

**TECHNICAL SPECIFICATIONS  
AND DRAWINGS**

**FOR**

**WATER PRODUCTION SYSTEM  
IMPROVEMENTS, WELL #5**

**PREPARED FOR**

**BELAH FELLOWSHIP WATER  
SYSTEM, INC.**

**MAY 2025  
REVISED JANUARY 2026**



**PREPARED BY:**

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**WATER PRODUCTION SYSTEM  
IMPROVEMENTS, WELL #5**

**FOR**

**BELAH FELLOWSHIP WATER SYSTEM, INC.**

**SCC PROJECT NO. 3511**

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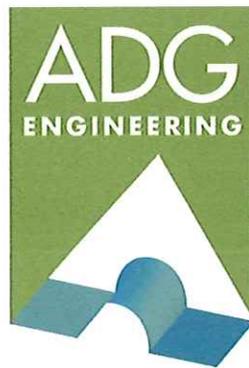
BELAH FELLOWSHIP WATER SYSTEM, INC.  
WATER PRODUCTION SYSTEM IMPROVEMENTS,  
WELL NO. 5

ELECTRICAL SPECIFICATIONS

SECTION 26 00 00  
SECTION 26 20 00  
SECTION 26 31 00

BASIC ELECTRICAL MATERIALS AND METHODS  
INTERIOR DISTRIBUTION SYSTEM  
DATA COMMUNICATIONS

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Project Number:  
25158

**WATER PRODUCTION SYSTEM  
IMPROVEMENTS, WELL #5**

**FOR**

**BELAH FELLOWSHIP WATER SYSTEM, INC.**

**SCC PROJECT NO. 3511**

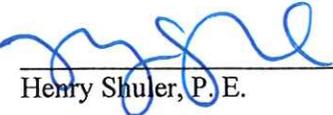
**TECHNICAL SPECIFICATIONS CERTIFICATION**

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**ENTITY AND PROJECT:**

**BELAH FELLOWSHIP WATER  
SYSTEM, INC.  
WATER PRODUCTION SYSTEM  
IMPROVEMENTS, WELL #5  
SCC PROJECT NO. 3349**



  
Henry Shuler, P. E.      5-23-2025  
(Date)

**DIVISION 03**

CONCRETE

## CONCRETE FORMWORK

### PART 1 GENERAL

#### 1.1 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required and design, install and remove formwork for cast-in-place concrete as shown on the Drawings and as specified herein.
- B. Secure to forms as required or set for embedment as required, all miscellaneous metal items, sleeves, reglets, anchor bolts, inserts and other items furnished under other Sections and required to be cast into concrete.

#### 1.2 RELATED WORK

- A. Concrete Reinforcement is included in Section 03 20 00.
- B. Concrete Joints and Joint Accessories are included in Section 03 25 00.
- C. Cast-in-Place Concrete is included in Section 03 30 00.
- D. Concrete finishes are included in Section 03 35 00.
- E. Grout is included in Section 03 60 00.

#### 1.3 SUBMITTALS

- A. Submit to the Engineer, in accordance with Section 01 33 00, shop drawings and product data showing materials of construction and details of installation for:
  - 1. Form release agent
  - 2. Form ties
- B. Samples
  - 1. Demonstrate to the Engineer on a designated area of the concrete substructure exterior surface that the form release agent will not adversely affect concrete surfaces to be painted, coated or otherwise finished and will not affect the forming materials.

C. Certificates

1. Certify form release agent is suitable for use in contact with potable water after 30 days (non-toxic and free of taste and odor). Certify that form release agent complies with Federal, State and Local VOC limitations.

1.4 REFERENCE STANDARDS

A. American Concrete Institute (ACI)

1. ACI 301 - Standard Specification for Structural Concrete
2. ACI 318 - Building Code Requirements for Reinforced Concrete
3. ACI 347 - Formwork for Concrete

B. American Plywood Association (APA)

1. Material grades and designations as specified

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

1.5 DESIGN OF FORMS

- A. Structural design responsibility: All forms and shoring shall be designed at the Contractor's expense by a professional engineer registered in the State of Louisiana. Formwork shall be designed and erected in accordance with the requirements of ACI 301 and ACI 318 and as recommended in ACI 347 and shall comply with all applicable regulations and codes. The design shall consider any special requirements due to the use of plasticized and/or retarded set concrete.

**PART 2 PRODUCTS**

2.1 GENERAL

- A. The usage of a manufacturer's name and model or catalog number is for the purpose of establishing the standard of quality and general configurations desired.

2.2 MATERIALS

- A. Forms for cast-in-place concrete shall be made of wood, metal, or other approved material. Wood forms for the project shall be new and unused. Construct wood forms of sound lumber or plywood of suitable dimensions and free from knotholes and loose

knots. Where used for exposed surfaces, dress and match boards. Sand plywood smooth and fit adjacent panels with tight joints. Metal forms may be used when approved by the Engineer and shall be of an appropriate type for the class of work involved. All forms shall be designed and constructed to provide a flat, uniform concrete surface requiring minimal finishing or repairs.

B. Wall Forms

1. Forms for all exposed exterior and interior concrete walls shall be new and unused "Plyform" exterior grade plywood panels manufactured in compliance with the APA and bearing the trademark of that group, or equal acceptable to the Engineer. Provide B grade or better veneer [with High Density Overlay] on all faces to be placed against concrete during forming. The class of material and grades of interior plies shall be of sufficient strength and stiffness to provide a flat, uniform concrete surface requiring minimal finishing and grinding.
2. All joints or gaps in forms shall be taped, gasketed, plugged, and/or caulked with an approved material so that the joint will remain watertight and will withstand placing pressures without bulging outward or creating surface patterns.

C. Rustications shall be at the location and shall conform to the details shown on the Drawings. Moldings for chamfers and rustications shall be milled and planed smooth. Rustications and corner strips shall be of a nonabsorbent material, compatible with the form surface and fully sealed on all sides to prohibit the loss of paste or water between the two surfaces.

D. Form Release Agent

1. Coat all forming surfaces in contact with concrete using an effective, non-staining, non-residual, water based, bond-breaking form coating unless otherwise noted. [Form release agents used in potable water containment structures shall be suitable for use in contact with potable water and shall be non-toxic and free of taste or odor].

E. Form Ties

1. Form ties encased in concrete other than those specified in the following paragraphs shall be designed so that, after removal of the projecting part, no metal shall remain within 1-1/2-in of the face of the concrete. The part of the tie to be removed shall be at least 1/2-in diameter or be provided with a wood or metal cone at least 1/2-in diameter and 1-1/2-in long. Form ties in concrete exposed to view shall be the cone-washer type.

2. Form ties for exposed exterior and interior walls shall be as specified in the preceding paragraph except that the cones shall be of approved wood or plastic.
3. Flat bar ties for panel forms shall have plastic or rubber inserts having a minimum depth of 1-1/2-in and sufficient dimensions to permit proper patching of the tie hole.
4. Ties for liquid containment structures shall have an integral waterstop that is tightly welded to the tie.
5. Common wire shall not be used for form ties.
6. Alternate form ties consisting of tapered through-bolts at least 1-in in diameter at smallest end or through-bolts that utilize a removable tapered sleeve of the same minimum size may be used at the Contractor's option. Obtain Engineer's acceptance of system and spacing of ties prior to ordering or purchase of forming. Clean, fill and seal form tie hole with non-shrink cement grout. The Contractor shall be responsible for watertightness of the form ties and any repairs needed.

### **PART 3 EXECUTION**

#### **3.1 GENERAL**

- A. Forms shall be used for all cast-in-place concrete including sides of footings. Forms shall be constructed and placed so that the resulting concrete will be of the shape, lines, dimensions and appearance indicated on the Drawings.
- B. Forms for walls shall have removable panels at the bottom for cleaning, inspection and joint surface preparation. Forms for walls of considerable height shall have closable intermediate inspection ports. Tremies and hoppers for placing concrete shall be used to allow concrete inspection, prevent segregation and prevent the accumulation of hardened concrete on the forms above the fresh concrete.
- C. Molding, bevels, or other types of chamfer strips shall be placed to produce blockouts, rustications, or chamfers as shown on the Drawings or as specified herein. Chamfer strips shall be provided at horizontal and vertical projecting corners to produce a 3/4-in chamfer. Rectangular or trapezoidal moldings shall be placed in locations requiring sealants where specified or shown on the Drawings. Sizes of moldings shall conform to the sealants manufacturer's recommendations.
- D. Forms shall be sufficiently rigid to withstand construction loads and vibration and to prevent displacement or sagging between supports. Construct forms so that the concrete will not be damaged by their removal. The Contractor shall be entirely responsible for the adequacy of the forming system.

- E. Before form material is re-used, all surfaces to be in contact with concrete shall be thoroughly cleaned, all damaged places repaired, all projecting nails withdrawn and all protrusions smoothed. Reuse of wooden forms for other than rough finish will be permitted only if a "like new" condition of the form is maintained.

### 3.2 FORM TOLERANCES

- A. Forms shall be surfaced, designed and constructed in accordance with the recommendations of ACI 347 and shall meet the following additional requirements for the specified finishes.
- B. Formed Surface Exposed to View: Edges of all form panels in contact with concrete shall be flush within 1/32-in and forms for plane surfaces shall be such that the concrete will be plane within 1/16-in in 4-ft. Forms shall be tight to prevent the passage of mortar, water and grout. The maximum deviation of the finish wall surface at any point shall not exceed 1/4-in from the intended surface as shown on the Drawings. Form panels shall be arranged symmetrically and in an orderly manner to minimize the number of seams.
- C. Formed surfaces not exposed to view or buried shall meet requirements of Class "C" Surface in ACI 347.
- D. Formed rough surfaces including mass concrete, pipe encasement, electrical duct encasement and other similar installations shall have no minimum requirements for surface smoothness and surface deflections. The overall dimensions of the concrete shall be plus or minus 1-in.
- E. Formed concrete Surfaces to Receive Paint: Surface deflections shall be limited to 1/32-in at any point and the variation in wall deflection shall not exceed 1/16-in per 4-ft. The maximum deviation of the finish wall surface at any point shall not exceed 1/4-in from the intended surface as shown on the Drawings.

### 3.3 FORM PREPARATION

- A. Wood forms in contact with the concrete shall be coated with an effective release agent prior to form installation.
- B. Clean, repair, remove projecting nails, fill holes, and smooth protrusions on all forms surfaces to be in contact with concrete before reuse. Do not reuse forms for exposed concrete unless a "like new" condition of the form is maintained that will produce surfaces equivalent in smoothness and appearance to those produced by new plywood panels.
- C. Steel forms shall be thoroughly cleaned and mill scale and other ferrous deposits shall be sandblasted or otherwise removed from the contact surface for all forms, except those utilized for surfaces receiving a rough finish. All forms shall have the contact surfaces coated with a release agent.

### 3.4 REMOVAL OF FORMS

- A. The Contractor shall be responsible for all damage resulting from removal of forms. Forms and shoring for structural slabs or beams shall remain in place in accordance with ACI 301 and ACI 347. Form removal shall conform to the requirements specified in Section 03 30 00.

### 3.5 INSPECTION

- A. The Engineer shall be notified when the forms are complete and ready for inspection at least 6 hours prior to the proposed concrete placement.
- B. Failure of the forms to comply with the requirements specified herein, or to produce concrete complying with requirements of this Section, shall be grounds for rejection of that portion of the concrete work. Rejected work shall be repaired or replaced as directed by the Engineer at no additional cost to the Owner. Such repair or replacement shall be subject to the requirements of this Section and approval of the Engineer.

## CONCRETE REINFORCING

### PART 1 GENERAL

#### 1.1 SUMMARY

- A. Related Documents:
  - 1. Drawings and general provisions of the Subcontract apply to this Section.
  - 2. Review these documents for coordination with additional requirements and information that apply to work under this Section.
- B. Section Includes: Concrete reinforcement and accessories.
- C. Related Sections:
  - 1. Section 32 00 01 - General

#### 1.2 REFERENCES

- A. General:
  - 1. The following documents form part of the Specifications to the extent stated. Where differences exist between codes and standards, the one affording the greatest protection shall apply.
  - 2. Unless otherwise noted, the referenced standard edition is the current one at the time of commencement of the Work.
  - 3. Refer to Division 01 Section "General Requirements" for the list of applicable regulatory requirements.
- B. ACI – American Concrete Institute:
  - 1. ACI 117 Tolerances for Concrete Construction
  - 2. ACI 301 Specifications for Structural Concrete
  - 3. ACI 315 Standard Practice for Detailing Reinforced Concrete Structures
- C. ASTM International:
  - 1. ASTM A185 / A185M Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete
  - 2. ASTM A615 / A615M Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
  - 3. ASTM A706 / A706M Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement
  - 4. ASTM A970 / A970M Standard Specification for Headed Steel Bars for Concrete Reinforcement
- D. CRSI - Manual of Standard Practice.
- E. ICBO - Evaluation Reports.

1.3 SUBMITTALS

- A. Submit under provisions of Division 01 Section "Submittal Procedures."
- B. Shop Drawings: Prepare placing drawings in accordance with ACI 315. Show size, shape and location of bars and wire fabric in structure. Show splice locations and lengths. Where details are not shown, conform to standards of practice indicated in ACI 315 and submit for approval.
  - 1. Bill reinforcing bars for walls on elevations. Bill reinforcing bars for slabs on plans. Plans and elevations need not be true views. When more than one wall or slab are identical, only one such wall or slab is required. Take sections to clarify the arrangement of reinforcement. Identify, but do not bill bars on sections.
  - 2. Unless the location of reinforcing is clear, give dimensions to some structural feature that will be readily distinguishable at time bars are placed.
  - 3. Make placing drawings complete, including the location of support bars and chairs, without reference to the design drawings.
- C. Submit data required to evaluate proposed mechanical splices.
- D. Submit manufacturer's certified mill test reports on each heat of reinforcing steel delivered, showing physical and chemical analysis before placing reinforcement.

1.4 QUALITY ASSURANCE

- A. Codes and Standards: Comply with provisions of ACI 301 CRSI's "Manual of Standard Practice", except where more stringent requirements are shown or specified.
- B. Requirements of Regulatory Agencies: Proprietary products, including bar couplers, shall have an active ICBO Evaluation Report.
- C. Material Quality Assurance: Mill test reports including chemical analysis, tensile properties and bend test shall be examined for all reinforcing. Conform to one of the following:
- D. Maintain positive identification of reinforcing by heat number. Provide certified mill test reports to Testing Laboratory.
- E. Where positive identification cannot be made and procedures are not deemed adequate to ensure compliance, Testing Laboratory will randomly sample and make one tensile and one bend test from each 2-1/2 tons or fraction thereof of each size of reinforcement. Subcontractor will bear the cost of testing.

## PART 2 PRODUCTS

### 2.1 REINFORCING MATERIALS

- A. Bar Reinforcement: ASTM A615, Grade 60, deformed billet bars.
  - 1. ASTM A706, where noted on Drawings.
  - 2. Recycled content shall be a minimum of 75 percent recycled post consumer steel.
- B. Headed Bar Reinforcement: ASTM A970.
- C. Spirals: ASTM A82.
- D. Welded Wire Fabric: ASTM A185.
- E. Threaded Bars: Grade 75, manufactured by DYWIDAY Systems International, Williams Form Engineering Corp. or equal substituted per Division 1.
- F. Smooth Dowels, ASTM A615, Grade 40 or 60, smooth; sawcut or grind one end to remove offsets; shop paint with iron oxide zinc chromate primer.
- G. Welded Deformed Bar Anchors: ASTM A-108  $f_y = 70,000$  psi, flux-filled deformed bar anchors welded to structural steel as shown; Nelson D2L, or equal substituted per Division 1.
- H. Mechanical Bar Couplers: Provide mechanical couplers with a current ICC evaluation report. Coupler shall develop 160% percent of specified minimum yield strength of spliced reinforcement. Subject to compliance with requirements provide one of the following, or approved equal:
  - 1. Barteck, Dextra Inc.
  - 2. Lenton Taper Threaded Connection, Erico Inc.
  - 3. Bar Lock, Dayton Superior Inc.

