in high Optima Bold upper case, Grid 2 spacing, white or black in color as approved depending on substrate. Use titles shown on mechanical drawings for bidding purposes. Titles shall be mounted at eye level on machines where possible or at the upper most broad vertical surface of low equipment. Where more than one piece of the equipment item to be titled exists, the items shall be numbered consecutively as indicated on the mechanical drawings or as directed by the Engineer; for example Pump No. 1, Pump No. 2, etc. Titles shall be composed in more than one line if required and justified on the left hand side as approved.

2.06 TESTING EQUIPMENT

- A. Furnish to the Engineer for use on the Project for paint inspection, wet and dry film thickness gauges and all other equipment required by the Engineer for inspection.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of work.
 - 1. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
 - a. Concrete: 12 percent.
 - b. Masonry (Clay and CMU): 12 percent.
 - c. Wood: 15 percent.
 - d. Gypsum Board: 12 percent.
 - 2. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
 - 3. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.
 - 4. Coating application indicates acceptance of surfaces and conditions.

3.02 PREPARATION

- A. All surfaces to be painted shall be prepared as specified herein and shall be dry and clean before painting.
- B. All metal welds, blisters, etc, shall be ground and sanded smooth. All pits and dents shall be filled and all imperfections shall be corrected so as to provide a smooth surface for painting. All rust, loose scale, oil, tar and asphalt bearing coatings, grease and dirt shall be removed by use of approved solvents, wire brushing, grinding or sanding.
- C. All PVC pipe and other plastic matrix surfaces to be painted shall be sanded to an approved profile and cleaned of residue before painting.
- D. All PVC pipe and other plastic matrix surfaces to be painted shall be lightly sanded and cleaned of residue before painting.
- E. Galvanized, aluminum, and copper surfaces shall have all oxidation and foreign material removed before painting by SSPC SP-1, using an approved V.O.C. compliant method. Galvanized and, when ordered, the other metal surfaces specified above shall be hand tool cleaned to SSPC SP-2 standards to provide a uniform 1 mil surface profile.
- F. Existing Surfaces to be Repainted
 - 1. Existing masonry, steel and other previously field painted surfaces so noted or as provided in Paragraph 1.01B shall be repainted.
 - 2. Preparation shall be in general as specified above for new surfaces except that all loose paint shall be removed and all edges of existing paint shall be feathered to ensure a smooth surface.

3. Paint removal, capture of its residue, and its disposal shall be handled in accordance with all laws and regulations concerning disposal of hazardous materials.
4. Primer (spot) and paint used for a particular surface shall, in general, be as scheduled for that type of new surface. Provide a CDM Smith approved organic zinc-rich (min. 83% zinc in dried film) primer as specified. Confirm with the paint manufacturer that the paint proposed for a particular repaint condition will be compatible with the existing painted surface. Perform adhesion and compatibility tests on existing substrates as ordered and required. Repainted areas shall be covered by the same guaranty specified for remainder of Project.

3.03 WORKMANSHIP

A. General

1. At the request of the Engineer, sample areas of the finished work prepared in strict accordance with this Section shall be furnished and all painting shall be equal in quality to the approved sample areas. Finished areas shall be adequate for the purpose of determining the quality of workmanship. Experimentation with factory or paint manufacturer's warehouse mixed colors shall be furnished to the satisfaction of the Engineer where standard chart colors are not satisfactory.
2. Protection of furniture and other movable objects, equipment, fittings and accessories shall be provided throughout the painting operation. Canopies of lighting fixtures shall be loosened and removed from contact with surface, covered and protected and reset upon completion. Remove all electric plates, surface hardware, etc, before painting, protect and replace when completed. Mask all machinery name plates and all machined parts not receiving a paint finish. Dripped or spattered paint shall be promptly removed. Lay drop cloths in all areas where painting is being done to adequately protect flooring and other work from all damage during the operation and until the finished job is accepted.
3. On metal surfaces apply each coat of paint at the rate specified by the manufacturer to achieve the minimum dry mil thickness required. If material has thickened or must be diluted for application by spray gun, the coating shall be built up to the same film thickness achieved with undiluted material. One gallon of paint as originally furnished by the manufacturer shall not cover a greater area when applied by spray gun than when applied unthinned by brush. Deficiencies in film thickness shall be corrected by the application of an additional coat(s). On masonry, application rates will vary according to surface texture; however, in no case shall the manufacturer's stated coverage rate be exceeded. On porous surfaces, it shall be the painter's responsibility to achieve a protective and decorative finish either by decreasing the coverage rate or by applying additional coats of paint.

B. Field Priming

1. Steel members, metal castings, mechanical and electrical equipment and other metals which are shop primed before delivery at the site will not require a prime coat on the job. All piping and other bare metals to be painted shall receive one coat of primer before exposure to the weather, and this prime coat shall be the first coat as specified in the painting schedule. Surface preparation of bare metal shall be the responsibility of the Contractor.

2. Equipment which is specified to receive a baked-on enamel finish or other factory finish shall not be field painted unless the finish has been damaged in transit or during installation. Surfaces that have been shop painted and have been damaged, or where the shop coat or coats of paint have deteriorated, shall be properly cleaned and retouched before any successive painting is done on them in the field. All such field painting shall match as nearly as possible the original finish. Preparation and painting shall be provided by the Contractor.
3. Equipment shipped with a protective shop painting coat or coats shall be touched up to the satisfaction of the Engineer with primers as recommended by the manufacturer of the finish paint. Preparation and painting shall be provided by the Contractor.

C. Field Painting

1. All painting at the site shall be under the strict inspection of the Engineer. Only skilled painters and, where dictated by special conditions or systems and so ordered, specialist painters shall be used on the work.
2. All paint shall be at room temperature before applying, and no painting shall be done when the temperature is below 60 degrees F, in dust-laden air, when rain or snow is falling, or until all traces of moisture have completely disappeared from the surface to be painted.
3. Successive coats of paint shall be different shades (from paint manufacturer's stock or shop mixed paint) of the required colors so as to make each coat easily distinguishable from each other with the final undercoat the approximate shade of the finished coat to ensure no show-through as approved.
4. Finish surfaces shall not show brush marks or other irregularities. Undercoats shall be thoroughly and uniformly sanded with the type paper appropriate for the undercoats to remove defects and provide a smooth even surface. Top and bottom edges of doors shall be painted.
5. Painting shall be continuous and shall be accomplished in an orderly manner so as to facilitate inspection. Materials subject to weather shall be primed coated as quickly as possible. Surfaces of exposed members that will be inaccessible after erection shall be cleaned and painted before erection.
6. All painting shall be performed by approved methods with number of coats modified as required to obtain the total dry film thickness specified. Spray painting shall be performed specifically by methods submitted and as approved by the Engineer.
7. All surfaces to be painted as well as the atmosphere in which painting is to be done shall be kept warm and dry by heating and ventilation, if necessary, until each coat of paint has hardened. Any defective paint shall be scraped off and repainted in accordance with the Engineer's directions.
8. Before final acceptance of the work, all damaged surfaces of paint shall be cleaned and repainted as directed by the Engineer.
9. Only the aluminum work noted on the Drawings or in the Painting Schedule shall be field painted.

3.04 FIELD QUALITY CONTROL

- A. Owner reserves the right to invoke the following procedure at any time and as often as Owner deems necessary during the period when coatings are being applied:
 - 1. Owner will engage the services of a qualified testing agency to sample coating material being used. Samples of material delivered to Project site will be taken, identified, sealed, and certified in presence of Contractor.
 - 2. Testing agency will perform tests for compliance with specified requirements.
 - 3. Owner may direct Contractor to stop applying coatings if test results show materials being used do not comply with specified requirements. Contractor shall remove noncomplying coating materials from Project site, pay for testing, and recoat surfaces coated with rejected materials. Contractor will be required to remove rejected materials from previously coated surfaces if, on recoating with complying materials, the two coatings are incompatible.

3.05 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing coating application, clean spattered surfaces. Remove spattered coatings by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from coating operation. Correct damage by cleaning, repairing, replacing, and recoating, as approved by Engineer, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced coated surfaces.