### 2.2 ACCESSORIES

- A. Tie Wire: Minimum 16-gage black annealed wire.
- B. Bar Supports:
  - 1. At surfaces not exposed to view in completed structure: Precast concrete bar supports with two 16 ga. embedded wires or CRSI Class 2 wire supports.
  - 2. Supports placed against ground or on top of vapor barrier: Precast concrete blocks not less than 3 inches square (1935 mm<sup>2</sup>) with two 16 ga. embedded wires.
  - 3. At Architectural Concrete and surfaces exposed to weather: CRSI Class 2 stainless steel or CRSI Class 1 plastic protected.
  - 4. Where support is no closer to concrete surface than 1/2 inch (13 mm): CRSI Class 3 wire supports.

## 2.3 FABRICATION

- A. Fabricate reinforcement in accordance with ACI 315 where specific details are not shown.

## PART 3 EXECUTION

### 3.1 PLACEMENT

- A. Surface Condition of Reinforcement: Before placing concrete, clean reinforcement of loose scale, dirt, grease and other substances which would impair bond with concrete.
- B. Place reinforcement in accordance with the Drawings and the CRSI Manual.
  - 1. Steel bars shall be of size and length indicated, accurately bent or formed to shapes detailed or scheduled by experienced shops by methods that will not injure the materials. Reinforcing bars shall be shop fabricated to lengths and bends shown on the drawings. Fabrication tolerance shall be in accordance with the requirements of ACI 315.
  - 2. Reinforcing bars shall be as long as possible with a minimum number of joints.
  - 3. Steel reinforcement shall not be bent or straightened in a manner that will injure the material or the embedding concrete. Bars with kinks or bends not shown on the Drawings shall not be used. Heating of reinforcement for bending will not be permitted.
  - 4. Reinforcement shall be tagged with suitable identification to facilitate sorting and placing.
- C. Place reinforcing bars accurately as to spacing and clearance and securely tied at intersections and supports with wire and in such a manner as will preclude displacement during pouring of concrete. Placing tolerances shall be in conformance with the requirements of ACI 117.
- D. Place and secure reinforcement to maintain the proper distance and clearance between parallel bars and from the forms. Provide vertical steel with metal spreaders to maintain steel properly centered in the forms. Horizontal reinforcement shall be supported at proper height on concrete pads, chairs or transverse steel bars.
- E. After placing, maintain bars in a clean condition until completely embedded in concrete.
- F. Bars shall not be spaced closer than 1-1/2 diameters of the largest of two adjacent bars, 1-1/2 times the maximum aggregate size, nor one inch, except at bar laps. Where reinforcement in members is placed in two layers, the clear distance between layers shall be not less than one inch (25 mm) or more than 1-1/2 inches (38 mm) unless otherwise noted on the drawings. The bars in the upper layer shall be placed directly above those in the bottom layer unless otherwise detailed.

Section 03 20 00 – Concrete Reinforcing

- G. Coverage of bars shall be as shown and scheduled. Conform to ACI 301 where not indicated.
- H. Where obstruction prevents the intended placement of reinforcement, provide additional reinforcement as directed by the University around the obstruction.
- I. Splice bars as indicated by lapping and securely wiring together. Splices at locations other than those indicated are subject to the approval of the University. Splices of reinforcement shall not be made at the point of maximum stress. Splices shall provide sufficient lap to transfer the stress between bars by bond and shear. Bars shall be spread the minimum distance specified. Stagger splices of adjacent bars where possible.
- J. Reinforcing bars shall not have welded joints.
- K. Mechanical Bar Couplers: Install in accordance with applicable ICC evaluation report. Maintain clearance and coverage at coupler. Stagger couplers wherever practical.

## CAST-IN-PLACE CONCRETE

### PART 1 GENERAL

#### 1.01 SCOPE OF WORK

- A. Furnish all labor and materials required and install cast-in-place concrete complete as shown on the Drawings and as specified herein.
- B. Furnish all sampling and testing of products and materials by an independent testing laboratory acceptable to the Engineer but engaged by and at the expense of the Contractor.

#### 1.02 RELATED WORK

- A. Concrete Reinforcement is included in Section 03 20 00.
- B. Sealant and Caulking is included in Section 07 91 26.

#### 1.03 SUBMITTALS

- A. Submit to the Engineer, in accordance with Section 01 33 00, shop drawings and product data shall include the following:
  - 1. Sources of cement and aggregates.
  - 2. Material Safety Data Sheets (MSDS) for all concrete components and admixtures.
  - 3. Air-entraining admixture. Product data including catalogue cut, technical data, storage requirements, product life, recommended dosage, temperature considerations and conformity to ASTM standards.
  - 4. Water reducing admixture. Product data including catalogue cut, technical data, storage requirements, product life, recommended dosage, temperature considerations and conformity to ASTM standards.
  - 5. High range water-reducing admixture (plasticizer). Product data including catalogue cut, technical data, storage requirements, product life, recommended dosage, temperature considerations, retarding effect, slump range and conformity to ASTM standards. Identify proposed locations of use.

6. Sheet curing material. Product data including catalogue cut, technical data and conformity to ASTM standard.
  7. Liquid curing compound. Product data including catalogue cut, technical data, storage requirements, product life, application rate and conformity to ASTM standards. Identify proposed locations of use.
- B. Samples
1. Fine and coarse aggregates if requested for examination by the Engineer.
- C. Test Reports
1. Sieve analysis, mechanical properties and deleterious substance content for coarse and fine aggregate.
  2. Chemical analysis and physical tests of each type of cement.
  3. Concrete mix for each formulation of concrete proposed for use including constituent quantities per cubic yard, water cementitious ratio, concrete slump, type and manufacturer of cement.
    - a. Standard deviation data for each proposed concrete mix based on statistical records.
    - b. Water cementitious ratio curve for concrete mixes based on laboratory tests. Give average cylinder strength test results at 28 days for laboratory concrete mix designs. Provide results of 7 and 14 day tests if available.
- D. Certifications
1. Certify admixtures used in the same concrete mix are compatible with each other and the aggregates.
  2. Certify admixtures are suitable for use in contact with potable water after 30 days of concrete curing.
  3. Certify curing compound is suitable for use in contact with potable water after 30 days (non-toxic and free of taste or odor).
  4. Certify the Contractor is not associated with the independent testing laboratory nor does the Contractor or its officers have a beneficial interest in the laboratory.
  5. Shrinkage test reports.

E. Qualifications

1. Independent testing laboratory: Name, address and qualifications. Laboratories affiliated with the Contractor or in which the Contractor or its officers have a beneficial interest are not acceptable.

1.04 REFERENCE STANDARDS

A. American Society for Testing and Materials (ASTM)

1. ASTM C31 - Standard Practice for Making and Curing Concrete Test Specimens in the Field.
2. ASTM C33 - Standard Specification for Concrete Aggregates.
3. ASTM C39 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
4. ASTM C42 - Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
5. ASTM C94 - Standard Specification for Ready-Mixed Concrete.
6. ASTM C143 - Standard Test Method for Slump of Hydraulic Cement Concrete
7. ASTM C150 - Standard Specification for Portland Cement
8. ASTM C157 -Standard Test Method for Length Change of Hardened Hydraulic-Cement Mortar and Concrete
9. ASTM C171 - Standard Specification for Sheet Materials for Curing Concrete
10. ASTM C173 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.
11. ASTM C231 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
12. ASTM C260 - Standard Specification for Air-Entraining Admixtures for Concrete.
13. ASTM C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.

14. ASTM C311 - Standard Test Methods for Sampling and Testing Fly Ash or Natural Pozzolans for Use as a Mineral Admixture in Portland-Cement Concrete.
  15. ASTM C494 - Standard Specification for Chemical Admixtures for Concrete.
  16. ASTM C596 - Standard Test Method for Drying Shrinkage of Mortar Containing Portland Cement.
  17. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete.
- B. American Concrete Institute (ACI).
1. ACI 211.1 - Standard Practice for Selecting Proportions for Normal, Heavyweight and Mass Concrete.
  2. ACI 304R - Guide for Measuring, Mixing, Transporting and Placing Concrete.
  3. ACI 304.2R - Placing Concrete by Pumping Methods.
  4. ACI 305R - Hot Weather Concreting.
  5. ACI 306R - Cold Weather Concreting.
  6. ACI 318 - Building Code Requirements for Reinforced Concrete.
  7. ACI 350R - Environmental Engineering Concrete Structures.
- C. 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. Only one source of cement and aggregates shall be used. Concrete shall be uniform in color and appearance.
- B. Well in advance of placing concrete, discuss with the Engineer the sources of individual materials and batched concrete proposed for use. Discuss placement methods, waterstops and curing. Propose methods of hot and cold weather concreting as required.
- C. If, during the progress of the work, it is impossible to secure concrete of the required workability and strength with the materials being furnished, the Engineer may order

such changes in proportions or materials, or both, as may be necessary to secure the desired properties. All changes so ordered shall be made at the Contractor's expense.

- D. If, during the progress of the work, the materials from the sources originally accepted change in characteristics, the Contractor shall, at his/her expense, make new acceptance tests of aggregates and establish new design mixes. Such testing and design shall be accomplished with the assistance of an independent testing laboratory acceptable to the Engineer.
- E. Reinforced concrete shall comply with ACI 318, the recommendations of ACI 350R and other stated requirements, codes and standards.
- F. All field testing and inspection services required will be provided by the Owner. The cost of such work, except as specifically stated otherwise, shall be paid for by the Owner. Methods of testing will comply with the latest applicable ASTM methods.
- G. Samples of constituents and of concrete as-placed will be subjected to laboratory tests. All materials incorporated in the work shall conform to accepted samples.

#### 1.06 DELIVERY, STORAGE AND HANDLING

- A. Cement: Store in weathertight buildings, bins or silos to provide protection from dampness and contamination and to minimize warehouse set.
- B. Aggregate: Arrange and use stockpiles to avoid excessive segregation or contamination with other materials or with other sizes of like aggregates. Build stockpiles in successive horizontal layers not exceeding 3-ft in thickness. Complete each layer before the next is started. Do not use frozen or partially frozen aggregate.
- C. Sand: Arrange and use stockpiles to avoid contamination. Allow sand to drain to a uniform moisture content before using. Do not use frozen or partially frozen aggregates.
- D. Admixtures: Store in closed containers to avoid contamination, evaporation or damage. Provide suitable agitating equipment to assure uniform dispersion of ingredients in admixture solutions which tend to separate. Protect liquid admixtures from freezing and other temperature changes which could adversely affect their characteristics.
- E. Sheet Curing Materials: Store in weathertight buildings or off the ground and under cover.
- F. Liquid Curing Compounds: Store in closed containers.

1.07 Construction Tolerances: The CONTRACTOR shall set and maintain concrete forms and perform finishing operations so as to ensure that the completed work is within the tolerances specified herein. Surface defects and irregularities are defined as finishes and are to be distinguished from tolerances. Tolerance is the specified permissible variation from lines, grades, or dimensions shown. Where tolerances are not stated in the specifications, permissible deviations will be in accordance with ACI 117.

1. The following construction tolerances are hereby established and apply to finished walls and slab unless otherwise shown: All tolerances must comply with manufacturer's requirements. The elevation of the aeration basins and clarifiers top of wall cannot vary more than 1/4-inch throughout the entire circumference.

Item	Tolerance
Variation of the constructed linear outline from the established position in plan.	In 10 feet: 1/4-inch; In 20 feet or more: 1/2-inch
Variation from the level or from the grades shown.	In 10 feet: 1/4-inch In 20 feet or more: 1/2-inch
Variation from the plumb.	In 10 feet: 1/4-inch In 20 feet or more: 1/2-inch
Variation in the thickness of slabs and walls.	Minus 1/4-inch; Plus 1/2-inch
Variation in the locations and sizes of slabs and wall openings.	Plus or minus 1/4-inch

## PART 2 PRODUCTS

### 2.01 GENERAL

- A. The use of manufacturer's name and model or catalog number is for the purpose of establishing the standard of quality and general configuration desired.
- B. Like items of materials shall be the end products of one manufacturer in order to provide standardization for appearance, maintenance and manufacturer's service.

### 2.02 MATERIALS

- A. Materials shall comply with this Section and any applicable State or local requirements.

- B. Cement: Domestic portland cement complying with ASTM C150. Air entraining cements shall not be used. Cement brand shall be subject to approval by the Engineer and one brand shall be used throughout the Work. The following cement type(s) shall be used:
1. Class A & B Concrete - Type I
  2. Class D Concrete - Type II
- C. Fine Aggregate: Washed inert natural sand conforming to the requirements of ASTM C33.
- D. Coarse Aggregate: Well-graded crushed stone or washed gravel conforming to the requirements of ASTM C33. Grading requirements shall be as listed in ASTM C33 Table 2 for the specified coarse aggregate size number. Limits of Deleterious Substances and Physical Property Requirements shall be as listed in ASTM C33 Table 3 for severe weathering regions. Size numbers for the concrete mixes shall be as shown in Table 1 herein.
- E. Water: Potable water free from injurious amounts of oil, acid, alkali, organic matter, or other deleterious substances.
- F. Admixtures: Admixtures shall be free of chlorides and alkalis (except for those attributable to water). When it is required to use more than one admixture in a concrete mix, the admixtures shall be from the same manufacturer. Admixtures shall be compatible with the concrete mix including other admixtures and shall be suitable for use in contact with potable water after 30 days of concrete curing.
1. Air Entraining Admixture: The admixture shall comply with ASTM C260. Proportioning and mixing shall be in accordance with manufacturer's recommendations.
  2. Water Reducing Agent: The admixture shall comply with ASTM C494, Type A. Proportioning and mixing shall be in accordance with manufacturer's recommendations.
  3. High-Range Water Reducer (Plasticizer): The admixture shall comply with ASTM C494, Type F and shall result in non-segregating plasticized concrete with little bleeding and with physical properties of low water/cement ratio concrete. The treated concrete shall be capable of maintaining plastic state in excess of 2 hours. Proportioning and mixing shall be in accordance with manufacturer's recommendations.
  4. Admixtures causing retarded or accelerated setting of concrete shall not be used without written approval from the Engineer. When allowed, the

admixtures shall be retarding or accelerating water reducing or high range water reducing admixtures.

- G. Sheet Curing Materials. Waterproof paper, polyethylene film or white burlap-polyethylene sheeting all complying with ASTM C171.
- H. Liquid Curing Compound. Liquid membrane-forming curing compound shall comply with the requirements of ASTM C309, Type 1-D (clear or translucent with fugitive dye) and shall contain no wax, paraffin, or oil. Curing compound shall be approved for use in contact with potable water after 30 days (non-toxic and free of taste or odor).