3.06 PAINTING SCHEDULE

- A. All colors will be selected by the Engineer.
- B. DFT for each paint product is not part of paint schedule. Submit both WFT and DFT for each product as part of submittal process. Apply paint and coating products to comply with manufacturer's DFT thickness and application recommendations in the approved submittal.
- C. The following types of paints by Tnemec Co. (TN), The Sherwin Williams Company (SW), PPG Protective & Marine Coatings, (PPG), and Ameron International (AME) have been used as a basis for the paint schedule; use one of these paints or equal:
 - 1. Epoxy:
 - a. TN: Hi-build Epoxoline II, Series N69.
 - b. SW: Macropoxy 646, B58 Series.
 - c. PPG: Pitt-Guard 97-145 Series Epoxy Mastic.
 - d. AME: Amerlock 2/400 Series Epoxy.
 - 2. Waterborne Cementitious Acrylic: Result in pinhole free surface.

- a. TN: Envirofil, Series 130-6602.
 - b. SW: Cement-Plex 875, B42 Series.
 - c. PPG: Cementitious Waterproofing Block Filler 95-217 Series.
 - d. AME: Amerlock 400 BF Epoxy Block Filler.
3. High-Build Acrylic Polyurethane Enamel:
 - a. TN: Endura-Shield - semi-gloss, Series V73.
 - b. SW: Acrolon 218 HS, B65 Series.
 - c. PPG: Pitthane HB Semigloss Urethane 95-8800 Series.
 - d. AME: Amercoat 450HSG Polyurethane.
 4. Tie Coat, Low VOC, Epoxy:
 - a. TN: FC Typoxy, Series V27.
 - b. SW: Macropoxy 646, B58 Series.
 - c. PPG: Pitt-Guard Epoxy Mastic 95-245 Series.
 - d. AME: Amercoat 385 Multi-Purpose Epoxy.
 5. Acrylic Latex Emulsion, Eggshell Finish:
 - a. TN: Tneme-Cryl, Series 6.
 - b. SW: DTM Primer/Finish, B66 Series.
 - c. PPG: Pitt-Tech Plus 90-1110 Series Satin DTM Acrylic.
 - d. AME: Amercoat 220 Waterborne Acrylic.
 6. Vinyl Acrylic Surface Sealer:
 - a. TN: PVA Sealer, Series 51.
 - b. SW: Prep-Rite 200 Primer, B28 Series.
 - c. PPG: Speedhide 6-2 Vinyl Acrylic Drywall Primer.
 - d. AME: Amercoat 148 Acrylic Primer.
- D. The following surfaces shall have the types of paint scheduled below applied at the dry film thickness (DFT) in mils per coat as recommended by manufacturer:
1. Exterior non submerged ferrous metals (except first coat-hollow metal-pressed metal work):
 - a. First Coat: On properly prepared unprimed metal or for touch-up:
 - 1) TN: Hi-build Epoxoline II, Series N69.
 - 2) SW: Macropoxy 646, B58 Series.
 - 3) PPG: Pitt-Guard 97-145 Series Epoxy Mastic.
 - 4) AME: Amerlock 2/400 Series Epoxy.
 - b. Second Coat:
 - 1) TN: Hi-build Epoxoline II, Series N69.
 - 2) SW: Macropoxy 646, B58 Series.
 - 3) PPG: Pitt-Guard 97-145 Series Epoxy Mastic.
 - 4) AME: Amerlock 2/400 Series Epoxy.
 - c. Third Coat:
 - 1) TN: Endura-Shield - semi-gloss, Series V73.
 - 2) SW: Acrolon 218 HS, B65 Series.
 - 3) PPG: Pitthane HB Semigloss Urethane 95-8800 Series.
 - 4) AME: Amercoat 450HSG Polyurethane.

2. Interior non-submerged concrete scheduled for painting:
 - a. First and Second Coats:
 - 1) TN: Hi-build Epoxoline II, Series N69.
 - 2) SW: Macropoxy 646, B58 Series.
 - 3) PPG: Pitt-Guard 97-145 Series Epoxy Mastic.
 - 4) AME: Amerlock 2/400 Series Epoxy.
3. Interior non-submerged ferrous metals (except first coat of previously painted metal work), on properly prepared unprimed metal or for touch-up:
 - a. First Coat:
 - 1) TN: Hi-build Epoxoline II, Series N69.
 - 2) SW: Macropoxy 646, B58 Series.
 - 3) PPG: Pitt-Guard 97-145 Series Epoxy Mastic.
 - 4) AME: Amerlock 2/400 Series Epoxy.
 - b. Second and Third Coats:
 - 1) TN: Hi-build Epoxoline II, Series N69.
 - 2) SW: Macropoxy 646, B58 Series.
 - 3) PPG: Pitt-Guard 97-145 Series Epoxy Mastic.
 - 4) PPG: Amerlock 2/400 Series Epoxy.
4. Submerged ferrous metals and ferrous metals subject to submersion or splashing. Surface shall be lightly sanded or abraded before application of first field coat.
 - a. First and Second Coats:
 - 1) TN: Hi-build Epoxoline II, Series N69.
 - 2) SW: Macropoxy 646, B58 Series.
 - 3) PPG: Pitt-Guard 97-145 Series Epoxy Mastic.
 - 4) PPG: Amerlock 2/400 Series Epoxy.
5. Plastic piping and, where scheduled to be painted, plastic components:
 - a. First and Second Coats:
 - 1) TN: Hi-build Epoxoline II, Series N69.
 - 2) SW: Macropoxy 646, B58 Series.
 - 3) PPG: Pitt-Guard 97-145 Series Epoxy Mastic.
 - 4) AME: Amerlock 2/400 Series Epoxy.
6. Previously Painted Metal Surfaces:
 - a. First coat on substrates prepared as approved and replacing first coat of above-specified systems. Complete painting with remainder of specified system for each type of substrate.
 - b. First Coat:
 - 1) TN: FC Typoxy, Series V27.
 - 2) SW: Macropoxy 646, B58 Series.
 - 3) PPG: Pitt-Guard 97-145 Series Epoxy Mastic.
 - 4) AME: Amerlock 2/400 Series Epoxy.

END OF SECTION

Attachment E

Section 11214 – Vertical Turbine Pumps

(17 pages)

SECTION 11214
VERTICAL TURBINE PUMPS

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required, install, complete and ready for operation and field test, three wet well mounted vertical turbine pumps, to replace the existing Bancroft High Lift Pumps, including their respective motors and accessories, as shown on the Drawings and as specified herein.
- B. These Specifications are intended to give a general description of what is required, but do not cover all details which will vary in accordance with the requirements of the equipment as offered. It is, however, intended to cover the furnishing, factory testing, delivery and complete installation and field testing of all materials, equipment and appurtenances for the complete pumping units as herein specified, whether specifically mentioned in these Specifications or not.
- C. The work under this Section shall include supervisory services during installation and field testing of each unit and instructing the regular operating personnel in the proper care, operation and maintenance of the equipment.
- D. The pump manufacturer (Manufacturer) shall coordinate the design of the pump with the motor. The pumps will utilize two speed motors as specified herein, and will not be powered through variable frequency drives.
- E. The bid alternates shall be as described in Section 01010.

1.02 RELATED WORK

- A. Medium Voltage Electric Motors are specified in Section 01176 and shall be furnished and installed under this Section.
- B. Demolition of existing vertical turbine pumps is included in Section 02050.
- C. Concrete work and the installation of anchor bolts are included in Division 3; however, anchor bolts for these units as recommended by the pump manufacturer shall be furnished by the Contractor under this Section.
- D. Electrical work except as hereinafter specified is included in Division 16.

1.03 REFERENCE STANDARDS

- A. Design, manufacture and assembly of elements of the equipment specified herein shall be in accordance with the following:
 - 1. American Concrete Institute (ACI).
 - 2. American Gear Manufacturers Association (AGMA).
 - 3. American Institute of Steel Construction (AISC).

4. American Iron and Steel Institute (AISI).
5. American Society of Mechanical Engineers (ASME).
6. American National Standards Institute (ANSI).
7. American Petroleum Institute (API).
8. American Society for Testing Materials (ASTM).
9. American Water Works Association (AWWA).
10. American Welding Society (AWS).
11. American Bearing Manufacturers Association (ABMA).
12. Hydraulic Institute (HI) Standards.
13. Institute of Electrical and Electronics Engineers (IEEE).
14. International Organization for Standardization (ISO).
15. National Electrical Code (NEC).
16. National Electrical Manufacturers Association (NEMA).
17. National Sanitation Foundation (NSF).
18. Occupational Safety and Health Administration (OSHA).
19. The Society for Protective Coatings (SPC).
20. Underwriters Laboratories (UL).

- B. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.04 SYSTEM DESCRIPTION

- A. The vertical turbine pumps will pump treated water from the water treatment plant clear well, through the distribution system to the Bancroft Road high service zone elevated storage tank. The on/off and speed of pump operation will be controlled manually by the plant staff in response to water levels within the storage tank. The equipment to be furnished under this Section shall include three complete vertical turbine pumps, including bowl and column assembly with inlet screen, sole plate, discharge head, two speed electric motor, and accessories, all as specified herein and as shown on the Drawings.
- B. The pumps will operate either singly or two together, one operating at high speed and one operating at low speed to meet the intended design flow rate of 12.5 mgd. The third pump will be standby. One pump operating alone at high speed shall have a best efficiency point at approximately 7000 gpm flow rate, and a design point of 7200 gpm at 265 feet of head. Pump shut-off head at high speed shall be approximately 540 feet. The combination of one pump

operating at high speed and one pump operating at low speed shall have a combined operating point of 8660 gpm at 290 feet of head.

- C. Each pump shall fit in the space occupied by the existing Bancroft High Lift Pumps to be demolished under Section 02050. The replacement pumps shall be arranged to fit up to the existing 20 inch ductile iron discharge piping with appropriate setting of the new concrete pump foundation and pump sole plate. The pump bowl assembly with suction anti-vortex screen shall fit through the existing opening in the concrete slab that is not less than 26.5 inches diameter.

1.05 QUALITY ASSURANCE

- A. To assure unity of responsibility, the bowl assemblies, discharge heads, sole plates, and motors shall be furnished and coordinated by the pump manufacturer. The Contractor and manufacturer shall assume responsibility for the satisfactory installation and operation of the entire pumping system including the pumps, motors, mountings, and accessories as specified.
- B. The equipment covered by this Section is intended to be standard pumping equipment of proven ability as manufactured by companies having extensive experience in the production of such equipment similar to the applications specified herein. The equipment provided shall be designed, constructed and installed to operate satisfactorily when installed as shown on the Drawings.
- C. Pumps shall be manufactured and installed in accordance with the Hydraulic Institute Standards. The manufacturer shall be certified to the ISO 9001 standard for design and manufacture of vertical turbine pumps.
- D. The pump manufacturer shall be fully responsible for the design, arrangement, and operation of all connected rotating components of the assembled pumping unit mounted on the soleplate supported by the concrete foundation, to ensure that harmful vibrations will not occur when the pump is in operation at either design operating speed.
- E. Perform a computer-based Finite Element Analysis (FEA) of the pump assembly for reed critical lateral frequency and torsional critical frequency occurring near each design operating speed of the pumping units. All analyses shall be performed using commercially available FEA programs. The dynamic vibration analysis required by the following paragraphs shall be performed by Mechanical Solutions Inc. (MSI) of Whippany, NJ, or Engineering Dynamics Inc. (EDI) of San Antonio, TX or alternatively by the Manufacturer if Manufacturer's demonstrated, successful, vibration analysis experience, in at least twenty projects similar in scope, with proposed personnel involved, may be acceptable to the Engineer with analyses in accordance with the specified requirements.
 - 1. The lateral rotordynamic analysis of the pump assembly, consisting of the motor, discharge head, structural support, and nearby piping to the first pipe restraint or expansion joint, and pump column, shaft couplings, shafting, bowls, impellers, and accessories shall identify and predict that the first lateral critical speed in two perpendicular directions to the shaft shall have a separation margin of not less than 20 percent above or below the two pump operating speeds. The discharge head shall be modeled in shell elements or solids. The motor shall be modeled using elements that duplicate the motor reed critical frequency data supplied by the motor manufacturer. If the first critical reed frequency is less than the pump run speed, verify that the second reed critical frequency is more than 20 percent above the pump run speed. Additionally, no natural frequencies or higher order multiples

of natural frequencies shall occur within 10 percent of 2x times running speed, line frequency, 2x line frequency, or vane pass frequency. If a design modification such as changing the stiffness of the pump head, foundation design, column size or wall thickness, bearing span, or shaft diameter cannot resolve a separation margin deficiency, a force damped response analysis shall be performed to demonstrate that the pump will not experience excessive vibration at the design run speed.

2. The torsional rotordynamic analysis of the complete rotating assembly (pump bowl impeller assembly, motor, intermediate shafting, and coupling) shall identify and predict that no torsional natural frequencies occur within a separation margin extending from 20 percent below to 20 percent above the specified range of pump operating speed. Additionally, no natural frequencies or higher order multiples of natural frequencies shall occur within 10 percent of 2x times running speed, line frequency, 2x line frequency, or vane pass frequency. If a design modification (i.e., such as a shaft diameter change or different coupling arrangement) cannot resolve a separation margin deficiency or is not practical, a forced damped response analysis shall be performed to show that infinite life will be achieved with a safety factor of at least two.
 3. Submit certification the above analysis has been completed, and a summary of results with the initial shop drawing submittal including Campbell diagrams documenting the structural lateral, rotating component lateral, and torsional analysis results, graphically demonstrating the separation margins specified above.
 4. Maximum vibration amplitude measured in the field shall comply with the requirements of ANSI/HI 9.6.4-latest edition.
- F. The pump manufacturer shall be fully responsible for designing and detailing the attachment of the bowl assembly to the discharge head, attachment of the discharge head to the sole plate, and anchorage of the sole plate to the existing concrete. Anchor bolt configuration and installation shall be in accordance with API RP 686 and ACI 318-08, Appendix D where not in conflict with the specific requirements contained herein. Anchor bolts shall be sleeve type cast-in-place headed bolts. Post-installed anchors shall not be used. Anchor bolts and washers shall be of Type 316 stainless steel. Nuts shall be Monel. An anti-seize compound shall be of molybdenum disulfide base such as Molycoat G or approved equal shall be used on the anchor bolt threads. Grouting under the sole plate after the equipment is set is included as work under this Section.
- G. Welding of pressure-containing fabrications shall be by welders qualified to ASME Code Section 9 or AWS D1.1 Structural Welding Code – Steel.
- H. Materials utilized in fabrication of the pumps shall be in conformance with ANSI/NSF 61 Annex G and ANSI/NSF 372.
- I. The Manufacturer shall have an authorized warranty center within a 200-mile radius of the job site, fully staffed with factory trained mechanics, and equipped with a stock of all necessary spare parts for the model of pump furnished under this contract. The service facility shall be an established entity prior to delivery of equipment for this project.
- J. All equipment furnished under this Specification shall be new and unused, shall be the standard product of manufacturers having a successful record of manufacturing and servicing similar equipment and systems to that specified herein for a minimum of five years.

- K. The pumping equipment shall be furnished complete with accessories required and shall meet the detailed requirements of the Specifications.

1.06 SUBMITTALS

- A. Submit, in accordance with Section 01300 and Article V of the General Conditions of the Contract, copies of all materials required to establish compliance with the specifications. Submittals shall include the following:

1. Certified dimensional drawings showing all important details of pump construction and auxiliary apparatus.
2. Certified pump sole plate dimensions, foundation and anchor bolt plans and details, including anchor bolt type, size, material, embedment depth, and minimum edge distance.
3. Certified analysis of impeller material.
4. Literature and drawings describing the equipment in sufficient detail, including materials of construction, to indicate full conformance with the detail specifications.
5. Motor and electrical data as required by Section 01176, and including rated horsepower, operating speeds, power factor, and efficiency curves at $\frac{1}{2}$, $\frac{3}{4}$, and full load, service factor, full load amps at each speed, motor moment of inertia, motor reed critical frequency, motor bearing thrust design, and statement and supporting documentation that the motor bearing life meeting or exceeds the specified value.
6. The weight of the individual major pump assembly components including strainer, bowls, column, discharge head, and sole plate, and the weight of the motors, shaft coupling, and accessories.
7. The total thrust exerted by the pump on the motor bearings at the design point and at shut-off head.
8. A complete materials table for all equipment establishing compliance with these specifications.
9. A list of the manufacturer's recommended spare parts with the manufacturer's current price for each item. Include gaskets, packing, etc. on the list.
10. Certification that the critical speed analyses as required in Paragraph 1.05 E above have been completed and that the specified vibration limitations will be met.
11. Complete description of surface preparation and shop painting.