### 2.03 MIXES

- A. Development of mix designs and testing shall be by an independent testing laboratory acceptable to the Engineer engaged by and at the expense of the Contractor.
- B. Select proportions of ingredients to meet the design strength and materials limits specified in Table 1 and to produce concrete having proper placability, durability, strength, appearance and other required properties. Proportion ingredients to produce a homogenous mixture which will readily work into corners and angles of forms and around reinforcement without permitting materials to segregate or allowing excessive free water to collect on the surface.
- C. The design mix shall be based on standard deviation data of prior mixes with essentially the same proportions of the same constituents or, if not available, be developed by laboratory tests. Water content of the concrete shall be based on a curve showing the relation between water cementitious ratio and 7 and 28 day compressive strengths of concrete made using the proposed materials. The curves shall be determined by four or more points, each representing an average value of at least three test specimens at each age. The curves shall have a range of values sufficient to yield the desired data, including the compressive strengths specified, without extrapolation. The water content of the concrete mixes to be used, as determined from the curve, shall correspond to strengths 16 percent greater than the required design strengths. The resulting mix shall not conflict with the limiting values for maximum water cementitious ratio and net minimum cementitious content as specified in Table 1.
- D. Compression Tests: Provide testing of the proposed concrete mix or mixes to demonstrate compliance with the compression strength requirements in conformity with the provisions of ACI 318.

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- E. Shrinkage Tests: Perform shrinkage tests on the design mix for Class D concrete. The tests shall conform to ASTM C157 as modified by ASTM C596. Concrete and not mortar specimens shall be used.
1. The average shrinkage at 28 days of air storage shall not exceed 0.036 percent.
- F. Entrained air, as measured by ASTM C231, shall be as shown in Table 1.
1. If the air entraining agent proposed for use in the mix requires testing methods other than ASTM C231 to accurately determine air content, make special note of this requirement in the admixture submittal required under Paragraph 1.03 above.
- G. Slump of the concrete as measured by ASTM C143, shall be as shown in Table 1. If plasticizer is used, the slump indicated shall be that measured before plasticizer is added. Plasticized concrete shall have a slump ranging from 7 to 10-in.
- H. Proportion admixtures according to the manufacturer's recommendations. Two or more admixtures specified may be used in the same mix provided that the admixtures in combination retain full efficiency and have no deleterious effect on the concrete or on the properties of each other.

TABLE 1

Class	Design Strength (1)	Cement (2)	Fine Aggregate (2)	Coarse Aggregate (3)	Cementitious Content (4)
A	2500	C150 Type I	C33	57	440
B	3000	C150 Type I	C33	57	480
D	4000	C150 Type II	C33	57	560
E	6000	C150 Type II	C33	57	600
Class	W/C Ratio (5)	AE Range (6)	WR (7)	Slump HRWR (8)	Range Inches
A	0.60 max.	3.5 to 5	Yes	No	1-4
B	0.50 max.	3.5 to 5	Yes	No	1-3

D	0.45 max.	3.5 to 5	Yes	No	3-4
E	0.40 max.	3.5 to 5	Yes	No	3-4

NOTES:

- (1) Minimum compressive strength in psi at 28 days
- (2) ASTM designation
- (3) Size Number in ASTM C33
- (4) Minimum cementitious content in lbs/cu yd
- (5) W/C is Water Cementitious ratio by weight
- (6) AE is percent air entrainment
- (7) WR is water reducing admixture
- (8) HRWR is high range water reducer

**PART 3 EXECUTION**

**3.01 MEASURING MATERIALS**

- A. Concrete shall be composed of portland cement, fine aggregate, coarse aggregate, water and admixtures as specified and shall be produced by a plant acceptable to the Engineer. All constituents, including admixtures, shall be batched at the plant.
- B. Measure materials for batching concrete by weighing in conformity with and within the tolerances given in ASTM C94 except as otherwise specified. Scales shall have been certified by the local Sealer of Weights and Measures within 1 year of use.
- C. Measure the amount of free water in fine aggregates within 0.3 of a percent with a moisture meter. Compensate for varying moisture contents of fine aggregates. Record the number of gallons of water as-batched on printed batching tickets.
- D. Admixtures shall be dispensed either manually using calibrated containers or measuring tanks, or by means of an automatic dispenser approved by the manufacturer of the specific admixture.
  1. Charge air-entraining and chemical admixtures into the mixer as a solution using an automatic dispenser or similar metering device.
  2. Inject multiple admixtures separately during the batching sequence.

**3.02 MIXING AND TRANSPORTING**

- A. Concrete shall be ready-mixed concrete produced by equipment acceptable to the Engineer. No hand-mixing will be permitted. Clean each transit mix truck drum

and reverse drum rotation before the truck proceeds under the batching plant. Equip each transit-mix truck with a continuous, nonreversible, revolution counter showing the number of revolutions at mixing speeds.

- B. Ready-mix concrete shall be transported to the site in watertight agitator or mixer trucks loaded not in excess of their rated capacities as stated on the name plate.
- C. Keep the water tank valve on each transit truck locked at all times. Any addition of water must be directed by the Engineer. Added water shall be incorporated by additional mixing of at least 35 revolutions. All added water shall be metered and the amount of water added shall be shown on each delivery ticket.
- D. All central plant and rolling stock equipment and methods shall comply with ACI 318 and ASTM C94.
- E. Select equipment of size and design to ensure continuous flow of concrete at the delivery end. Metal or metal-lined non-aluminum discharge chutes shall be used and shall have slopes not exceeding 1 vertical to 2 horizontal and not less than 1 vertical to 3 horizontal. Chutes more than 20-ft long and chutes not meeting slope requirements may be used if concrete is discharged into a hopper before distribution.
- F. Retempering of concrete or mortar which has partially hardened (that is, mixing with or without additional cement, aggregate, or water) will not be permitted.
- G. Handle concrete from mixer to placement as quickly as practicable while providing concrete of required quality in the placement area. Dispatch trucks from the batching plant so they arrive at the work site just before the concrete is required, thus avoiding excessive mixing of concrete while waiting or delays in placing successive layers of concrete in the forms.
- H. Furnish a delivery ticket for ready mixed concrete to the Engineer as each truck arrives. Each ticket shall provide a printed record of the weight of cement and each aggregate as batched individually. Use the type of indicator that returns for zero punch or returns to zero after a batch is discharged. Clearly indicate the weight of fine and coarse aggregate, cement and water in each batch, the quantity delivered, the time any water is added, and the numerical sequence of the delivery. Show the time of day batched and time of discharge from the truck. Indicate the number of revolutions of transit mix truck.
- I. Temperature and Mixing Time Control
  - 1. In cold weather (see Paragraph 3.06D below) maintain the as-mixed temperature of the concrete and concrete temperatures at the time of placement in the forms as indicated in Table 2.

2. If water or aggregate has been heated, combine water with aggregate in the mixer before cement is added. Do not add cement to mixtures of water and aggregate when the temperature of the mixture is greater than 90 degrees F.
3. In hot weather, cool ingredients before mixing to maintain temperature of the concrete below the maximum placing temperature of 90 degrees F. If necessary, substitute well-crushed ice for all or part of the mixing water.
4. The maximum time interval between the addition of mixing water and/or cement to the batch and the placing of concrete in the forms shall not exceed the following:

TABLE 2

AIR OR CONCRETE TEMPERATURE (WHICHEVER IS HIGHER) MAXIMUM TIME

(27 Degree C)	80 to 90 Degree F	(32 Degree C)...45 minutes
(21 Degree C)	70 to 79 Degree F	(26 Degree C)...60 minutes
(5 Degree C)	40 to 69 Degree F	(20 Degree C)...90 minutes

If an approved high range water reducer (plasticizer) is used to produce plasticized concrete, the maximum time interval shall not exceed 90 minutes.

3.03 INSPECTION AND COORDINATION

- A. The batching, mixing, transporting, placing and curing of concrete shall be subject to the inspection of the Engineer at all times. The Contractor shall advise the Engineer of his/her readiness to proceed at least 24 hours prior to each concrete placement. The Engineer will inspect the preparations for concreting including the preparation of previously placed concrete, the reinforcing and the alignment, cleanliness and tightness of formwork. No placement shall be made without the inspection and acceptance of the Engineer.

3.04 CONCRETE APPEARANCE

- A. Concrete mix showing either poor cohesion or poor coating of the coarse aggregate with paste shall be remixed. If this does not correct the condition, the concrete shall be rejected. If the slump is within the allowable limit, but excessive bleeding, poor workability, or poor finishability are observed, changes in the concrete mix shall be obtained only by adjusting one or more of the following:
  1. The gradation of aggregate.
  2. The proportion of fine and coarse aggregate.

3. The percentage of entrained air, within the allowable limits.
- B. Concrete for the work shall provide a homogeneous structure which, when hardened, will have the required strength, durability and appearance. Mixtures and workmanship shall be such that concrete surfaces, when exposed, will require no finishing. When concrete surfaces are stripped, the concrete when viewed in good lighting from 10-ft away shall be pleasing in appearance, and at 20-ft shall show no visible defects.

### 3.05 PLACING AND COMPACTING

#### A. Placing

1. Verify that all formwork completely encloses concrete to be placed and is securely braced prior to concrete placement. Remove ice, excess water, dirt and other foreign materials from forms. Confirm that reinforcement and other embedded items are securely in place. Have a competent workman at the location of the pour who can assure that reinforcement and embedded items remain in designated locations while concrete is being placed. Sprinkle semi-porous subgrades or forms to eliminate suction of water from the mix. Seal extremely porous subgrades in an approved manner.
2. Deposit concrete as near its final position as possible to avoid segregation due to rehandling or flowing. Place concrete continuously at a rate which ensures the concrete is being integrated with fresh plastic concrete. Do not deposit concrete which has partially hardened or has been contaminated by foreign materials or on concrete which has hardened sufficiently to cause formation of seams or planes of weakness within the section. If the section cannot be placed continuously, place construction joints as specified or as approved.
3. Pumping of concrete will be permitted. Use a mix design and aggregate sizes suitable for pumping and submit for approval.
4. Remove temporary spreaders from forms when the spreader is no longer useful. Temporary spreaders may remain embedded in concrete only when made of galvanized metal or concrete and if prior approval has been obtained.
5. Do not place concrete for supported elements until concrete previously placed in the supporting element (columns, slabs and/or walls) has reached adequate strength.

6. Where surface mortar is to form the base of a finish, especially surfaces designated to be painted, work coarse aggregate back from forms with a suitable tool to bring the full surface of the mortar against the form. Prevent the formation of excessive surface voids.

7. Slabs

a. After suitable bulkheads, screeds and jointing materials have been positioned, the concrete shall be placed continuously between construction joints beginning at a bulkhead, edgeform, or corner. Each batch shall be placed into the edge of the previously placed concrete to avoid stone pockets and segregation.

b. Avoid delays in casting. If there is a delay in casting, the concrete placed after the delay shall be thoroughly spaded and consolidated at the edge of that previously placed to avoid cold joints. Concrete shall then be brought to correct level and struck off with a straightedge. Bullfloats or darbies shall be used to smooth the surface, leaving it free of humps or hollows.

c. Where slabs are to be placed integrally with the walls below them, place the walls and compact as specified. Allow 1 hour to pass between placement of the wall and the overlying slab to permit consolidation of the wall concrete. Keep the top surface of the wall moist so as to prevent cold joints.

8. Formed Concrete

a. Place concrete in forms using tremie tubes and taking care to prevent segregation. Bottom of tremie tubes shall preferably be in contact with the concrete already placed. Do not permit concrete to drop freely more than 4-ft. Place concrete for walls in 12 to 24-in lifts, keeping the surface horizontal. If plasticized concrete is used, the maximum lift thickness may be increased to 7-ft and the maximum free fall of concrete shall not exceed 15-ft.

B. Compacting

1. Consolidate concrete by vibration, puddling, spading, rodding or forking so that concrete is thoroughly worked around reinforcement, embedded items and openings and into corners of forms. Puddling, spading, etc, shall be continuously performed along with vibration of the placement to eliminate air or stone pockets which may cause honeycombing, pitting or planes of weakness.

2. All concrete shall be placed and compacted with mechanical vibrators. The number, type and size of the units shall be approved by the Engineer in advance of placing operations. No concrete shall be ordered until sufficient approved vibrators (including standby units in working order) are on the job.
3. A minimum frequency of 7000 rpm is required for mechanical vibrators. Insert vibrators and withdraw at points from 18 to 30-in apart. At each insertion, vibrate sufficiently to consolidate concrete, generally from 5 to 15 seconds. Do not over vibrate so as to segregate. Keep a spare vibrator on the site during concrete placing operations.
4. Concrete Slabs: Concrete for slabs less than 8-in thick shall be consolidated with vibrating screeds; slabs 8 to 12-in thick shall be compacted with internal vibrators and (optionally) with vibrating screeds. Vibrators shall always be placed into concrete vertically and shall not be laid horizontally or laid over.
5. Walls and Columns: Internal vibrators (rather than form vibrators) shall be used unless otherwise approved by the Engineer. In general, for each vibrator needed to melt down the batch at the point of discharge, one or more additional vibrators must be used to densify, homogenize and perfect the surface. The vibrators shall be inserted vertically at regular intervals, through the fresh concrete and slightly into the previous lift, if any.
6. Amount of Vibration: Vibrators are to be used to consolidate properly placed concrete but shall not be used to move or transport concrete in the forms. Vibration shall continue until:
  - a. Frequency returns to normal.
  - b. Surface appears liquefied, flattened and glistening.
  - c. Trapped air ceases to rise.
  - d. Coarse aggregate has blended into surface, but has not disappeared.

### 3.06 CURING AND PROTECTION

- A. Protect all concrete work against injury from the elements and defacements of any nature during construction operations.
- B. Curing Methods

1. Curing Methods for Concrete Surfaces: Cure concrete to retain moisture and maintain specified temperature at the surface for a minimum of 7 days after placement. Curing methods to be used are as follows:
  - a. Water Curing: Keep entire concrete surface wet by ponding, continuous sprinkling or covered with saturated burlap. Begin wet cure as soon as concrete attains an initial set and maintain wet cure 24 hours a day.
  - b. Sheet Material Curing: Cover entire surface with sheet material. Securely anchor sheeting to prevent wind and air from lifting the sheeting or entrapping air under the sheet. Place and secure sheet as soon as initial concrete set occurs.
  - c. Liquid Membrane Curing: Apply over the entire concrete surface except for surfaces to receive additional concrete. Curing compound shall NOT be placed on any concrete surface where additional concrete is to be placed, where surface coatings are to be used, or where the concrete finish requires an integral floor product. Curing compound shall be applied as soon as the free water on the surface has disappeared and no water sheen is visible, but not after the concrete is dry or when the curing compound can be absorbed into the concrete. Application shall be in compliance with the manufacturer's recommendations.
2. Specified applications of curing methods.
  - a. Slabs for Water Containment Structures: Water curing only.
  - b. Slabs on Grade and Footings (not used to contain water): Water curing, sheet material curing or liquid membrane curing.
  - c. Structural Slabs (other than water containment): Water curing or liquid membrane curing.
  - d. Horizontal Surfaces which will Receive Additional Concrete, Coatings, Grout or Other Material that Requires Bond to the substrate: Water curing.
  - e. Formed Surfaces: None if nonabsorbent forms are left in place 7 days. Water cure if absorbent forms are used. Sheet cured or liquid membrane cured if forms are removed prior to 7 days. Exposed horizontal surfaces of formed walls or columns shall be water cured for 7 days or until next placement of concrete is made.