- B. Design Data:

1. Data on the characteristics and performance of the selected pump. Data shall include guaranteed performance curves to ANSI/HI 14.6 acceptance grade 1U for all specified points, based on actual factory tests of similar units, which show that the pump meets the specified requirements for head, flow rate, efficiency, guaranteed maximum net positive suction head required (NPSH3), submergence and horsepower. Curves shall be submitted

on 8-1/2-inch by 11-inch sheets, at as large a scale as is practical. Curves shall be plotted from zero flow at shut off head to pump flow rate at minimum recommended total head (TH). The POR and AOR (refer to ANSI/HI 9.6.3) shall be clearly shown on the curves. This information shall be prepared specifically for the pump proposed. Submit also catalog sheets showing the family of curves applicable to the pump bowl and impeller selection.

C. Test Reports:

1. Description of pump factory test procedures and equipment.
2. Factory and field performance test data as specified in PART 2 and PART 3.
3. A schedule of the date of factory testing and delivery of the equipment to the job site.
4. Certified motor test data as described in Section 01176.

D. Instructions, Certifications, and Reports:

1. Manufacturer's Installation Instructions
2. Manufacturer's certification of installation as specified in PART 3.
3. Manufacturer's field report as specified in PART 3.
4. Warranty information to demonstrate conformance to Paragraph 1.10.
5. Identify the entity and experienced individual who will inspect the installation in accordance with Paragraph 1.07.

E. Project Record Documents.

F. Vibration reports specified in Paragraph 3.02:

1. Installation vibration report
2. Six-month follow up vibration testing report as specified in Paragraph 3.02.

G. In the event that it is not practical to conform to certain details of the specifications because of different manufacturing techniques, describe completely all nonconforming aspects.

1.07 MANUFACTURER SERVICES INCLUDING OPERATING INSTRUCTIONS

A. Operating and Maintenance Manual:

1. Furnish operating and maintenance manuals prepared specifically for this installation and including all required cuts, drawings, equipment lists, description, etc. that are required to instruct operating and maintenance personnel unfamiliar with such equipment. The maintenance instructions shall include trouble shooting data, full preventative maintenance schedules, and complete spare parts lists with ordering information.

B. Installation Inspection and Startup:

1. The Contractor shall include in his bid price the services of a pump manufacturer's factory representative who has complete knowledge of proper operation and maintenance shall be provided to instruct representatives of the Owner and the Engineer on proper operation and maintenance. This work may be conducted in conjunction with the inspection of the installation and start-up. If there are difficulties in operation of the equipment because of the Manufacturer's design or fabrication, additional service shall be provided at no additional cost to the Owner. The listed service requirements are exclusive of travel time, and shall not limit or relieve the Contractor of the obligation to provide sufficient service necessary to place the equipment in satisfactory and functioning condition. Also refer to requirements in PART 3 of this Section.
2. Installation inspection: Complete review of installation in accordance with Section 01465. Provide written certification that the installation is complete and operable in all respects, and that no conditions exist which may affect the warranty. Qualified supervisory services, including Manufacturers' engineering representatives, shall be provided to ensure that the installation is done in a manner fully approved by the Manufacturer. The manufacturer's factory representative shall specifically supervise the installation and alignment of the pump with the driver, the grouting, and the alignment of the connecting piping and the installation of the field installed packing. If there are difficulties in the start-up or operation of the equipment due to the Manufacturer's design or fabrication, additional service shall be provided at no additional cost to the Owner. Services of the manufacturer's factory representative and training shall be provided when the first pump is started, with follow-up visits upon start-up of each subsequent pump.
 - a. Minimum time on-site shall be one 8-hour day per pump.
3. Start-Up: Services of the manufacturer's factory representative shall be provided when the first pump is started, with follow-up visits upon start-up of each subsequent pump. Provide written report, summarizing test procedures, tested and measured variables (flow rates, total heads, shaft-speed, vibration measurements, alignment check, etc.):
 - a. Minimum time on-site shall be one 8-hour day per pump.

C. Training

1. Field and classroom instruction on operation and maintenance of the equipment, including start-up, shut-down troubleshooting, lubrication, maintenance and safety.
2. The Manufacturer shall provide detailed manuals to supplement the training courses. The manuals shall include specific details of equipment supplied and operations specific to the project.
3. The Manufacturer shall make use of teaching aids, manuals, slide/video presentations, etc. After the training services, such materials shall be delivered to Owner.
 - a. Minimum time on-site shall be one 8-hour day.

- D. The Contractor alone shall be responsible for requesting these services, and shall coordinate these requests with all other relevant trades, to ensure the effectiveness of the Manufacturers' service. In the event that the lack of coordination by the Contractor results in the need to recall the manufacturer's factory representative, the lost time shall not be counted against the above days.

1.08 MAINTENANCE

- A. Furnish all special tools and test equipment required for the proper servicing of all equipment as specified in Section 01170. All such tools and test equipment shall be furnished in a suitable steel tool chest complete with lock and duplicate keys.
- B. All spare parts shall be properly protected for long periods of storage and packed in containers that are clearly identified with indelible markings as to contents.
- C. Furnish the following spare parts.
 - 1. Three sets of packing.
 - 2. One packing gland.
- D. Provide to the Owner a list of all spare and replacement parts with individual prices and location where they are available. Prices shall remain in effect for a period of not less than one year after start-up and final acceptance.
- E. Special tools and spare parts shall be furnished in accordance with Section 01170.

1.09 PRODUCT HANDLING

- A. Delivery, storage and handling of equipment shall be in accordance with Section 01600 and as specified herein.
- B. All parts shall be properly protected so that no damage or deterioration will occur during a prolonged delay from the time of fabrication, including storage in accordance with Manufacturer's requirements, until the unit and equipment are ready for operation.
- C. All equipment and parts must be properly protected against any damage during shipment. Store the equipment in accordance with manufacturer's recommendations.
- D. Factory assembled parts and components shall not be dismantled for shipment unless permission is received in writing from the Engineer.
- E. The finished surfaces of all exposed flanges shall be protected by wooden or equivalent blank flanges, strongly built and securely bolted thereto.
- F. Finished iron or steel surfaces not painted shall be properly protected to prevent rust and corrosion.
- G. No shipment shall be made until approved by the Engineer in writing.
- H. For protection of bearings during shipment and installation, the bearing shall be properly processed. Anti-friction bearings, if pre-lubricated, shall be protected in accordance with the bearing manufacturer's recommendations against formation of rust during a long period of storage while awaiting completion of installation and start-up of the machine in which they are used. Anti-friction bearings which are not pre-lubricated shall be properly treated in accordance with the bearing manufacturer's recommendation against formation of rust during a long period

of storage while waiting completion of installation and start-up by the application of an appropriate rust preventative treatment.

1.10 WARRANTY

- A. All equipment supplied under this Section of the Specifications shall be warranted for a period of one year from Substantial Completion by the Contractor and the Manufacturer. Warranty period shall commence on the date of Owner acceptance, as outlined in Division 1 and in Division 0.
- B. The equipment shall be warranted to be free from defects in workmanship, design and materials. If any part of the equipment should fail during the warranty period, it shall be replaced in the machine(s) and the unit(s) restored to service at no expense to the Owner.
- C. The Manufacturer's warranty period shall run concurrently with the Contractor's warranty period. No exception to this provision shall be allowed.
- D. Refer to Section 01740 and Article IX of the General Conditions of the Contract for additional warranty requirements.