- f. Concrete Joints: Water cured or sheet material cured.
- C. Finished surfaces and slabs shall be protected from the direct rays of the sun to prevent checking and crazing.
- D. Cold Weather Concreting:
1. "Cold weather" is defined as a period when for more than 3 successive days, the average daily outdoor temperature drops below 40 degrees F. The average daily temperature shall be calculated as the average of the highest and the lowest temperature during the period from midnight to midnight.
  2. Concrete placed during cold weather shall be batched, delivered, placed, cured and protected in compliance with the recommendations of ACI 306R and the additional requirements specified herein.
  3. Discuss a cold weather work plan with the Engineer. The discussion shall encompass the methods and procedures proposed for use during cold weather including the production, transportation, placement, protection, curing and temperature monitoring of the concrete. The procedures to be implemented upon abrupt changes in weather conditions or equipment failures shall also be discussed. Cold weather concreting shall not begin until the work plan is acceptable to the Engineer.
  4. The minimum temperature of concrete immediately after placement and during the protection period shall be as indicated in Table 3. The temperature of the concrete in place and during the protection period shall not exceed these values by more than 20 degrees F. Prevent overheating and non-uniform heating of the concrete.

TABLE 3

Concrete Temperatures Minimum Dimension of Section

	<u>&lt; 12-in</u>	<u>12 to 36-in</u>
Min. conc temp:	55 Degree F	50 Degree F

5. During periods of cold weather, concrete shall be protected to provide continuous warm, moist curing (with supplementary heat when required) for a total of at least 350 degree-days of curing.
  - a. Degree-days are defined as the total number of 24 hour periods multiplied by the weighted average daily air temperature at the

surface of the concrete (eg: 5 days at an average 70 degrees F = 350 degree-days).

- b. To calculate the weighted average daily air temperature, sum hourly measurements of the air temperature in the shade at the surface of the concrete taking any measurement less than 50 degrees F as 0 degrees F. Divide the sum thus calculated by 24 to obtain the weighted average temperature for that day.
6. Salt, manure or other chemicals shall not be used for protection.
  7. At the end of the protection period, allow the concrete to cool gradually to the ambient temperature. If water curing has been used, the concrete shall not be exposed to temperatures below those shown in Table 3 until at least 24 hours after water curing has been terminated.
  8. During periods not defined as cold weather, but when freezing temperatures are expected or occur, protect concrete surfaces from freezing for the first 24 hours after placing.

E. Hot Weather Concreting

1. "Hot weather" is defined as any combination of high air temperatures, low relative humidity and wind velocity which produces a rate of evaporation as estimated in ACI 305R, approaching or exceeding 0.2 lbs/sqft/hr).
2. Concrete placed during hot weather, shall be batched, delivered, placed, cured and protected in compliance with the recommendations of ACI 305R and the additional requirements specified herein.
  - a. Temperature of concrete being placed shall not exceed 90 degrees F and every effort shall be made to maintain a uniform concrete mix temperature below this level. The temperature of the concrete shall be such that it will cause no difficulties from loss of slump, flash set or cold joints.
  - b. All necessary precautions shall be taken to promptly deliver, to promptly place the concrete upon its arrival at the job and to provide vibration immediately after placement.
  - c. The Engineer may direct the Contractor to immediately cover plastic concrete with sheet material.
3. Discuss with the Engineer a work plan describing the methods and procedures proposed to use for concrete placement and curing during hot

weather periods. Hot weather concreting shall not begin until the work plan is acceptable to the Engineer.

### 3.07 REMOVAL OF FORMS

- A. Except as otherwise specifically authorized by the Engineer, forms shall not be removed before the concrete has attained a strength of at least 30 percent of its specified design strength, nor before reaching the following number of day-degrees of curing (whichever is the longer):

TABLE 4

<u>Forms for</u>	<u>Degree Days</u>
Beams and slabs	500
Walls and vertical surfaces	100

(See definition of degree-days in Paragraph 3.06D above).

- B. Shores shall not be removed until the concrete has attained at least 60 percent of its specified design strength and also sufficient strength to support safely its own weight and the construction live loads upon it.

### 3.08 FIELD TESTS

- A. Sets of field control cylinder specimens will be taken by the Engineer (or inspector) during the progress of the work, in compliance with ASTM C31. The number of sets of concrete test cylinders taken of each class of concrete placed each day shall not be less than once a day, nor less than once for each 150 cu yds of concrete nor less than once for each 5,000 sq ft of surface area for slabs or walls.
1. A "set" of test cylinders consists of four cylinders: one to be broken at 7 days and two to be broken and their strengths averaged at 28 days. The fourth may be used for a special break at 3 days or to verify strength after 28 days if 28 day breaks are low.
  2. When the average 28 day compressive strength of the cylinders in any set falls below the required compressive strength or below proportional minimum 7 day strengths (where proper relation between seven and 28 day strengths have been established by tests), proportions, water content, or temperature conditions shall be changed to achieve the required strengths.
- B. Cooperate in the making of tests by allowing free access to the work for the selection of samples, providing an insulated closed curing box for specimens, affording protection to the specimens against injury or loss through the operations

and furnish material and labor required for the purpose of taking concrete cylinder samples. All shipping of specimens will be paid for by the Contractor. Curing boxes shall be acceptable to the Engineer.

- C. Slump tests will be made in the field immediately prior to placing the concrete. Such tests shall be made in accordance with ASTM C143. If the slump is greater the specified range, the concrete shall be rejected.
- D. Air Content: Test for air content shall be made on a fresh concrete sample. Air content for concrete made of ordinary aggregates having low absorption shall be made in compliance with either the pressure method complying with ASTM C231 or by the volumetric method complying with ASTM C173. If lightweight aggregates or aggregates with high absorptions are used, the latter test method shall be used.

### 3.09 FIELD CONTROL

- A. The Engineer may have cores taken from any questionable area in the concrete work such as construction joints and other locations as required for determination of concrete quality. The results of tests on such cores shall be the basis for acceptance, rejection or determining the continuation of concrete work.
- B. Cooperate in obtaining cores by allowing free access to the work and permitting the use of ladders, scaffolding and such incidental equipment as may be required. Repair all core holes. The work of cutting and testing the cores will be at the expense of the Contractor.

### 3.10 FAILURE TO MEET REQUIREMENTS

- A. Should the strengths shown by the test specimens made and tested in compliance with the previous provisions fall below the values given in Table 1, the Engineer shall have the right to require changes in proportions outlined to apply to the remainder of the work. Furthermore, the Engineer shall have the right to require additional curing on those portions of the structure represented by the test specimens which failed. The cost of such additional curing shall be at the Contractor's expense. In the event that such additional curing does not give the strength required, as evidenced by core and/or load tests, the Engineer shall have the right to require strengthening or replacement of those portions of the structure which fail to develop the required strength. The cost of all such core borings and/or load tests and any strengthening or concrete replacement required because strengths of test specimens are below that specified, shall be entirely at the expense of the Contractor. In such cases of failure to meet strength requirements the Contractor and Engineer shall confer to determine what adjustment, if any, can be made in compliance with Sections titled "Strength" and "Failure to Meet Strength Requirements" of ASTM C94. The "purchaser" referred to in ASTM C94 is the Contractor in this Section.

- B. When the tests on control specimens of concrete fall below the required strength, the Engineer will permit check tests for strengths to be made by means of typical cores drilled from the structure in compliance with ASTM C42 and C39. In case of failure of the cores, the Engineer, in addition to other recourses, may require, at the Contractor's expense, load tests on any one of the slabs, beams, piles, caps, and columns in which such concrete was used. Test need not be made until concrete has aged 60 days.
- C. Should the strength of test cylinders fall below 60 percent of the required minimum 28 day strength, the concrete shall be rejected and shall be removed and replaced.

### 3.11 PATCHING

- A. As soon as the forms have been stripped and the concrete surfaces exposed, fins and other projections shall be removed; recesses left by the removal of form ties shall be filled; and surface defects which do not impair structural strength shall be repaired. Clean all exposed concrete surfaces and adjoining work stained by leakage of concrete, to approval of the Engineer.
- B. Immediately after removal of forms remove plugs and break off metal ties as required by Section 03100. Holes are then to be promptly filled upon stripping as follows: Moisten the hole with water, followed by a 1/16-in brush coat of neat cement slurry mixed to the consistency of a heavy paste. Immediately plug the hole with a 1 to 1.5 mixture of cement and concrete sand mixed slightly damp to the touch (just short of "balling"). Hammer the grout into the hole until dense, and an excess of paste appears on the surface in the form of a spiderweb. Trowel smooth with heavy pressure. Avoid burnishing.
- C. When patching exposed surfaces the same source of cement and sand as used in the parent concrete shall be employed. Adjust color if necessary by addition of proper amounts of white cement. Rub lightly with a fine Carborundum stone at an age of 1 to 5 days if necessary to bring the surface down with the parent concrete. Exercise care to avoid damaging or staining the virgin skin of the surrounding parent concrete. Wash thoroughly to remove all rubbed matter.

### 3.12 REPAIRS

- A. It is the intent of this Section to require quality work including adequate forming, proper mixture and placement of concrete and curing so completed concrete surfaces will require no patching.

### 3.13 SCHEDULE

- A. The following (Table 5) are the general applications for the various concrete classes and design strengths, unless otherwise specified in the plans:

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TABLE 5

<u>Class</u>	<u>(psi)</u>	<u>Design Strength Description</u>
A	2,500	Concrete fill
B	3,000	Concrete overlay slabs and pavements
D	4,000	Concrete slab on grade

\*REFERENCE PLANS FOR CONCRETE

**DIVISION 26**

ELECTRICAL

**SECTION 26 00 00**  
**BASIC ELECTRICAL MATERIALS AND METHODS**

**PART 1 GENERAL**

1.1 REFERENCES

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

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 709 (2017) Laminated Thermosetting Material

CODE OF FEDERAL REGULATIONS (CFR)

29 CFR 1910.147 Control of Hazardous Energy (Lock Out/Tag Out)

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS, INC.(IEEE)

IEEE C2 (2023) National Electrical Safety Code

IEEE 100 (2000; Archived) The Authoritative Dictionary of IEEE Standard Terms

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250 (2020) Enclosures for Electrical Equipment (1000 Volts Maximum)

NEMA 10030 (2024) Industrial Control and Systems: Enclosures

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2020) National Electrical Code

1.2 RELATED REQUIREMENTS

This section applies to all sections of Division 26, "Electrical," of this project specification unless specified otherwise in the individual sections.

1.3 DEFINITIONS

- A. Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, shall be as defined in IEEE 100.
- B. The technical sections referred to herein are those specification sections that describe products, installation procedures, and equipment operations and that refer to this section for detailed description of submittal types.
- C. The technical paragraphs referred to herein are those paragraphs in PART 2 - PRODUCTS and PART 3 - EXECUTION of the technical sections that describe products, systems, installation procedures, equipment, and test methods.

## 1.4 ELECTRICAL CHARACTERISTICS

Electrical characteristics for this project shall be 120/240 volt, single phase, three wire, 60 Hz. Final connections to the power distribution system at the weatherhead shall be made by the Power Company (Entergy-Contact: Chris LaCroix 318/787-8776). The Contractor shall coordinate his work with Entergy and the Owner.

## 1.5 SUBMITTALS

Submittals required in the sections which refer to this section shall conform to the requirements of the Submittals Section and to the following additional requirements. Submittals shall include the manufacturer's name, trade name, place of manufacture, catalog model or number, nameplate data, size, layout dimensions, capacity, project specification and technical paragraph reference. Submittals shall also include applicable federal, military, industry, and technical society publication references, and years of satisfactory service, and other information necessary to establish contract compliance of each item to be provided. Photographs of existing installations are unacceptable and will be returned without approval.

- A. **Manufacturer's Catalog Data:** Submittals for each manufactured item shall be current manufacturer's descriptive literature of cataloged products, equipment drawings, diagrams, performance and characteristic curves, and catalog cuts. Handwritten and typed modifications and other notations not part of the manufacturer's preprinted data will result in the rejection of the submittal. Should manufacturer's data require supplemental information for clarification, the supplemental information shall be submitted as specified for certificates of compliance.
- B. **Drawings:** Include wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure a coordinated installation. Wiring diagrams shall identify circuit terminals and indicate the internal wiring for each item of equipment and the interconnection between each item of equipment. Drawings shall indicate adequate clearance for operation, maintenance, and replacement of operating equipment devices.
- C. **Instructions:** Where installation procedures or part of the installation procedures are required to be in accordance with manufacturer's instructions, submit printed copies of those instructions prior to installation. Installation of the item shall not proceed until manufacturer's instructions are received. Failure to submit manufacturer's instructions shall be cause for rejection of the equipment or material.
- D. **Certificates:** Submit manufacturer's certifications as required for products, materials, finishes, and equipment as specified in the technical sections. Certificates from material suppliers are not acceptable. Preprinted certifications and copies of previously submitted documents will not be acceptable. The manufacturer's certifications shall name the appropriate products, equipment, or materials and the publication specified as controlling the quality of that item. Certification shall not contain statements to imply that the item does not meet requirements specified, such as "as good as"; "achieve the same end use and results as materials formulated in accordance with the referenced publications"; or "equal or exceed the service and performance of the specified material." Certifications shall simply state that the item conforms to the requirements specified. Certificates shall be printed on the manufacturer's letterhead and shall be signed by the manufacturer's official authorized to sign certificates of compliance.

1. Reference Standard Compliance: Where equipment or materials are specified to conform to industry and technical society reference standards of the organizations such as American National Standards Institute (ANSI), American Society for Testing and Materials (ASTM), National Electrical Manufacturers Association (NEMA), Underwriters Laboratories Inc. (UL), and Association of Edison Illuminating Companies (AEIC), submit proof of such compliance. The label or listing by the specified organization will be acceptable evidence of compliance.
  2. Independent Testing Organization Certificate: In lieu of the label or listing, submit a certificate from an independent testing organization, competent to perform testing, and approved by the Design Professional. The certificate shall state that the item has been tested in accordance with the specified organization's test methods and that the item complies with the specified organization's reference standard.
- E. Material and Equipment Manufacturing Date: Products manufactured more than three years prior to date of delivery to site shall not be used, unless specified otherwise.

#### 1.6 QUALITY ASSURANCE

- A. Material and Equipment Qualifications: Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship. Products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year period shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period. Where two or more items of the same class of equipment are required, these items shall be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in the technical section.
- B. Regulatory Requirements: Equipment, materials, installation, and workmanship shall be in accordance with the mandatory and advisory provisions of NFPA 70.
- C. Alternative Qualifications: Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.
- D. Service Support: The equipment items shall be supported by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.
- E. Manufacturer's Nameplate: Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.
- F. Modification of References: In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the Design Professional.

## 1.7 ELECTRICAL REQUIREMENTS

Electrical installations shall conform to IEEE C2, NFPA 70, and requirements specified herein.

## 1.8 MECHANICAL REQUIREMENTS

All control equipment to provide the proper sequence of operation shall be furnished and installed by the electrical contractor.

All conduit and wiring for control purposes shall be furnished and installed as work of this electrical section. All control wiring shall be color coded.

## 1.9 LOCKOUT REQUIREMENTS

Provide disconnecting means capable of being locked out for machines and other equipment to prevent unexpected startup or release of stored energy in accordance with 29 CFR 1910.147.

## **PART 2 PRODUCTS**

Not used.

## **PART 3 EXECUTION**

### 3.1 PAINTING OF EQUIPMENT

- A. **Factory Applied:** Electrical equipment shall have factory-applied painting systems which shall, as a minimum, meet the requirements of NEMA 10030 corrosion-resistance test.
- B. **Field Applied:** Paint electrical equipment as required to match finish of adjacent surfaces or to meet the indicated or specified safety criteria.