PART 2 PRODUCTS

2.01 GENERAL

- A. The pumping units shall be supplied by one manufacturer and shall be complete including pump bowl and column assemblies, discharge head, sole plate, electric motor, couplings, and appurtenances. The pumps shall conform to AWWA E-103, Horizontal and Vertical Line-Shaft Pumps Standard, where not in conflict with the requirements specified herein. Ample room shall be provided for inspection, repairs and adjustments.
- B. The pump(s) shall be capable of temporary operation at and near shut off head during the three minute, maximum, opening and closing of the pump discharge control valve as the pump starts and stops.
- C. The pumps shall be designed and built for 24-hour continuous service at any and all points within the required range of operation, without overheating, excessive vibration or strain.
- D. The existing pumps and sole plates shall be removed, and the grout/foundation to the floor level. The dimensions of the replacement pump discharge head shall be compatible with the dimensions of the existing connecting piping, or the Contractor shall be responsible for modifications to the existing piping to achieve connection and alignment. Furnish and install new pump sole plates to provide a level and stable foundation for the replacement pumps. New complete replacement pumps including motors shall be vertical solid shaft arrangement. The pump motor shall be designed and constructed to prevent reverse rotation using a non-reverse ratchet installed in the motor.
- E. Each major piece of equipment shall be furnished with a stainless steel nameplate (with embossed data) securely mounted to the body of the equipment. At a minimum, the nameplate for the pumps shall include the manufacturer's name and model number, serial number, rated flow rate, head, and speed. As a minimum, nameplates for motors shall include the

manufacturer's name and model number, serial number, horsepower, speed, input voltage, amps, frequency, power factor, and service factor.

- F. The nameplate ratings of the motor shall not be exceeded, nor shall the design service factor be reduced when the pump is operating at any point on its performance curve within the specified operating range at maximum speed.
- G. Mechanical equipment shall be supplied and installed in accordance with applicable OSHA regulations. The Contractor's attention is drawn to the requirement for guards on all rotating assemblies.

2.02 CONDITIONS OF OPERATION

- A. The pumps shall be Model 24 GLC 7 stage by Goulds; Model H24 MC by National Pump; or equal. The pumps shall be identical in every respect with all parts interchangeable.
- B. Each bowl assembly shall be designed for the conditions of service tabulated as follows. The pumps shall have a continuously rising head-flow rate performance curve for stable pump operation within the Acceptable Operating Range.

TABLE 11214-1
PUMPING UNIT DESIGN REQUIREMENTS

Item Description	Design Conditions
Service	Finished Water
Number of Pumps (operating/standby)	3 (2/1)
Motor Speed (FLS) (rpm)(nominal)	900/720
Motor Horsepower (non-overloading throughout operating range) (HP)	600/380
Motor Design Voltage/Phase/Frequency	4160/3/60
Maximum Anticipated Pumped Fluid Temperature (degrees F.)	70
Pump Discharge Nozzle Size (inches)	20
Pump Column Diameter (inches)	16
Pump Shut-Off Head at Motor High Speed (feet)	540
Design Point Flow Rate (gpm)	7200
Minimum TH at Design Point when Measured From Discharge Flange (ft)	265
Minimum Efficiency at Design (%)	86
Maximum NPSH3 at Design Point (feet)	40
Best Efficiency Point (BEP) Flow Rate (gpm)	7000
Minimum Run-Out Point (High Speed)	8500 gpm @ 180 ft
Minimum Submergence Above Pump Suction Bell (feet)	6.0

- C. The design point and shut-off head are selected to allow combined operation of one pump at high speed and one pump at low speed to deliver a total flow rate from the two pumps of not less than 8660 gpm at a total head of approximately 290 ft. It is a requirement of this project to achieve a total pumping rate of 12.5 mgd (8660 gpm) with one pump running at high speed and one pump running a low speed.

- D. Total head (TH) specified shall be understood to consist of the sum of the pressure head plus the velocity head at the bowl assembly outlet minus the wet well static head at the pump suction inlet taken in reference to the pump datum. The efficiency of the pump shall be understood to be based upon the defined total head. Pump performance requirements specified herein are bowl performance, not including losses in the suction screen, column, or discharge head.
- E. The following are approximate elevations of the existing pumping system. Select the length of the pump column to provide maximum possible pump suction submergence and setting above the bottom of the clear well in accordance with current Hydraulic Institute recommendations.
 - 1. Pump Room Floor: EL 125.00
 - 2. Bottom of Clearwell: EL 102.00
 - 3. Centerline of 20 inch Discharge: EL 126.635

2.03 PUMP CONSTRUCTION

- A. Vertical turbine line-shaft pumps shall be product lubricated with open line-shaft bearings, equipped with above floor discharge head and motor support, and solid shaft motor.
- B. Pump bowls, including suction bell, shall be ASTM A48 Class 30 cast iron, flanged and bolted construction with bearings as specified below. All bowl hardware shall be Type 316 stainless steel with monel nuts. Bowls shall be equipped with cast iron or Type 420 stainless wear rings. Pump bowl interior surfaces shall be coated with NSF 61 approved coating system as specified herein.
- C. The suction bell shall be of ASTM A48 Class 30 epoxy coated cast iron, flanged and bolted construction with ASTM B505, Alloy C89835 bismuth tin bronze suction bearing, packed and permanently lubricated with non-water soluble food grade grease suitable for use with drinking water supply pumps in accordance with AWWA E-103. Pump suction bell shall incorporate a basket or strainer type vaned vortex suppressor, or other approved device to reduce the possibility of vortices entering the pump suction. Suppressor shall be of the same material as the suction bell with Type 316 stainless steel basket or strainer.
- D. Impellers shall be cast nickel aluminum bronze, ASTM B148, Alloy UNS No. C95200 certified analysis of the impeller pour metal required; enclosed type; statically and dynamically balanced to ISO 1940-1 quality grade G 2.5. As an alternate, CF8M cast stainless steel impellers are acceptable. Select first stage impeller dimensions, configuration, and performance to meet the specified NPSHA conditions.
- E. Bowl shafts shall be ASTM A582 Type 416 or 17-4 PH stainless steel, or Nitronic 50. Impellers shall attach to the shaft by a double key arrangement utilizing axial and radial keys of Type 416 stainless steel with bronze bolts.
- F. Line-shafts shall be provided in accordance with AWWA E-103 and shall be Type 416 stainless steel and shall be field replaceable. Maximum shaft lengths shall be 10-ft and shall be verified with vibration analysis as specified herein. Couplings of bowl shaft and line shafts shall be self-tightening threaded couplings of Type 416 stainless steel. Bearing retainers shall be constructed of cast bronze or Type 316 stainless steel. The top line shaft shall extend through the pump head and shaft seal housing, and shall be one piece solid shaft construction, with threaded

connection to the motor shaft coupling located above the stuffing box. The section of the top shaft that extends through the stuffing box shall be fitted with a replaceable Type 416 stainless steel sleeve, that extends beyond the face of the stuffing box far enough to accommodate the packing and gland. The sleeve shall be held to the shaft with set screws, key, or other means to prevent rotation and shall be sealed to prevent leakage between the shaft and the sleeve. Minimum shaft sleeve thickness shall be 0.25 inch.

- G. Open line-shaft and bowl bearings above each impeller shall be removable self-flushing product lubricated bismuth tin bronze ASTM 505 Alloy C89835.
- H. Discharge columns shall be carbon steel pipe, ASTM A-53, flanged and bolted construction in lengths not exceeding 10-ft. All flange hardware shall be Type 316 stainless steel with monel nuts. The minimum column wall thickness shall be in accordance with AWWA E-103 and as required for the pump discharge pressure. Flange joints shall be O-Ring sealed, precision machined for straightness and registered fit of column sections and the bearing retainers, and registered fit of the column section to the discharge head. Design the column and flange joint bolting for minimum of 150 percent of pump shut-off head.
- I. The pump discharge head shall be of fabricated steel or cast/ductile iron, above the floor, "L" Type, braced and reinforced as required to withstand up to 150 percent of the pump shut-off head and to assure the first order natural frequency of the discharge head and motor assembly is above the pump operating speed plus the specified margin. Discharge flange shall match the existing discharge piping. The discharge head shall mate with the pump base sole plate. The discharge head shall have a machined and drilled and tapped registered fit for connection of the top of the pump column, incorporating O-Ring seals. The discharge head arrangement shall provide access openings for the pump shaft coupling and packing. Provide a ¼ inch tap at the spring line of the discharge nozzle for a discharge pressure gauge. Provide a 2 inch tap with plug at the top centerline of the discharge nozzle for an air release valve. Provide two 2 inch taps in the discharge head base to align with the sole plate opening for connection of vents or drains.
 - 1. The discharge head shall include an ASTM A48 cast iron stuffing box housing bolted to a machined, O-Ring sealed registered fit to align with the motor shaft. Seal the stuffing box with product flushed acrylic yarn and graphite packing rings. Stuffing box shall include a bronze split packing gland, Type 16 stainless steel studs and Monel nuts. Seal water arrangement shall be API Plan 13.
 - 2. Motor mounting flange for the vertical driving motor shall have a P-base with a registered fit in accordance with NEMA standards.
- J. Furnish a rectangular sole plate for mounting to the concrete foundation, to provide a level surface for mounting and firm support of the pump head. The sole plate shall be proportioned to support the entire pump/motor assembly and the loads (including the result of the dynamic vibration analysis) to which it may be subjected during operation. The sole plate shall be of ASTM A36 steel plate of the same thickness as the pump head base flange, with tapped bolt holes to match the discharge head base flange bolt holes. The sole plate shall extend beyond the discharge head base flange diameter to provide anchorage to the concrete equipment foundation, to support the weight of the entire assembled pumping unit. The contact surface between the pump head base and the sole plate shall be accurately machined to provide a flat mating surface between the pump head and the sole plate. Provide bolt holes to secure the sole plate to the concrete foundation with anchor bolts. Provide jack bolts in tapped holes in the sole

plate located to provide for accurate leveling and support of the sole plate on the rough concrete foundation during placement of the grout.