**\*\*\* END OF SECTION \*\*\***

**SECTION 26 20 00**  
**INTERIOR DISTRIBUTION SYSTEM**

**PART 1 GENERAL**

**1.1 REFERENCES**

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

**AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)**

ANSI C80.1 (2020) Electrical Rigid Steel Conduit (ERSC)

ANSI C80.3 (2020) Steel Electrical Metallic Tubing (EMT)

**AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)**

ASTM B1 (2018) Hard-Drawn Copper Wire

ASTM B8 (2011; R2023) Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft

ASTM D 709 (2011; R2017) Laminated Thermosetting Materials

**INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)**

NETA ATS (2021) Acceptance Testing Specifications

**NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)**

NEMA 250 (2020) Enclosures for Electrical Equipment (1000 Volts Maximum)

NEMA ICS 1 (2022) Industrial Control and Systems; General Requirements

NEMA ICS 4 (2015) Industrial Control and Systems: Terminal Blocks

NEMA IA 10030 (2024) Industrial Control and Systems: Enclosures

NEMA KS 1 (2013) Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum)

ANSI/NEMA MG 00001 (2024) Motor and Generators

ANSI/NEMA MG 10 (2017) Energy Management Guide for Selection and Use of Fixed Frequency Medium AC Squirrel-Cage Polyphase Induction Motors

NEMA MG 10009 (2022) Energy Management Guide of Selection and Use of Single-Phase Motors

NEMA TC 2	(2020) Electrical Polyvinyl Chloride (PVC) Tubing and Conduit
NEMA TC 3	(2021) Polyvinyl Chloride PVC Fittings for Use with Rigid PVC Conduit and Tubing
NEMA TC 14	(BG 2002; R2020) Reinforced Thermosetting Resin Conduit (RTRC) and Fittings
NEMA WD 1	(1999; R2020) General Color Requirements for Wiring Devices
NEMA WD 6	(2021) Wiring Devices - Dimensional Requirements
NEMA Z535.4	(2023) Product Safety Signs and Labels

#### NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2020) National Electrical Code
NFPA 70E	(2024) Electrical Safety in the Workplace

#### UNDERWRITERS LABORATORIES INC. (UL)

UL 1	(2005; R2023) Flexible Metal Conduit
UL 6	(2022) Electrical Rigid Metal Conduit - Steel
UL 20	(2025) General-Use Snap Switches
UL 50	(2024 Edition 14) Enclosures for Electrical Equipment
UL 67	(2018, R2025) Panelboards
UL 83	(2017; R2020) Thermoplastic-Insulated Wires and Cables
UL 360	(2013; R2024) Liquid-Tight Flexible Steel Conduit
UL 467	(11 <sup>th</sup> Edition -2022) Grounding and Bonding Equipment
UL 486A-486B	(2025) Wire Connectors
UL 486C	(2023; R2025) Splicing Wire Connectors
UL 489	(2025) Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures
UL 506	(2017; R2022) Specialty Transformers
UL 508	(2024) Industrial Control Equipment
UL 510	(2020; R2024) Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape

UL 514A	(2024) Metallic Outlet Boxes
UL 514B	(2012; R2024) Conduit, Tubing and Cable Fittings
UL 514C	(2014; R2024) Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers
UL 651	(2011; R2022) Schedule 40 and 80 Rigid PVC Conduit
UL 797	(2007; R2023) Electrical Metallic Tubing -- Steel
UL 869A	(2006; R2020) Reference Standard for Service Equipment
UL 943	(2016; R2023) Ground-Fault Circuit-Interrupters
UL 1242	(2006; R2022) Electrical Intermediate Metal Conduit – Steel
UL 1449	(2021; R2025) Surge Protective Devices

## 1.2 RELATED REQUIREMENTS

Section 26 00 00, "Basic Electrical Materials and Methods," applies to this section with additions and modifications specified herein

## 1.3 QUALITY ASSURANCE

In each standard referred to herein, consider the advisory provisions to be mandatory, as though the word "shall" has been substituted for "should" wherever it appears. Interpret references in these standards to "authority having jurisdiction," or words of similar meaning, to mean Design Professional.

## 1.4 SUBMITTALS: Submit the following:

### A. Manufacturer's Catalog Data

1. Surge Protective Devices (SPD's)
2. Motor controllers
3. Automatic Transfer Switch

### B. Manufacturer's Catalog Data

1. Panelboards

## **PART 2 PRODUCTS**

### **2.1 MATERIALS AND EQUIPMENT**

Materials, equipment, and devices shall, as a minimum, meet requirements of UL, where UL standards are established for those items, and requirements of NFPA 70.

### **2.2 CONDUIT AND FITTINGS**

Shall be rigid steel (zinc-coated) conduit, rigid nonmetallic conduit, intermediate metal conduit (IMC), electrical metallic tubing (EMT), flexible metal conduit, and liquid-tight flexible conduit, conforming to the following:

- A. Rigid Steel Conduit (Zinc-Coated): ANSI C80.1, UL 6.
- B. Rigid Nonmetallic Conduit: PVC Type EPC-40 in accordance with NEMA TC 2.
- C. Intermediate Metal Conduit (IMC): UL 1242, zinc-coated steel only.
- D. Electrical Metallic Tubing (EMT): UL 797, ANSI C80.3.
- E. Flexible Metal Conduit: UL 1.
  - 1. Liquid-Tight Flexible Metal Conduit, Steel: UL 360.
- F. Fittings for Metal Conduit, EMT, and Flexible Metal Conduit: UL 514B. Ferrous fittings shall be cadmium- or zinc-coated in accordance with UL 514B.
  - 1. Fittings for Rigid Metal Conduit and IMC: Threaded-type. Split couplings unacceptable.
  - 2. Fittings for EMT: Steel or Die Cast compression type.
- G. Fittings for Rigid Nonmetallic Conduit: NEMA TC 3.

2.3 OUTLET BOXES AND COVERS UL 514A, cadmium- or zinc-coated.

### **2.4 CABINETS, JUNCTION BOXES, AND PULL BOXES**

Volume greater than 100 cubic inches, UL 50, hot-dip, zinc-coated, if sheet steel.

### **2.5 WIRES AND CABLES**

Wires and cables shall meet applicable requirements of NFPA 70 and UL for type of insulation, jacket, and conductor specified or indicated. Wires and cables manufactured more than 12 months prior to date of delivery to site shall not be used.

- A. Conductors: Conductors No. 8 AWG and larger diameter shall be stranded. Conductors No. 10 AWG and smaller diameter shall be solid, except that conductors for remote control, alarm, and signal circuits, classes 1, 2, and 3, shall be stranded unless specifically indicated otherwise. Conductor sizes and ampacities shown are based on copper, unless indicated otherwise. All

conductors shall be copper.

1. Minimum Conductor Sizes: Minimum size for branch circuits shall be No. 12 AWG.
- B. Color Coding: Provide for service, feeder, branch, control, and signaling circuit conductors. Color shall be green for grounding conductors and white for neutrals. Color of ungrounded conductors shall be as follows:
  1. 120/240 volt, single phase: Black and red
- C. Insulation: Unless specified or indicated otherwise or required by NFPA 70, power and lighting wires shall be 600-volt, Type THWN/THHN conforming to UL 83, except that grounding wire may be type TW conforming to UL 83; remote-control and signal circuits shall be Type TW or TF, conforming to UL 83. Where lighting fixtures require 90-degree Centigrade (C) conductors, provide only conductors with 90-degree C insulation or better.
- D. Bonding Conductors: ASTM B1, solid bare copper wire for sizes No. 8 AWG and smaller diameter; ASTM B8, Class B, stranded bare copper wire for sizes No. 6 AWG and larger diameter.

## 2.6 SPLICES AND TERMINATION COMPONENTS

UL 486A-UL486B for wire connectors and UL 510 for insulating tapes. Connectors for No. 10 AWG and smaller diameter wires shall be insulated, pressure-type in accordance with UL 486A-UL486B or UL 486C (twist-on splicing connector). Provide solderless terminal lugs on stranded conductors.

- A. Temperature Limitations: Contractor shall comply with the temperature limitations included in NEC Article 110-14(c). Ampacity rating of conductors shall be computed at the temperature rating of the equipment termination.

## 2.7 DEVICE PLATES

Provide UL listed, one-piece device plates for outlets to suit the devices installed. For metal outlet boxes, plates on unfinished walls shall be of zinc-coated sheet steel or cast metal having round or beveled edges. Plates on finished walls shall be nylon or lexan, minimum 0.03 inch wall thickness. Plates shall be same color as receptacle or toggle switch with which they are mounted. Screws shall be machine-type with countersunk heads in color to match finish of plate. Sectional type device plates will not be permitted. Plates installed in wet locations shall be gasketed and UL listed for "wet locations."

## 2.8 SWITCHES

- A. Toggle Switches: UL 20, totally enclosed with bodies of thermosetting plastic and mounting strap. Handles shall be ivory. Wiring terminals shall be screw-type, side-wired. Switches shall be rated quiet-type AC only, 120/277 volts, with 20 amp current rating and number of poles indicated.
- B. Disconnect Switches: NEMA KS 1. Provide heavy duty-type switches where indicated, where switches are rated higher than 240 volts, and for double-throw switches. Fused switches shall utilize Class R fuseholders and fuses, unless indicated otherwise. Switches serving as motor-disconnect means shall be horsepower rated. Provide switches in NEMA 3R, enclosure per

NEMA 10030.

## 2.9 RECEPTACLES

UL 498 and NEMA WD 1, specification grade, heavy-duty, grounding-type. Ratings and configurations shall be as indicated. Bodies shall be of ivory thermosetting plastic supported on a metal mounting strap. Dimensional requirements shall be per NEMA WD 6. Provide screw-type, side-wired wiring terminals. Connect grounding pole to mounting strap.

- A. Weatherproof Receptacles: Provide in cast metal box with gasketed, weatherproof, cast-metal cover plate and gasketed cap over each receptacle opening. Provide caps with a spring-hinged flap. Receptacle shall be UL listed for use in "wet locations with plug in use."
- B. Ground-Fault Circuit Interrupter (GFI) Receptacles: UL 943, duplex type for mounting in standard outlet box. Device shall be capable of detecting current leak of 6 milliamperes or greater and tripping per requirements of UL 943 for Class A GFI devices.

## 2.10 GROUNDING AND BONDING EQUIPMENT

UL 467. Ground rods shall be copper-clad steel, with minimum diameter of 3/4 inch and minimum length of 10 feet.

## 2.11 PANELBOARDS

UL 67 and UL 50. Panelboards shall be circuit breaker-equipped. Design shall be such that individual breakers can be removed without disturbing adjacent units or without loosening or removing supplemental insulation supplied as means of obtaining clearances as required by UL. Where "space only" is indicated, make provisions for future installation of breaker sized as indicated. Panelboard locks shall be keyed same. Directories shall indicate load served by each circuit of panelboard. Directories shall also indicate source of service (upstream panel, switchboard, motor control center, etc.) to panelboard. Type directories and mount in holder behind transparent protective covering.

- A. Panelboard Buses: Support bus bars on bases independent of circuit breakers. Main buses and back pans shall be designed so that breakers may be changed without machining, drilling, or tapping. Provide isolated neutral bus in each panel for connection of circuit neutral conductors. Provide separate ground bus identified as equipment grounding bus per UL 67 for connecting grounding conductors; bond to steel cabinet.
- B. Circuit Breakers: UL 489, thermal magnetic-type having a minimum short-circuit current rating equal to the short-circuit current rating of the panelboard in which the circuit breaker shall be mounted. Breaker terminals shall be UL listed as suitable for type of conductor provided. Series rated circuit breakers and plug-in circuit breakers are unacceptable.
  - 1. Multipole Breakers: Provide common trip-type with single operating handle. Breaker design shall be such that overload in one pole automatically causes all poles to open. Maintain phase sequence throughout each panel so that any two adjacent breaker poles are connected to Phases A, and B, respectively.
- C. Surge Protective Device (SPD): SPD unit shall be mounted adjacent to Panel and connected to breaker in panel with leads as short as possible. SPD unit shall be rated at 160,000 amps per phase of surge protection with maximum response time of 0.5 nanosecond. UL 1449 suppression

rating of 700 volts L-N, 700 volts N-G, 700 volts L-G, and 1200 volts L-L, and tested to withstand 8,000 IEEE/ANSI C62.41, Category 3 (10,000 amp peak) impulses without failure or performance degradation. SPD shall be equal to ASCO model 510 series 120/240V 1Ø.

## 2.12 MOTORS

NEMA MG 00001. Provide the size in terms of HP, or kVA, or full-load current, or a combination of these characteristics, and other characteristics, or each motor as indicated or specified. Determine specific motor characteristics to ensure provision of correctly sized starters and overload heaters. Motors shall be designed to operate at full capacity with voltage variation of plus or minus Motors for operations on 240-volt, 3-phase circuits shall have terminal voltage rating of 230 volts. Motors shall be designed to operate at full capacity with voltage variation of plus or minus 10 percent of motor voltage.

- A. High Efficiency Single-Phase Motors: Single-phase fractional-horsepower alternating-current motors be high efficiency types corresponding to the applications listed in NEMA MG 10009.
- B. High Efficiency Polyphase Motors: Polyphase motors shall be selected based on high efficiency characteristics relative to the applications as listed in NEMA MG 10. Additionally, polyphase squirrel-cage medium induction motors with continuous ratings shall meet or exceed energy efficient ratings in accordance with Table 12-10 of NEMA MG 00001.
- C. Motor Sizes: Provide size for duty to be performed, not exceeding the full-load nameplate current rating when driven equipment is operated at specified capacity under most severe conditions likely to be encountered. When motor size differs from size indicated or specified, make adjustments to wiring, disconnect devices, and branch circuit protection to accommodate equipment actually provided.

## 2.13 MOTOR CONTROLLERS

UL 508, NEMA ICS 1, AND NEMA ICS 2. Controllers shall have thermal overload protection in each phase and shall have one spare normally open and one spare closed auxiliary contact. Magnetic-type motor controllers shall have undervoltage protection when used with momentary-contact pushbutton stations or switches and shall have undervoltage release when used with maintained-contact pushbutton stations or switches. When used with pressure, float, or similar automatic-type or maintained-contact switch, controller shall have hand/off/automatic selector switch. Connections to selector switch shall be such that only normal automatic regulatory control devices are bypassed when switch is in "hand" position. Safety control devices, such as low and high pressure cutouts, high temperature cutouts, and motor overload protective devices, shall be connected in motor control circuit in "hand" and "automatic" positions. Control circuit connections to hand/off/automatic selector switch or to more than one automatic regulatory control device shall be made in accordance with indicated or manufacturer's approved wiring diagram. Selector switch shall have means for locking in any position. For each motor not in sight of controller or where controller disconnecting means is not in sight of motor location and driven machinery location, controller disconnecting means shall be capable of being locked in open position. As an alternative, provide a manually operated, lockable, nonfused switch which disconnects motor from supply source within sight of motor. Overload protective devices shall provide adequate protection to motor windings; be thermal inverse-time-limit type; and include manual reset-type pushbutton on outside of motor controller case. Cover of combination motor controller and manual switch or circuit breaker shall be interlocked with operating handle of switch or circuit breaker so that cover cannot be opened unless handle of switch or circuit breaker is in "off" position.

- A. Control Circuits: Control circuits shall have maximum voltage of 120 volts derived from control transformer in same enclosure. Transformers shall conform to UL 506, as applicable. Transformers, other than transformers in bridge circuits, shall have primaries wound for voltage available and secondaries wound for correct control circuit voltage. Size transformers so that 80 percent of rated capacity equals connected load. Provide disconnect switch on primary side. One secondary lead shall be fused; other shall be grounded.
- B. Enclosures for Motor Controllers: NEMA IA 10030.
- C. Pushbutton Stations: Provide with "start/stop" momentary contacts having one normally open and one normally closed set of contacts, and red lights to indicate when motor is running. Stations shall be heavy duty, oil-tight design.
- D. Pilot and Indicating Lights: Provide transformer, resistor, or diode type.
- E. Terminal Blocks: NEMA ICS 4.