2.04 MOTOR TO PUMP COUPLING

- A. The pump top shaft shall be directly connected to the solid shaft motor by means of a flanged adjustable spacer coupling, sized to transmit the required driving and starting torque of the motor and the axial thrust of the pump. The coupling shall have a threaded connection to the pump top shaft and a double keyed connection to the motor output shaft. Design the coupling for easy access for impeller clearance adjustment and for access to the packing. Select coupling rigidity to coordinate with the torsional vibration requirements of the entire rotating assembly.

2.05 MOTORS

- A. Each pump shall be driven by a vertical two-speed solid shaft squirrel cage induction electric motor with speeds and rated horsepower as specified in Paragraph 2.02. Motors shall conform to all requirements of Section 01176. Motors shall be suitable for driving the pumps continuously over the entire pumping range. Motor output power required shall not exceed the nameplate rating at 1.0 service factor. The pump motors shall be furnished by the pump manufacturer.
- B. Motor thrust bearing shall bear the entire up-thrust and down-thrust of the pump during start-up and steady state operation, and shall be anti-friction, rolling element type bearings. Select the motor thrust bearing in conjunction with selection of the impeller design to assure that the motor can accept the required mechanical and hydraulic thrust load and provide bearing life as specified in Section 01176, including starting the pump against a closed discharge valve.
- C. Motors shall have non-reverse ratchets to provide immediate protection against reversing because of phase reversal or from backspin caused by backflow through the pump. The non-reverse ratchet shall be a shaft mounted mechanical device configured with an outer rotating component equipped with a series of holes bored at angles. The holes shall house hardened steel balls. The inner stationary component shall consist of a series of flutes to receive the balls, with one of which shall engage in the locked position the instant the motor stops turning forward. The number of flutes shall differ from the number of balls to increase the number of possible locking positions. The non-reverse ratchet shall be robust enough to withstand the motor torque developed during accidental reverse rotation including that caused by phase reversal. The non-reverse ratchet shall disengage in response to normal rotation speed of no more than 20 percent of rated motor speed.

2.06 PRESSURE GAUGES

- A. Each pump shall be equipped with a discharge pressure gauge. Pressure gauges shall be bronze bourdon tube Ametek U.S. Gauge, SOLFRUNT Duragauge Series 1980 Black Phenol Turret type with 316 stainless steel rack and pinion movement or equal. The gauges shall be glycerin filled. Gauges shall be calibrated from 0 to 400 psig for discharge service. Gauges shall be 4-1/2-in diameter furnished with 1/4-in inlet. All fittings and cocks shall be Type 316 stainless steel. Pressure gauges shall be furnished with isolating pulsation dampers. All gauges shall be furnished by the Contractor.

2.07 SHOP PAINTING

- A. The pump motor shall receive primer at the motor manufacturer's shop. Prime painting shall conform to Section 09901, with primer compatible with the finish paint to be field applied in accordance with Section 09902.
- B. The exterior of the pump discharge head and the pump sole plate shall be prepared and shop primed in accordance with Section 09901, at the pump manufacturer's shop, with primer compatible with the finish paint to be field applied in accordance with Section 09902. Mating flange surfaces and surfaces to be in contact with the concrete grout shall not receive paint.
- C. All wetted surfaces of the pump discharge heads, pump columns, the bowl assemblies, and suction bell assembly with vortex suppressor shall be prepared and cleaned of all rust and mill scale, grease, dirt, other foreign matter, shop primed, and finish coated with a coating system accepted by the NSF/ANSI 61 and ANSI/NSF 372-2011 for use in contact with potable water.
 - 1. Prior to painting, all surfaces shall be abrasive blast cleaned in accordance with SPC-SP 10/NACE No. 2. Clean locations where abrasive blast cleaning is not feasible or permissible to SPC-SP 11.
 - 2. The blast cleaning procedure shall use angular grit abrasive. No steel shot shall be utilized. The size and gradation shall be such as to produce a two to three mils angular anchor profile that is sharp and clean with no embedded spent abrasive materials. All welds shall be ground smooth before blast cleaning commences. Should any grinding be done after grit blasting, perform needle gunning of welds or grinding.
- D. All nameplates shall be properly protected during painting.

2.08 SHOP TESTS

- A. Each pump bowl assembly and column sections shall receive non-witnessed shop tests as described in ANSI/HI 14.6, American National Standard for Rotodynamic Pumps for Hydraulic Performance Acceptance Tests, as specified herein.
- B. The Manufacturer shall perform hydrostatic test on the pressure-containing parts in accordance with ANSI/HI 14.6. Test shall be conducted on all pump components prior to shipment.
- C. Cast surfaces of all components shall be examined by visual inspection per MSS SP-55.
- D. Shop tests shall be the basis of acceptance of the hydraulic performance of the pump bowl assemblies. The Manufacturer shall factory test all pumps prior to shipment in accordance with the Hydraulic Institute standards. Test and record flow rate, total head, efficiency and input power for at least seven points on the pump performance curve. Test shall be performed to demonstrate that the pumps meet ANSI/HI 14.6, acceptance grade 1U for all specified points, except that the maximum pump power input at any point on the pump curve shall be limited to the nameplate Brake Horsepower rating of the motor size specified in Paragraph 2.02. The test points shall include the points specified in Paragraph 2.02. If any pump tested fails to meet any specification requirement, it shall be modified until it meets all specification requirements. If any pump tested fails to meet the flow rate, head or efficiency requirements for any of the conditions listed in Paragraph 2.02 of this Section and all reasonable attempts to correct the

deviation are unsuccessful, the pump(s) shall be replaced with a unit(s) that meets the specified requirements.

- E. Submit certified pump performance curves, including total head, flow rate, bowl efficiency and total brake horsepower for each pump supplied. Test data shall be submitted for approval by the Engineer prior to shipment.
- F. Submit also NPSH3 performance data. If the pump manufacturer does not have historical records for NPSH3 at the specified design pump speed, one pump shall be tested to demonstrate NPSH3 performance versus flow rate.
- G. All meters, gauges, and other test instruments shall be calibrated within the manufacturer's established time period prior to the scheduled test and certified calibration data shall be provided. If the Manufacturer has no ISO standard calibration period, Hydraulic Institute Standards shall govern.
- H. Pump bowls shall be tested with a laboratory column pipe and discharge head similar in size to the existing pump head. If possible, the length of column pipe shall be the same as will be required to set the bowl in the field.
- I. The pumps shall be tested at 100 percent of the design speed. Submit performance curves adjusted to the low speed (710 rpm) utilizing the affinity laws.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Refer to Section 01170 for maintenance of pumping operation. One pump at a time may be taken out of service for bowl replacement.
- B. Take all necessary measurements in the field to determine the exact dimensions for all work and the required sizes of all equipment under this Contract. All pertinent data and dimensions shall be verified.
- C. Installation shall be in strict accordance with the Manufacturer's instructions and recommendations in the locations shown on the Contract Documents and pump shop drawings. Refer to Paragraph 1.07 for additional requirements. The Contractor shall furnish all required oil and grease for initial operation, if required, in accordance with the Manufacturer's recommendations. Anchor bolts shall be set in accordance with the Manufacturer's recommendations and setting plans.
- D. Refer to Paragraph 2.01 for additional installation (sole plate temporary support, grouting, etc.) requirements. Connection of piping to pumps shall be done in the presence of the Engineer. All piping connections to the pump shall be done without bending and/or twisting the piping to mate with the pump flange connections.
- E. A certificate from the equipment manufacturer shall be submitted stating that the installation of their equipment is satisfactory, that the equipment is ready for operation, and that the Owner's operating personnel have been suitably instructed in the operation, lubrication and care of each unit.

3.02 INSPECTION AND TESTING

A. General:

1. The Engineer shall have the right to inspect any equipment to be furnished under this Section prior to their shipment from place of manufacture.
2. The Engineer shall be notified in writing no fewer than ten working days prior to initial shipment, so that arrangements can be made for inspection by the Engineer.
3. Field tests shall not be conducted until such time that the pumping system, including controls, is complete and ready for testing.

B. Field Testing:

1. In the presence of the Engineer, necessary tests shall be performed to indicate that the pumps generally conform to the operating conditions specified. The factory testing specified above will be the basis of performance acceptance. A 7 day operating period of the pumps will be required before acceptance. If a pump performance does not generally agree with the factory test results, corrective measures shall be taken or the pump shall be removed and replaced with a pump that satisfies the conditions specified. Provide, calibrate and install all temporary gauges and meters, make necessary tapped holes in the pipes, and install all temporary piping and wiring required for the field acceptance tests. Written test procedures shall be submitted to the Engineer for approval no fewer than 30 days prior to testing.
2. After installation and as soon as conditions permit full speed operation, the Contractor shall retain the services of the independent mechanical vibration testing and analysis firm, Lindskog Balancing (Boxborough, MA), without equal to perform a detailed vibration signature analysis of each unit(s) in accordance with ANSI/ISO 9.6.4, including both "Bump Tests" and X-Y vibration profiles, to (a) prove compliance with the specified vibration limitations and (b) prove there are no field installed resonant conditions due to misalignment, the foundation, or the connecting piping and its supports, when operating at any speed within the specified operating range. A written report shall be submitted including a detailed schematic drawing of the units indicating thereon where and in which direction the vibration readings were taken and recorded showing (a) peak-to-peak displacement, in mils, (b) frequency spectrum, (c) peak velocity level, in inches per second, (d) velocity level, in inches per second RMS. The report shall contain a complete analysis of their findings, describing any problem encountered, if any, probable cause and specific recommendations for any required corrective action.
 - a. If required, take corrective action and re-test the units to ensure full compliance with this Section.
 - b. The testing and analysis indicated above shall be repeated six months after the signature testing. A report shall be prepared comparing the results of the six month tests with the results of the signature tests. Significant worsening of the vibration, to be determined by the Engineer, during the six month tests shall require corrective action and retesting.
3. If required, take corrective action and have the units retested to ensure full compliance with the specified requirements. All costs associated with the field tests or any required corrective action shall be borne by the Contractor.

3.03 DISINFECTION

- A. The Owner is in possession of a Standard Operating Procedure (SOP) for disinfection of new equipment and appurtenances. The Contractor shall consult the Owner for this SOP and shall perform disinfection of all equipment upon installation.

END OF SECTION

Attachment F

Section 15072 – Ductile Iron Pipe and Fittings

(7 pages)

SECTION 15072
DUCTILE IRON PIPE AND FITTINGS

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required, install, disinfect and test ductile iron pipe and fittings for plant mechanical piping as shown on the Drawings and as specified herein.
- B. Mechanical piping shall include all piping and fittings installed above grade, in utility tunnel or gallery and shall exclude pipe in valve vaults, manholes, cleanouts and similar yard structures.
- C. Mechanical piping shall be installed as shown on the Drawings. Provide pipe supports, hangers and couplings as required to achieve a complete pipe system.
- D. Where the word "pipe" is used, it shall refer to pipe, fittings, or appurtenances unless otherwise noted.

1.02 RELATED WORK

- A. Delivery, Storage and Handling is included in Section 01600.
- B. Painting is included in Section 09901 and Section 09902.
- C. General Piping Requirements are included in Section 15050.
- D. Valves and Appurtenances are included in Section 15100.

1.03 SUBMITTALS

- A. Submit, in accordance with Section 01300, shop drawings and product data required to establish compliance with the Section. Submittals shall include the following
 - 1. Tabulated layout drawings showing actual pipe lengths, diameters, fittings and appurtenances.
 - 2. Prior to shipment of pipe, submit a certified affidavit of compliance from the pipe manufacturer stating that the pipe, fittings, gaskets, linings and exterior coatings for this project have been manufactured and tested in accordance AWWA and ASTM standards and requirements specified herein.

1.04 REFERENCE STANDARDS

- A. ASTM International (ASTM):
 - 1. ASTM C150 - Standard Specification for Portland Cement.
- B. American National Standards Institute (ANSI):

1. ANSI B1.1 - Unified Inch Screw Threads (UN and UNR Thread Form).
2. ANSI B16.1 - Cast Iron Pipe Flanges and Flanged Fittings Classes 25, 125 and 250.
3. ANSI B18.2 - Square and Hex Bolts and Screws Inch Series Including Hex Cap Screws and Lag Screws.

C. American Water Works Association (AWWA):

1. AWWA C104 - Cement-Mortar Lining for Ductile-Iron Pipe and Fittings.
2. AWWA C110 - Ductile-Iron and Gray-Iron Fittings. (3-in Through 48-in (80mm Through 1200mm) for Water).
3. AWWA C111 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
4. AWWA C115 - Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges.
5. AWWA C116 - Protective Fusion-Bonded Epoxy Coatings for the Interior and Exterior Surfaces of Ductile-Iron and Gray-Iron Fittings.
6. AWWA C150 - Thickness Design of Ductile-Iron Pipe.
7. AWWA C151 - Ductile-Iron Pipe, Centrifugally Cast.
8. AWWA C153 - Ductile-Iron Compact Fittings for Water Service.
9. AWWA C600 - Installation of Ductile-Iron Water Mains and Their Appurtenances.
10. AWWA C606 - Grooved and Shouldered Joints.
11. AWWA C651 - Disinfecting Water Mains.

- D. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.05 QUALITY ASSURANCE

- A. Each length of ductile iron pipe supplied for the project shall be hydrostatically tested at the point of manufacture to 500 psi for a duration of 10 seconds per AWWA C151. Testing may be performed prior to machining bell and spigot. Failure of ductile iron pipe shall be defined as any rupture of the pipe wall. Certified test results shall be furnished in duplicate to the Engineer prior to time of shipment.
- B. Ductile-iron pipe and fittings to be installed under this project shall be inspected and tested at the foundry as required by the standard specifications to which the material is manufactured. Furnish in duplicate to the Engineer sworn certificates of such tests and their results prior to the shipment of the pipe.

- C. Pipe and fittings to be installed under this Contract may be inspected at the plant for compliance with this Section by an independent testing laboratory selected by the Owner, at the Owner's expense.
- D. Inspection of the pipe and fittings will also be made by the Engineer or representative of the Owner after delivery. The pipe shall be subject to rejection at any time on account of failure to meet any of the specified requirements, even though sample pipes may have been accepted as satisfactory at the place of manufacture. Pipe rejected after delivery shall be marked for identification and shall be removed from the job.
- E. Pipe and fittings shall be permanently marked with the following information:
 - 1. Manufacturer, date.
 - 2. Size, type, class, or wall thickness.
 - 3. Standard produced to (AWWA, ASTM, etc).

1.06 DELIVERY, STORAGE AND HANDLING

- A. See Section 01600 for general requirements.
- B. Care shall be taken in loading, transporting and unloading to prevent injury to the pipe or coatings. Under no circumstances shall the pipe be dropped or skidded against each other. Slings, hooks, or pipe tongs shall be padded and used in such a manner as to prevent damage to the exterior surface or internal lining of the pipe.
- C. Materials, if stored, shall be kept safe from damage. The interior of all piping, fittings and other appurtenances shall be kept free from dirt or foreign matter at all times.
- D. Pipe ends including flange faces shall be protected from damage. All openings shall be adequately covered to prevent entrance of dirt, water and debris, and keep the pipe interior clean.
- E. Pipe shall not be stacked higher than the limits recommended by its manufacturer. The bottom tier shall be kept off the ground on timbers, rails, or concrete. Stacking shall conform to manufacturer's recommendations.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Pipe:
 - 1. Ductile iron pipe shall conform to AWWA C115 and C110. Flanged and groove end pipe shall be Thickness Class 53 as per AWWA C150.
 - 2. Pipe shall be supplied in standard lengths as much as possible.
 - 3. Ductile iron pipe shall be as manufactured by U.S. Pipe and Foundry Company, Inc.; American Cast Iron Pipe Company; Clow Water System Company, or equal.