## 2.14 AUTOMATIC TRANSFER SWITCH

### A. GENERAL

1. The automatic transfer switch shall be listed by Underwriter's Laboratory, Standard 1008 with circuit breaker protection. Representative production samples of the transfer switch supplied shall have demonstrated through tests the ability to withstand at least 10,000 mechanical operation cycles. One operation cycle is the electrically operated transfer from normal to emergency and back to normal. Wiring must comply with NEC table 373-6(b). The manufacturer shall furnish schematic and wiring diagrams for the particular automatic transfer switch and a typical wiring diagram for the entire system.

### B. RATINGS & PERFORMANCE

1. The automatic transfer switch shall be rated for continuous operation in ambient temperatures of -20 degrees Fahrenheit (-30 degrees Celsius) to +140 degrees Fahrenheit (+60 degrees Celsius). Main power switch contacts shall be rated for 600 V AC minimum. The transfer switch supplied shall have a minimum withstand and closing rating when fuse protected of 200,000 amperes. Where the line side overcurrent protection is provided by circuit breakers, the short circuit withstand and closing ratings shall be 42,000 amperes RMS. These RMS symmetrical fault current ratings shall be the rating listed in the UL listing or component recognition procedures for the transfer switch. All withstand tests shall be performed with the overcurrent protective devices located external to the transfer switch. Ratings shall be 200 amp-2 pole, NEMA 3R.

### C. CONSTRUCTION

1. The transfer switch shall be double throw construction, positively electrically and mechanically interlocked to prevent simultaneous closing and mechanically held in both normal and emergency positions. Independent break before make action shall be used to positively prevent dangerous source to source connections. When switching the neutral, this action prevents the objectionable ground currents and nuisance ground fault tripping that can result from overlapping designs. The transfer switch shall be approved for manual operation. The electrical operating means shall be by electric solenoid. Every portion of the contactor is to be positively mechanically connected. No clutch or friction drive mechanism is allowed, and parts are to be kept to a minimum. This transfer switch shall not contain integral overcurrent devices in the main power circuit, including molded case circuit breakers or fuses.

2. The transfer switch electrical actuator shall have an independent disconnect means to disable the electrical operation during manual switching. Maximum electrical transfer time in either direction shall be 160 milliseconds, exclusive of time delays. Main switch contacts shall be high pressure silver alloy with arc chutes and separate arcing contacts to resist burning and pitting for long life operation.

#### D. CONTROLS

1. All control equipment shall be mounted on the inside of the cabinet door in a metal lockable enclosure with transparent safety shield to protect all solid state circuit boards. This will allow for ease of service access when main cabinet lockable door is open, but to prevent access by unauthorized personnel. Control boards shall have installed cover plates to avoid shock hazard while making control adjustments. The solid state voltage sensors and time delay modules shall be plug-in circuit boards with silver or gold contacts for ease of service.
2. A solid state undervoltage sensor shall monitor all phases of the normal source and provide adjustable ranges for field adjustments for specific application needs. Pick-up and drop-out settings shall be adjustable from a minimum of 70% to a maximum of 95% of nominal voltage. A utility sensing interface shall be used, stepping down system voltage of 120/240 VAC 1 phase to 24 VAC, helping to protect the printed circuit board from voltage spikes and increasing personnel safety when troubleshooting.
3. Signal the engine-generator set to start in the event of a power interruption. A set of contacts shall close to start the engine and open for engine shutdown. A solid state time delay start, adjustable, .1 to 10 seconds, shall delay this signal to avoid nuisance start-ups on momentary voltage dips or power outages.
4. Transfer the load to the engine-generator set after it reached proper voltage, adjustable from 70-90% of system voltage, and frequency, adjustable from 80-90% of system frequency. A solid state time delay, adjustable from 5 seconds to 3 minutes, shall delay this transfer to allow the engine-generator to warm-up before application of load. There shall be a switch to bypass this warm-up timer when immediate transfer is required.
5. Retransfer the load to the line after normal power restoration. A return to utility timer, adjustable from 1-30 minutes, shall delay this transfer to avoid short term normal power restoration.
6. The operating power for transfer and retransfer shall be obtained from the source to which the load is being transferred. Controls shall provide an automatic retransfer of the load from emergency to normal if the emergency source fails with the normal source available.
7. Signal the engine-generator to stop after the load retransfers to normal. A solid state engine cooldown timer, adjustable from 1-30 minutes, shall permit the engine to run unloaded to cooldown before shutdown. Should the utility power fail during this time, the switch will immediately transfer back to the generator.
8. Provide an engine minimum run timer, adjustable from 5-30 minutes, to ensure an adequate engine run period.
9. Provide a solid state plant exercise clock. It must allow selection of any combination of days of the week and the time of day for the generator set exercise period. Clock shall have a one week cycle and be powered by the load side of the transfer switch. A battery must be supplied to maintain the circuit board clock operation when the load side of the transfer switch is de-energized. Include a switch to select if the load will transfer to the engine-generator set during the exercise period.
10. The transfer switch shall have a time delay neutral feature to provide a time delay, adjustable from .1-10 seconds, during the transfer in either direction, during which time the load is isolated from both power sources. This allows residual voltage components of motors or other inductive loads (such as

transformers) to decay before completing the switching cycle. A switch will be provided to bypass all transition features when immediate transfer is required.

11. The transfer switch shall have an inphase monitor which allows the switch to transfer between live sources if their voltage waveforms become synchronous within 20 electrical degrees within 10 seconds of transfer initiation signal. A switch must be provided to bypass this feature if not required.
12. If the inphase monitor will not allow such a transfer, the control must default to time delay neutral operation. Switches with inphase monitors which do not default to time delay neutral operation are not acceptable.
13. Front mounted controls shall include a selector switch to provide for a NORMAL TEST mode with full use of time delays, FAST TEST mode which bypasses all time delays to allow for testing the entire system in less than one minute, or AUTOMATIC mode to set the system for normal operation.
14. Provide bright lamps to indicate the transfer switch position in either UTILITY (white) or EMERGENCY (red). A third lamp is needed to indicate STANDBY OPERATING (amber). These lights must be energized from utility or the engine-generator set.
15. Provide manual operating handle to allow for manual transfer. This handle must be mounted inside the lockable enclosure so accessible only by authorized personnel.
16. Provide a safety disconnect switch to prevent load transfer and automatic engine start while performing maintenance. This switch will also be used for manual transfer switch operation.
17. Provide LED status lights to give a visual readout of the operating sequence. This shall include utility on, engine warm-up, standby ready, transfer to standby, inphase monitor, time delay neutral, return to utility, engine cooldown and engine minimum run. A "signal before transfer" lamp shall be supplied to operate from optional circuitry.

## **PART 3 EXECUTION**

### **3.1 INSTALLATION**

Electrical installations shall conform to requirements of NFPA 70 and to requirements specified herein.

- A. Service Entrance Identification: Service entrance disconnect devices, switches, and enclosures shall be labeled and identified as such.
- B. Wiring Methods: Provide insulated conductors installed in rigid steel conduit, IMC, rigid nonmetallic conduit, or EMT, except where specifically indicated or specified otherwise or required by NFPA 70 to be installed otherwise. Grounding conductor shall be separate from electrical system neutral conductor. Provide insulated green equipment grounding conductor for circuit(s) installed in conduit and raceways. Minimum conduit size shall be 1/2 inch in diameter for low voltage lighting and power circuits.
  1. Restrictions Applicable to EMT
    - a. Do not install underground.
    - b. Do not encase in concrete, mortar, grout, or other cementitious materials.
    - c. Do not use in areas subject to severe physical damage including but not limited to equipment rooms where moving or replacing equipment could physically damage the EMT.

- d. Do not use outdoors.
2. Nonmetallic Conduit
    - a. Restrictions applicable to PVC Schedule 40
      - 1) Do not use above slab or grade, except that they may be used within chlorine building.
  3. Restrictions Applicable to Flexible Conduit: Use only as specified in paragraph entitled "Flexible Connections."
  4. Underground Conduit: Rigid steel; steel IMC; PVC, Type EPC-40. Convert nonmetallic conduit, to rigid, or IMC, steel conduit before rising through floor slab or above grade.
- C. Conduit Installation: Unless indicated otherwise, conceal conduit under floor slabs and within finished walls, ceilings, and floors. Keep conduit minimum 6 inches away from parallel runs of flues and steam or hot water pipes. Install conduit parallel with or at right angles to ceilings, walls, and structural members where conduit will be visible after completion of project.
1. Conduit Support: Support conduit by pipe straps, wall brackets, hangers, or ceiling trapeze. Fasten by wood screws to wood; by toggle bolts on hollow masonry units; by concrete inserts or expansion bolts on concrete or brick; and by machine screws, welded threaded studs, or spring-tension clamps on steel work. Threaded C-clamps may be used on rigid steel conduit only. Do not weld conduits or pipe straps to steel structures. Load applied to fasteners shall not exceed one-fourth proof test load. Fasteners attached to concrete ceiling shall be vibration resistant and shock-resistant. Holes cut to depth of more than 1 1/2 inches in reinforced concrete beams or to depth of more than 3/4 inch in concrete joints shall not cut main reinforcing bars. Fill unused holes.
  2. Directional Changes in Conduit Runs: Make changes in direction of runs with symmetrical bends or cast-metal fittings. Make field-made bends and offsets with hickey or conduit-bending machine. Do not install crushed or deformed conduits. Avoid trapped conduits. Prevent plaster, dirt, or trash from lodging in conduits, boxes, fittings, and equipment during construction. Free clogged conduits of obstructions.
  3. Pull Wire: Install pull wires in empty conduits. Pull wire shall be plastic having minimum 200 pound tensile strength. Leave minimum 36 inches of slack at each end of pull wire.
  4. Locknuts and Bushings: Fasten conduits to sheet metal boxes and cabinets with two locknuts where required by NFPA 70, where insulated bushings are used, and where bushings cannot be brought into firm contact with the box; otherwise, use at least minimum single locknut and bushing. Locknuts shall have sharp edges for digging into wall of metal enclosures. Install bushings on ends of conduits, and provide insulating type where required by NFPA 70.
  5. Flexible Connections: Provide flexible steel conduit between 3 and 6 feet in length for equipment subject to vibration, noise transmission, or movement; and for motors. Install flexible conduit to allow 20 percent slack. Minimum flexible steel conduit size shall be 1/2 inch diameter. Provide liquidtight flexible conduit in wet and damp locations for equipment subject to vibration, noise transmission, movement or motors. Provide separate ground conductor across flexible connections.

D. Boxes, Outlets, and Supports: Provide boxes in wiring and raceway systems wherever required for pulling of wires, making connections, and mounting of devices or fixtures. Boxes for metallic raceways shall be cast-metal, hub-type when located in wet locations, when surface mounted on outside of exterior surfaces, when specifically indicated. Boxes in other locations shall be sheet steel. Each box shall have volume required by NFPA 70 for number of conductors enclosed in box. Boxes for mounting lighting fixtures shall be minimum 4 inches square, or octagonal, except that smaller boxes may be installed as required by fixture configurations, as approved. Boxes for use in masonry-block or tile walls shall be square-cornered, tile-type, or standard boxes having square-cornered, tile-type covers. Provide gaskets for cast-metal boxes installed in wet locations and boxes installed flush with outside of exterior surfaces. Provide separate boxes for flush or recessed fixtures when required by fixture terminal operating temperature; fixtures shall be readily removable for access to boxes unless ceiling access panels are provided. Fasten boxes and supports with wood screws on wood, with bolts and expansion shields on concrete or brick, with toggle bolts on hollow masonry units, and with machine screws or welded studs on steel. In open overhead spaces, cast boxes threaded to raceways need not be separately supported except where used for fixture support; support sheet metal boxes directly from building structure or by bar hangers. Where bar hangers are used, attach bar to raceways on opposite sides of box, and support raceway with approved-type fastener maximum 24 inches from box. When penetrating reinforced concrete members, avoid cutting reinforcing steel.

1. Boxes: Boxes for use with raceway systems shall be minimum 1 1/2 inches deep, except where shallower boxes required by structural conditions are approved. Boxes for other than lighting fixture outlets shall be minimum 4 inches square, except that 4 by 2 inch boxes may be used where only one raceway enters outlet.
2. Pull Boxes: Construct of at least minimum size required by NFPA 70 of code-gauge aluminum or galvanized sheet steel, and compatible with nonmetallic raceway systems, except where cast-metal boxes are required in locations specified herein. Provide boxes with screw-fastened covers. Where several feeders pass through common pull box, tag feeders to indicate clearly electrical characteristics, circuit number, and panel designation.

E. Mounting Heights: Mount panelboards, circuit breakers, motor controller and disconnecting switches so height of operating handle at its highest position is maximum 78 inches above floor. Mount lighting switches 48 inches above finished floor, receptacles 18 inches above finished floor, and other devices as indicated. Measure mounting heights of wiring devices and outlets to center of device or outlet.

F. Conductor Identification: Provide conductor identification within each enclosure where tap, splice, or termination is made. For conductors No. 6 AWG and smaller diameter, color coding shall be by factory-applied, color-impregnated insulation. For conductors No. 4 AWG and larger diameter, color coding shall be by plastic-coated, self-sticking markers; colored nylon cable ties and plates; or heat shrink-type sleeves.

G. Splices: Make splices in accessible locations. Make splices in conductors No. 10 AWG and smaller diameter with insulated, pressure-type connector. Make splices in conductors No. 8 AWG and larger diameter with solderless connector, and cover with insulation material equivalent to conductor insulation.

- H. Covers and Device Plates: Install with edges in continuous contact with finished wall surfaces without use of mats or similar devices. Plaster fillings are not permitted. Install plates with alignment tolerance of 1/16 inch. Use of sectional-type device plates are not permitted. Provide gasket for plates installed in wet locations.
- I. Grounding and Bonding: In accordance with NFPA 70. Ground exposed, non-current-carrying metallic parts of electrical equipment, metallic raceway systems, grounding conductor in metallic and nonmetallic raceways, and neutral conductor of wiring systems. Make ground connection at main service equipment, and extend grounding conductor to point of entrance of metallic water service. Make connection to water pipe by suitable ground clamp or lug connection to plugged tee. If flanged pipes are encountered, make connection with lug bolted to street side of flanged connection. Supplement metallic water service grounding system with additional made electrode in compliance with NFPA 70.
  - 1. Resistance: Maximum resistance-to-ground of grounding system shall not exceed 5 ohms under dry conditions. Where resistance obtained exceeds 5 ohms, contact Design Professional for further instructions.
- J. Equipment Connections: Provide power wiring for the connection of motors and control equipment under this section of the specification. Except as otherwise specifically noted or specified, automatic control wiring, control devices, and protective devices within the control circuitry are not included in this section of the specifications but shall be provided under the section specifying the associated equipment.

### 3.2 FIELD QUALITY CONTROL

- A. Devices Subject to Manual Operation: Each device subject to manual operation shall be operated at least five times, demonstrating satisfactory operation each time.
- B. 600-Volt Wiring Test: Test wiring rated 600 volt and less to verify that no short circuits or accidental grounds exist. Perform insulation resistance tests on wiring No. 6 AWG and larger diameter using instrument which applies voltage of approximately 500 volts to provide direct reading of resistance. Minimum resistance shall be 250,000 ohms.
- C. GFI Receptacle Test: Test GFI receptacles with a "load" (such as a plug in light) to verify that the "line" and "load" leads are not reversed.
- D. Grounding System Test: Test grounding system to ensure continuity, and that resistance to ground is not excessive. Test each ground rod for resistance to ground before making connections to rod; tie grounding system together and test for resistance to ground. Make resistance measurements in dry weather, not earlier than 48 hours after rainfall.

**\*\*\* END OF SECTION \*\*\***

**SECTION 26 31 00  
DATA COMMUNICATIONS**

**PART 1 – GENERAL**

1.1 **Scope:** This section includes an extension to the existing managed, cellular-based communication system for alarm monitoring and remotely controlling water systems equipment with data collection and reporting services.

1.2 **System Components:**

1. Remote terminal units to collect and transmit data from Project site to central server location.
2. Cellular communications via Mission specified carriers between remote terminal units and central server location.
3. Central server location to receive, record, and analyze telemetry reported by remote terminal units.
4. Alarm notification system to alert operating personnel about system alarms and malfunction conditions.
5. Secure web-based user interface to access recorded data, generate system reports, and control local equipment through remote terminal unit.

1.3 **Definitions:**

- A. **Remote Terminal Unit (RTU):** Microprocessor-controlled electronic device that interfaces between equipment and SCADA system by transmitting telemetry and object status data to central server center, and by using messages from central server center to remotely control connected objects.
- B. **Supervisory Control and Data Acquisition (SCADA):** Managed system operating with coded signals over cellular communication channels to acquire information about remote equipment status for display, recording, and alarm signaling functions and to provide control of remote equipment.

1.4 **Submittals:**

- A. **Product Data:** For each type of device and system:
  1. Include product data sheets and equipment brochures showing standard products and specified accessories.
  2. Include list of owners, locations, and duration of service, where products are in use upon request.

- B. Manufacturer's installation instructions.
- C. Operation and Maintenance Manual: For remote terminal units, data communication system, and support service.

1.5 Quality Assurance:

- A. Manufacturer Qualifications: Firm engaged in manufacture of cellular-based remote terminal units (RTUs) and operation of managed SCADA service for a minimum of 10 years.
- B. Supplier Qualifications: Manufacturer, or firm that is manufacturer's authorized and trained agent, or combination of both, that provides, maintains, and warrants on-site monitoring equipment and web-based data reporting system.
  - 1. Provide required monitoring-related services with field equipment. Maintain ongoing cellular service agreements through relationships with cellular carrier provider(s).
  - 2. Provide specified server center and server infrastructure.
  - 3. Provide continuous technical support, at all times.
  - 4. Demonstrate similar services are currently provided to minimum 100 United States public agencies.

1.6 Delivery, Storage, and Handling:

- A. Deliver products to the Project site, unless otherwise indicated.
- B. Label products with manufacturer's name, product, or product brand name. Assign unique, original identifier (serial number) to each RTU.

**PART 2 – PRODUCTS AND SERVICES**

2.1 Manufacturers:

- A. To ensure compatibility with Owner's existing equipment, provide products and systems by basis of design manufacturer or comparable products and systems by Mission Communications as locally represented by:

J.H. Wright & Associates  
27395 Pollard Road  
P.O. Box 1085  
Daphne, Alabama 36526  
Phone (251) 621-1491  
Fax: (251) 621-8111  
Attention: Joe Tuggle (318)787-7484

B. Products:

1. MISSION M852 MYDRO w/NEMA 4X ENCLOSURE
2. MISSION SW-587 CONTROL SOFTWARE PKG
3. MISSION SP800 SERVICE PKG 1 YR
4. MISSION IT473S-0-150PSI PRESSURE TRANSDUCER

2.2 Remote Terminal Units (RTU) – General:

- A. RTU: Factory assembled and programmed data collection and reporting device, contained within electrical enclosure designed for 25 year life expectancy.
- B. Data Cellular Radio: Communicate with central server location via cellular radio transmitting data through Transmission Control Protocol (TCP) socket connection.
1. Provide encrypted and end-to-end acknowledged transmissions. Short Message Service (SMS), User Datagram Protocol (UDP), and satellite-based data transmission methods are not permitted.
  2. Accommodate radios from various cellular carriers; field-interchangeable within 10 minutes.
  3. Support LTE, 3GPP and 3GPP/2 technology for CDMA and HSPA+ networks.
    - a. LTE: Quad Band LTE:  
700/850/AWS (1700/2100)/1900 MHz;  
FDD-Band (17,5,4,2);  
Tri Band UMTS (WCDMA): 850/AWS (1700/2100)/1900 MHz;  
FDD-Band (5,4,2) Quad Band GSM/GPRS/EDGE:  
850/900/1800/1900 MHz
    - b. GSM: Quad-band (850/900/1800/1900 MHz) GSM/GPRS/EDGE, 3GPP release 99/4 improved SAIC.
    - c. CDMA: Triple-band CDMA2000, Bands: BC0/BC1 & BC10 subclass 2+3 (800/1900 MHz), 3GPP2: 1xAdvanced, EV-DO Rev. A.
- C. Remote Terminal Unit (RTU) Enclosure: NEMA 250, Type 4X Enclosure: Outdoor, watertight enclosure with front sun shield to reduce internal temperature and with accommodation for housing 12 V, 5Ahr back-up battery. Size (W x H x D): 13.75 x 13.75, 5.5 inches.
- D. Power Requirements: UL Recognized, 120 VAC to 12 VAC transformer. Includes back-up battery capable of powering RTU for 20 to 48 hours.

E. Digital Inputs:

1. Eight (8) inputs shall detect normal, off-normal and wire fault (supervised) state changes.
  - a. Model M110: Three over-the-air configurable inputs to report hourly pump runtimes and pump starts per hour. User-selectable normally open (NO) or normally closed (NC) logic and LED lamp with indication for open, closed, and wire fault conditions.
  - b. Model M800: Eight over-the-air configurable inputs to report real-time pump run status and run times. User-selectable normally open (NO) or normally closed (NC) logic and LED lamp with indication for open, closed, and wire fault conditions.
  - c. Model M150: Three over-the-air configurable inputs to report hourly pump runtimes to the closest one minute and pump starts per hour. User-selectable normally open (NO) or normally closed (NC) logic. Selectable input type (with wire fault supervision, without wire fault supervision, or with strap on current sensor where greater than 5A indicates pump run.) LCD Touch screen for indication of open, closed, and wire fault conditions.
  - d. Model M850: Eight over-the-air configurable inputs to report real-time pump run status and run times User-selectable normally open (NO) or normally closed (NC) logic. Selectable input type (with wire fault supervision, without wire fault supervision, or with strap on current sensor where greater than 5A indicates pump run.) LCD Touch screen for indication of open, closed, and wire fault conditions.

F. Analog Inputs:

1. Two inputs measuring 4-20 mA or 0-5 VDC at 10 bit resolution. Transmit value every two minutes or more rapidly when value deviates from previous transmission by 5% or more of full scale.
2. Alarm Threshold: Four, user configurable alarm points for each input.
3. Input Option Board: Includes four (4) additional analog inputs and two (2) pulse inputs.

G. Pulse Inputs:

1. Input Option Board: Includes two (2) pulse counting inputs. Transmit data every two minutes when change in pulse data occurs.
2. Input Type: Open collector circuits or dry switch state changes of up 60 Hz and duration as low as 18 milliseconds.
3. Input Scaling: Based on unit of measurement.

H. Digital Outputs:

1. Number: Three, form C, dry contact relay outputs rated at 5 ampere at 12 or 24VDC.
2. Type: Single pole double throw (SPDT) for NO or NC.
3. Circuit Logic: Fail-safe.

I. Analog Outputs:

1. Output Option Board: Two capable of transmitting a 4-20 mA output signal.
2. Output Scaling: Accessible from web portal.
3. Output Value Changes: Performed by manual page from remote interface, or automatically via intertie to analog value from another RTU.

J. On-Board Telemetry Data: Report AC voltage, battery voltage, signal strength and printed circuit board temperature, hourly. Dispatch alarms for AC failure, low battery voltage, elevated and low temperature, and loss of communications.

K. Electronic Key: Provide electronic key reader, accessible without opening RTU enclosure to record personnel site visits to RTU. Sound audible tone confirming key reading.

1. Key Functions: Place RTU in service state for one hour; acknowledge alarms; and/or document site personnel's presence.
2. Service Status Light: Activates optional local light indicating RTU service state when connected to an unused digital relay output configured for that purpose.
3. Key Identity: Code keys uniquely identifiable to Owner assigned personnel.

2.3 Communications:

A. RTU Communication: Transmit data through cellular radios that communicate through third and fourth generation GSM and, or CDMA cellular networks.

1. Provide cellular radios with private IP addresses.
2. Communication Link Structure: TCP socket connection from RTU through cellular system to the Supplier's servers. Short Message Service (SMS), User Datagram Protocol (UDP), and satellite-based data transmission methods are not permitted.
  - a. Provide private gateways through respective cellular networks.
3. Data Encryption: Transmit data after application layer encryption and with carrier level encryption.

4. End-to-End Data Acknowledgment: Confirm every data packet from RTU to central server with central server acknowledgement back to RTU in real-time.
5. Communication Failure Alarms: Dispatch communication failure alarm.
  - a. Monitor and report secure socket connections for end-to-end uptime.
  - b. Report interruption durations 15 seconds and greater, and every disconnect/reconnect event.

B. Cellular Service:

1. Provide relationships with cellular providers.
2. Included in annual managed service fee.
3. Maintain cellular data contract with cellular carrier and interface with carrier when technical support is required.
4. Obtain approval from cellular provider, accepting cellular radios for use on respective cellular network in accordance with FCC requirements.

C. Data Transmission Rates

1. Off-normal conditions: Transmit data on occurrence to initiate alarm notifications. Ability to delay alarm notifications via the web portal user interface.
2. The data transmission rates shall be configurable over-the-air by Manufacturer.
3. Pump state transmitted in real-time. Transmit analog value every two minutes or more rapidly when value deviates from previous transmission by 5% or more of full scale. Pulse count transmitted every 2 minutes.
  - a. System monitored telemetry data transmitted every hour (signal strength, board temperature, AC and battery voltages).

2.4 Server Center and Server Infrastructure:

- A. Provide and maintain central server center that will house redundant and linked servers, interconnects, databases, power supplies, inbound cellular connections, and outbound internet hubs and providers.

B. Server Center Performance Requirements:

1. Survivability: Server center structure sufficient to maintain continuous operations following direct hit by F-3 tornado.
2. Redundancy: N+1 with at least six separate and redundant, on-site power generating facilities to back up local utility power for stand-alone operation of center for minimum 24 hours.
3. Security: Provide security guards at server center entrances at all times. Require at least two forms of identification, retina scan, and fingerprint validation to secure entry into facility.

C. Data:

1. Ownership: Data is Owner's property and will not be disclosed, unless authorized by Owner in writing.
  - a. Provide historical RTU data storage forever.
  - b. Manufacturer shall backup and archive databases daily.
2. Data Export and Data Links: Provide the following capabilities.
  - a. Interfacing to an Object Linking and Embedding for Process Control (OPC) compliant Human Machine Interface (HMI) for client/server SCADA systems.
  - b. Connection will be based OPC-UA 1.03 (October 2015) or greater
  - c. Security:
    1. User must be authenticated before a connection can be established
    2. Authentication must support X.509 certificates before connection is allowed
    3. All messages encrypted with 128 bit or better encryption
    4. All messages must be signed to ensure that they are received exactly as they are sent
    5. Owner's firewalls will not be required to accept incoming socket connections.
  6. Allow for multiple concurrent OPC connections to provide redundant HMI database operation at Owner's locations.
  7. Auditing and logging must be available for all user activities

- D. Security: Provide access to web portals via TLS cryptographic security protocol. SSL methods must be disabled. Web portal must receive an A rating from [Shttps://www.ssllabs.com/ssltest/](https://www.ssllabs.com/ssltest/)

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2.5 Alarm and Alert Notification System:

A. Alarms:

1. Provide alarm notifications for off-normal conditions and upon return-to-normal conditions.
  - a. Provide capability to transmit return to normal alarms to different notification group.

2. Alarm Notification: Via telephone (voice call), fax, pager (numeric or alphanumeric - short alpha or long alpha format), text message, email, or any combination, simultaneously.
3. Provide capability to allow alarm notification cycles with configurable delay between each cycle and with each cycle containing multiple notification destinations.
4. Provide capability to acknowledge alarms at time of initial alarm delivery or by a toll free return phone call, text message, two-way pager, email or via Owner's web portal.
5. Provide system capability to cease alarm notification when user acknowledges alarm event, with capability to re-initiate alarm notification when alarm input remains off-normal after user settable time.
6. Provide capability for specific users to be notified of individual alarm events.
7. Provide capability for alarm notifications to be configured based on time of alarm. Permit alarm notification groups to switch between groups at different hours of the day and different days of week.
  - a. Provide alarm notification groups that accommodate multiple teams within each group to easily facilitate rotation of teams of on-call personnel.

B. Alarm Message Formats

1. Alarm Notifications: Describe alarm condition, time, location, time of off normal condition. Provide pump status.
2. Provide capability for alarms to be delivered individually or grouped into one message so multiple, simultaneous alarms (like AC Fail at multiple sites) can be delivered and acknowledged in one phone call.
3. Deliver alarm with added introductory message asking for specific person, when calling a phone where the person answering is not known.

C. Voice Alarm Delivery Capacity:

1. Provide capacity to deliver minimum 20 outbound simultaneous voice phone lines.

D. Alarm Dispatch Logs: Document each alarm event with the following:

1. Event information:
  - a. Date.
  - b. Time.
  - c. Station name.
  - d. Alarm condition.

2. Notification information:

- a. Date.
- b. Time.
- c. Name of person notified.
- d. Notification method (phone, text message, email, fax etc.).
- e. Status of Notification: "Success", "Failure", or "Event Acknowledged".

1. For notification failure, log failure reason (i.e., line busy, call dropped, etc.).

3. Provide recording of each voice notification attempt, to document notification.

E. Alert Notification System:

1. Provide email and/or fax alerts for less critical items, such as low battery voltage and communication failure reminder.
2. Provide analyses for daily pump runtimes over 30 days, with an alert triggered if pump runtime falls outside 30-day high or low average runtime pattern.
3. Provide analyses of hourly pump runtimes and automatically compare runtimes to two user-set thresholds. Dispatch an alert next day when alert threshold is exceeded. Dispatch alarm immediately when alarm threshold is exceeded.
4. Provide analysis of hourly pump starts and automatically compare starts to two user-set thresholds. Dispatch an alert next day when alert threshold is exceeded. Dispatch alarm immediately when alarm threshold is exceeded.

2.6 Remote Data Access:

A. Remote Data Access Format:

1. Provide remote access to system collected data via web browser, through internet-enabled smart phone, tablet, laptop, or desktop computer.
  - a. UI must be optimized for viewing both on small screens and large monitors.
2. Provide secure access through specified phone that does not require web access (Voice SCADA). This will require user login credentials, with minimum of numeric five-digit login and associated phone number for that site to maintain site security.
3. Provide access to web portals via TLS cryptographic security protocol. SSL methods must be disabled. Web portal must receive an A rating from [Shttps://www.ssllabs.com/ssltest/](https://www.ssllabs.com/ssltest/).

4. Provide web portal display of graphs, reports, alarms, and RTU setup.
  - a. Optimize data to minimize page loading times.
  - b. Windows (reports, graphs) must update automatically when new data is available.
  - c. Utilize Responsive Design patterns where the Graphical User Interface (GUI) automatically adapts to the screen size.
5. System Access: Require user name and password credentials for access to web portal.
  - a. Provide three levels of access:
    1. Read only: Can view pages but cannot make changes.
    2. Administrator: Can view pages, can make system changes, and alter control functions.
    3. Super Admin: Can view pages, make system changes, alter control functions and add, modify or remove user credentials.