B. Joints:

1. Ductile iron pipe shall have flanged or grooved joints. Flange shall be flat face or raised face type, unless otherwise noted, meeting ANSI requirements ANSI B16.1 Class 250.
2. Flange gasket shall be full face type per AWWA C111 to provide positive sealing for the flanged ductile iron joints. Thickness shall be 1/8-in unless otherwise indicated. The gasket materials for potable water pipe shall be certified by NSF61.
3. Assembly bolts shall be square headed carbon steel machine bolts with hexagon nuts per ANSI B18.2. Thread shall conform to ANSI B1.1. Bolt length shall be such that after joints are assembled, the bolts shall protrude through the nuts, but not more than 1/2-in. Steel flanges in conformance with AWWA C207, Class D, may be mated to iron valves, fittings, or other parts having either integral Class 250 iron flanges or screwed Class 250 companion flanges. When such construction is used, the raised face on mating flanges shall be removed.
4. Grooved joints shall conform to AWWA C606 standard rigid couplings and shall be Style 31 couplings as manufactured by Victaulic, Anvil International, or approved equal.
 - a. For direct connection of ductile pipe to steel pipe of IPS sizes: Victaulic Style 307 transition coupling with offsetting, angle-pattern, bolt pads.
 - b. Grooved end fittings for AWWA ductile iron pipe shall conform to ANSI A21.10/AWWA C110 for center-to-end dimensions and ANSI A21.10/AWWA C110 or AWWA C153 for wall thickness, with AWWA C606 grooved ends.
5. Sleeve type couplings shall be Dresser Style 38 or 138 as manufactured by Dresser Industries, or equivalent products of Smith-Blair, Romac Industries, Ford Meter Box Co or approved equal.
6. Flanged coupling adaptors shall be Smith-Blair Type 913, or equivalent products of Klamflex Pipe Couplings (PTY) LTD, Robar Industries LTD or approved equal.

C. Fittings:

1. Pipe fittings shall be ductile iron with a pressure rating of 250 psi. Fittings shall meet the requirements of AWWA C110 as applicable. Fittings shall have the same pressure rating, as a minimum, of the connecting pipe.

D. Interior Lining:

1. Ductile iron pipe and fittings shall have the same type of lining as specified or indicated on the Drawings.
2. Ductile iron pipe and fittings shall have a polyethylene lining. The lining shall consist of a blend of polyethylene powders applied to the interior of a preheated pipe. The lining film thickness shall be 40 mils minimum. Polyethylene lining of ductile iron pipe shall be done at the pipe manufacturer's plant; fittings shall be done at the manufacturer's plant or at experienced shop approved by the pipe manufacturer.
3. Interior linings for potable water use shall be certified by NSF 61.

E. Exterior Coatings:

1. Unless otherwise specified, all coatings shall be shop applied with "hold-backs" provided as required at pipe and fitting ends for satisfactory installation for joint connections in the field. Provide all necessary coating materials to perform field coating applications at joints. Unless otherwise noted, field applied coating material shall be compatible with or equal to the shop applied material. Field repair of pipe with damaged coating shall receive prior approval of the Engineer. If, in the opinion of the Engineer that the coating damage is beyond repair the pipe shall be replaced at the expense of the Contractor. All flange bearing surfaces shall be uncoated.
2. Unless otherwise specified, all exposed exterior ferrous surfaces shall be painted with an applicable paint system as specified under Division 9. Surface preparation and application thereof shall be in conformance with applicable provisions of Division 9.
3. All exterior coating and linings shall be applied to the ductile iron surface that has been mechanically cleaned or brush blasted. Chemical cleaning or wiping with solvent as a preparation method is not acceptable.

F. Pipe Hangers and Supports:

1. Pipe hangers and supports shall be provided at suitable distance along the pipeline regardless whether they are shown or not shown on the Drawings.

PART 3 EXECUTION

3.01 PIPE INSTALLATION

A. General:

1. Piping and fittings shall be installed true to alignment and rigidly supported. Anchorage shall be provided where required. Damage to linings shall be repaired to the satisfaction of the Engineer before the pipe is installed. Each length of pipe shall be cleaned out before installation. All of manufacturer's recommendations shall be complied with.
2. Deflection at joints shall not exceed that recommended by the pipe manufacturer. Fittings, in addition to those shown on the Drawings, shall be provided, if required, in areas where conflict exists with the existing facilities.
3. When pipe cutting is acceptable to the Engineer, the cutting shall be done by abrasive saw, leaving a smooth cut at right angles to the axis of the pipe. Damage to the lining shall be repaired to the satisfaction of the Engineer. Field cut ends shall be sealed with approved epoxy coating in accordance with manufacturer's instructions.

B. Jointing:

1. Flanged joints shall be made using gaskets, bolts, bolt studs with a nut on each end, or studs with nuts where the flange is tapped. The number and size of bolts shall conform to the same ANSI Standard as the flanges.
2. Bolts in flanged joints or mechanical joints shall be tightened alternately and evenly.

3. Sleeve type couplings and grooved joints using split ring couplings shall be installed in accordance with the procedures recommended by their respective manufacturers.
- C. Pipe and appurtenances connected to equipment shall be supported in such a manner as to prevent any strain being imposed on the equipment. When manufacturers have indicated requirements that piping loads shall not be transmitted to their equipment, submit a certification stating that such requirements have been complied with.
- D. Sleeves of proper size shall be installed for all pipes passing through floors or walls. Sleeves shall be installed as shown on the Drawings. Where indicated on the Drawings or required for liquid or gas-tightness, the pipe shall be sealed with a mechanical seal similar to Link-Seal as manufactured by Thunderline Corporation, or equal.
- E. Sleeves and wall pipes shall have thrust collar located at the mid-depth of wall.
- F. Concrete inserts for hangers and supports shall be furnished and installed as recommended by the manufacturer as shown on the Drawings or as specified herein. The inserts shall be set in accordance with the requirements of the piping layout and their locations verified from approved piping layout drawings and the structural drawings.

3.02 TESTING

- A. Piping shall be subject to acceptance tests. Provide all necessary utilities, labor and equipment for flushing and testing and dispose all waste after the test including water.
- B. Pipe and fittings shall be pressure tested using water to 1.5 times the working pressure for one hour and the pipeline shall show no leakage.
- C. Correct leakage and repair all damage to the pipe and pipe appurtenances or to any structures resulting from, or caused by tests. All leaks shall be repaired and lines retested.
 1. All pieces which fail the field test specified herein or do not meet the maximum allowable pinhole requirement specified in ASTM B1000 shall be replaced at no additional cost to the Owner.

3.03 CLEANING

- A. Clean the pipe by flushing with water or other means to remove all dirt, stones, pieces of wood, or other material which may have entered during the construction period. All debris shall be removed from the pipeline. The lowest segment outlet shall be flushed last to assure debris removal.

3.04 DISINFECTION

- A. Ductile iron pipe used for potable water service shall be disinfected after cleaning. Provide all necessary equipment and labor for the disinfection.
- B. Disinfection shall be in accordance with AWWA C651.
- C. Discharge of chlorinated water shall comply with all Federal, State and local standards. Provide sodium bisulfite for dechlorination prior to discharge.

3.05 PIPE MARKING

- A. Exposed piping, exterior and interior, shall be identified by painted legend markers, directional arrow markers and number markers as required. Pipe marking colors shall contrast with pipe color for ease of visibility. Pipe marking shall match the existing markings. Letters and markers 1-1/8-in in width shall be installed on pipes under 3-in in diameter. Markers 2-1/2-in in width shall be installed on pipes 3-in in diameter and larger. Legend markers, directional arrow markers and number markers shall be placed as directed by the Engineer. Markers shall be located where pipes pass through walls or floors, at piping intersections and maximum 15-ft spacing on piping runs.

END OF SECTION