B. Data Presentation

- a. Map to display location of each unit and color coded status indication.
- b. Battery voltage, AC voltage, temperature, and radio status condition.
- c. Report end-to-end uptime history and daily connection percentage of each RTU.
- d. RTU electronic key reads with user names, time of read, and site name.
- e. Pump runtimes by hour and day with historical graphs and tables and individual pump flow estimates.
- f. Automatic daily analysis of pump runtimes for abnormalities with automatic notification of abnormalities.
- g. Pump starts with hourly analysis of excess pump starts with automatic notifications of excess pump starts.

C. Security Data:

1. Passwords and Access
  - a. Log accesses to User web portal. Include date, time, and duration of access; User Name and Password to access site, and IP address of accessing computer.
    1. Provide accessibility to log through User web portal.
    2. Store passwords in encrypted/blind format. There are no default passwords.
2. Tank and Well Control package requires password for system changes.

## 2.7 Real Time Remote Control:

- A. Tank and Well. Automatic control logic for well operation shall be maintained by the hosted SCADA service. The hosted service shall monitor, at least every two minutes the level of the tank(s). The central server center shall issue control relay commands to the associated well(s) when pre-programmed low, off, lead, lag, lag 2, lag 3, lag 4 and high tank level thresholds are reached. The thresholds shall be programmable by the customer via the secure web portal. All threshold changes shall be password protected and logged. The secure web portal shall also provide the customer the ability to put each well pump(s) in automatic, off or hand operation mode. The secure web site shall provide the customer the ability to enable/disable alternation of the well(s). The central server center shall provide control for three with an option of up to five wells from a single tank. Multiple tanks may be depicted and controlled on a single customer web portal.
1. The Tank and Well remote control system shall utilize M800 or M850 RTUs and a pressure transducer (15, 25, 50 or 100 PSI) as close to the base of the tank(s) as possible. The pressure transducer shall have a voltage surge suppressor. The surge suppressor and transducer shall be grounded in accordance with local and NEC regulations. The grounding rod shall be within five feet of the surge suppressor.
  2. Display the current state of the virtual H/O/A operational status and the current target setting for well pump(s) off, lead, lag and lag 2 thresholds, the current status of well pump alternation, the current status of well(s) call to run and a graphic depicting the current and previous 24-hour tanks level and which well pump(s) were called during fill cycles.
  3. Positive relay feedback in conjunction with a digital input shall transmit an alarm callout if:
    - a. Call to run, fail to run: Pump called to run and the relay closes, but the pump does not run.
    - b. Call to stop, fail to stop: Pump called to stop and the relay opens, but the pump does not stop.
    - c. Pump started prematurely: Pump started before the relay closed.
    - d. Pump stopped prematurely: Pump stopped before the relay opened.
- B. Analog Output
1. Mirror analog signal on same or another real-time unit based on analog input value.
- C. Analog Intertie
1. Open or close digital output relay on same or another M800 or M850 based on analog input value. (Also known as Tank and Remote Well Control.)

D. Digital Intertie

1. Open or close digital output relay on same or another M800 or M850 based on digital input closure from any Mission RTU.

**PART 3 – EXECUTION**

3.1 Installation

- A. Provide a new remote terminal unit in accordance with Manufacturer and Supplier's recommendations.
1. Delineate timing of RTU installation and commissioning.
  2. Conform to National Electric Code and local codes.
  3. Label inputs as to their purpose on enclosure lid schematic.
  4. Terminations inside RTU enclosure: Low voltage.
  5. Provide Manufacturer's Representative inspection of sites prior to completion.
  6. Test inputs for successful transmission prior to municipality acceptance.
  7. Adjust antenna placement or elevation to obtain consistent, stable system operation.
- B. Provide programming as required to accomplish the control logic described in Section 13000 "Mode of Operation".

3.2 Demonstration and Training

- A. Startup Training: After the system modifications and additions are complete, provide three (3) trips with a minimum of three (3) hours per trip for three (3) on-site trainings for the Owner's personnel, as follows:
- Demonstrate proper methods for operating and maintaining equipment, and explain contents of operation and maintenance manual to Owner's personnel.
- B. Ongoing Training: Provide ongoing training at no charge throughout initial year of service, in form of weekly webinars, online videos, white papers, and other documents.
1. A training library shall be available on the Supplier's website.
  2. Provide additional, on-site training as a cost of \$750 per day, plus reasonable traveling expenses.

3.3 Field Quality Control

- A. Manufacturer's Representative approval that installed equipment operates satisfactorily and in compliance with the requirements of this Section.

### 3.4 Service Agreement

- A. Beginning at Substantial Completion, provide continuous, renewable annual service agreement including:
1. Data Services: Cellular data connections, servers and infrastructure that acts on and stores Owner's data, and administration of same. No separate overage charges or early termination fees shall apply.
  2. Notifications: Provide real-time alarm notifications and alarm notification recording.
  3. Provide record of success or failure of each event including audio recording of voice alarm callouts.
  4. Web Portal: Web portals optimized for personal computers and mobile devices.
  5. Technical support: Provide live telephone technical support from 8 AM to 6 PM eastern time. Provide emergency technical support at all times at no additional charge.

### 3.5 Monitoring Point Schedule

- A. Provide new RTU as follows:
1. Digital inputs:
    - a. DI-1: Pump Station on generator power (future)
    - b. DI-2: Generator running (future)
    - c. DI-3: Well #5 running
    - d. DI-4:
    - e. DI-5:
    - f. DI-6:
    - g. DI-7:
    - h. DI-8:
  2. Relay outputs:
    - a. R-1: Start Well No. 5
    - b. R-2:
    - c. R-3:

## **PART 4 - MEASUREMENT AND PAYMENT**

4.1 Method of Measurement and Payment: This work will not be measured for payment. The cost of this work shall be included in other items to which it is subsidiary.

**\*\*\* END OF SECTION \*\*\***

**DIVISION 31**

EARTHWORK

## EARTHWORK

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Protection, modification and/or installation of utilities as sitework progresses paying particular attention to grade changes and any necessary staging of work.
- B. Cutting, filling and grading to required lines, dimensions, contours and proposed elevations for proposed improvements.
- C. Scarifying, compaction, drying and removal of unsuitable material to ensure proper preparation of areas for fills or proposed improvements.

#### 1.02 RELATED SECTIONS

- A. Section 02 41 00 - Demolition
- B. Section 31 11 00 - Site Preparation
- C. Section 31 23 16 - Excavation, Backfill and Compaction for Pavement
- D. Section 31 23 33 - Excavation, Backfill and Compaction for Utilities
- E. Section 32 11 23 - Aggregate Materials
- F. Construction Drawings

#### 1.03 REFERENCE STANDARDS

- A. American Society for Testing and Materials (ASTM) latest edition.
  - D 422 Method for Particle Size Analysis of Soils
  - D 698 Test for Moisture-Density Relations of Soils Using 5.5 lb. (2.5 kg) Rammer and 12-inch (304.8 mm) Drop (Standard Proctor)
  - D 1556 Test for Density of soil in Place by the Sand Cone Method
  - D 1557 Test for Moisture-Density Relations of Soils Using 10-lb (4.5 Kg) Rammer and 18-inch (457 mm) Drop (Modified Proctor)
  - D 1559 Test Method for Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus
  - D 2167 Test for Density of Soil in Place by the Rubber Balloon Method
  - D 2216 Laboratory Determination of Moisture content of Soil
  - D 2487 Classification of Soils for Engineering Purposes
  - D 2922 Tests for Density of Soil and Soil- Aggregate in Place by Nuclear Methods (Shallow Depth)

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- D 3017 Test for Moisture Content of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
- D 4318 Test for Plastic Limit, Liquid Limit, and Plasticity Index of Soils
- C 25 Chemical Analysis of Limestone, Quicklime and Hydrate Lime
- C 110 Physical Testing for Quicklime and Hydrated Lime, Wet Sieve Method
- C 618 Specification for Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete
- C 977 Quicklime and Hydrated Lime for Soil Stabilization

- B. American Association of State Highway and Transportation Officials (AASHTO) latest edition
  - T 88 Mechanical Analysis of Soils

1.04 QUALITY ASSURANCE

- A. Independent Testing Laboratory selected and paid by owner, shall be retained to perform construction testing on site. Frequency of tests will be as follows:
  - 1. In cut areas: Not less than one compaction test for every 5,000 square feet.
  - 2. In fill areas: Same rate of testing for each 8" lift (measured loose).
- B. If compaction requirements are not complied with at any time during construction process, remove and recompact deficient areas until proper compaction is obtained at no additional expense to owner.
- C. The following tests shall be performed on each type of on-site or imported soil material used as compacted fill as part of construction testing requirements.
  - 1. Moisture and Density Relationship: ASTM D 698 or ASTM D1557.
  - 2. Mechanical Analysis: AASHTO T-88
  - 3. Plasticity Index: ASTM D 4318
- D. Field density tests for in-place materials shall be performed according to one of the following standards as part of construction testing requirements.
  - 1. Sand-Cone Method: ASTM D 1556
  - 2. Balloon Method: ASTM D 2167
  - 3. Nuclear Method: ASTM D 2922 (Method B-Direct Transmission)
- E. Independent Testing Laboratory shall prepare test reports that indicate test location, elevation data, and test results. Owner, architect, and contractor shall be provided with copies of reports within 96 hours of time test was performed. In event that any test performed fails to meet these Specifications, owner and contractor shall be notified immediately by independent testing laboratory.

- F. All costs related to retesting due to failures shall be paid for by the contractor at no additional expense to owner. Owner reserves the right to employ an Independent Testing Laboratory and to direct any testing that is deemed necessary. Contractor shall provide free access to site for testing activities.

#### 1.05 SUBMITTALS

- A. Submit a sample of each type of off-site fill materials that is to be used at the site in an air tight, 10 lb container for the testing laboratory.
- B. Submit the name of each material supplier and specific type and source of each material. Any change in source throughout the job requires approval of the owner or engineer.
- C. For use of fabrics or geogrids, a sample and "cut sheet" shall be submitted for approval by the Owner.

### **PART 2 PRODUCTS**

#### 2.01 MATERIALS

- A. Excavated and re-used material for subsoil fill as specified herein (outside limits of pavement only).
- B. Aggregate fill as specified in Section 32 11 23.
- C. Imported select material - sandy clay having a PI of 4 to 15, a maximum LL of 35, and less than 60% passing #200 sieve.
- D. Acceptable stabilization fabrics and Geogrids:
  - 1. Mirafi 500X or 600X
  - 2. Phillips 66 Supac 6WS
  - 3. Dupont Typar 3401 and 3601

### **PART 3 EXECUTION**

#### 3.01 PREPARATION

- A. Identify required lines, levels, contours and datum.
- B. Locate and identify existing utilities that are to remain and protect them from damage.

- C. Notify utility companies to remove and/or relocate any utilities that are in conflict with the proposed improvements.
- D. Protect plant life, lawns, fences, existing structures, sidewalks, paving and curbs from excavating equipment and vehicular traffic.
- E. Protect benchmarks, property corners and all other survey monuments from damage or displacement. If a marker needs to be removed it shall be referenced by a licensed land surveyor and replaced, as necessary, by the same.
- F. Remove from site material encountered in grading operations that, in opinion of owner, is unsuitable or undesirable for backfilling, subgrade or foundation purposes. Dispose of in a manner satisfactory to owner. Backfill areas with layers of suitable material and compact as specified.
- G. Prior to placing fill in low areas, such as previously existing ditches, perform following procedures:
  - 1. Drain water out by gravity with ditch having flow line lower than lowest elevation in low area. If drainage cannot be performed by gravity ditch, use adequate pump to obtain same results.
  - 2. After drainage of low area is complete, remove mulch, mud, debris, and other unsuitable material by using acceptable equipment and methods that will keep natural soils underlying low areas dry and undisturbed.
  - 3. If material is found to be unsuitable, all unsuitable material shall be removed from site.

### 3.02 EXCAVATION FOR FILLING AND GRADING

- A. Classification of Excavation: Contractor by submitting bid acknowledges that he has investigated the site to determine type, quantity, quality, and character of excavation work to be performed. Excavation shall be considered unclassified common excavation.
- B. Perform excavation using capable, well maintained equipment and methods acceptable to owner and governing agencies.
- C. When performing grading operations during periods of wet weather, provide adequate drainage and ground water management to control moisture of soils.
- D. Shore, brace, and drain excavations as necessary to maintain safe, secure, and free of water at all times.
- E. Excavated material is unacceptable as fill within the paving area.

3.03 FILLING AND SUBGRADE PREPARATION

- A. Fill areas to contours and elevations shown with unfrozen materials.
- B. Place fill in continuous lifts specified herein.
- C. Refer to Section 31 23 16 for filling requirements for pavements.
- D. Areas exposed by excavation or stripping and on which subgrade preparations are to be performed shall be proofrolled to detect any areas of yielding material. Proofrolling shall be accomplished by making a pass with a fully-loaded tandem-axle dump truck, or approved equivalent. Areas of failure shall be excavated and re-compacted as stated above. Care shall be taken to not overload soils; pumping of soft material shall be avoided.
- E. Place geofabric directly on smooth graded native subgrade prior to placement of any fill. Install in accordance with manufacturer's instructions.
- F. Fill materials used in preparation of subgrade shall be placed in lifts or layers not to exceed 8" loose measure and compacted to a minimum density of 95% of optimum density, in accordance with ASTM D 1557, at a moisture content of not less than 1% below and not more than 3% above the optimum moisture content.
- G. Material imported from off-site shall be capable of producing a CBR (California Bearing Ratio) value equal to or above the pavement design subgrade CBR value of 6 as indicated on the Drawings.

3.04 MAINTENANCE OF SUBGRADE

- A. Finished subgrades and subbase shall be verified to ensure proper elevation and conditions for construction above subgrade.
- B. Protect subgrade and subbase from excessive wheel loading during construction, including concrete trucks and dump trucks.
- C. Remove areas of finished subgrade or subbase found to have insufficient compaction density to depth necessary and replace in a manner that will comply with compaction requirements by use of select material. Surface of subgrade or subbase after compaction shall be hard, uniform, smooth, stable, and true to grade and cross-section.
- D. After all filling and grading operations are complete, and prior to cutting of cement into base material, all areas of roadway will be proofrolled in the presence of the Engineer's designated representative in accordance with their policy. Weight ticket for the tandem dump truck used shall indicate on 18 ton are load for this operation.

3.05 FINISH GRADING

- A. Grade all areas where finish grade elevations or contours are indicated on Drawings, other than paved areas and buildings, including excavated areas, filled and transition areas, and landscaped areas. Graded areas shall be uniform and smooth, free from rock, debris, or irregular surface changes. Finished subgrade surface shall not be more than 0.10 feet above or below established finished subgrade elevation, and all ground surfaces shall vary uniformly between indicated elevations. Finish ditches shall be graded to allow for proper drainage without ponding and in a manner that will minimize erosion potential.
  
- B. Correct all settlement and eroded areas within one year after date of completion at no additional expense to owner. Bring grades to proper elevation. Replant or replace any grass, shrubs, bushes, or other vegetation that appears dead, dying or disturbed by construction activities. Refer to Section 31 35 00 for slope protection and erosion control.

## SITE CLEARING

### **PART 1 GENERAL**

#### **1.1 DESCRIPTION**

This Section covers all clearing, grubbing and stripping work required for the construction of the project.

#### **1.2 CLEARING AND GRUBBING**

(A) The CONTRACTOR shall clear and grub areas as designated on the Drawings or required by the ENGINEER dependent upon existing field conditions in order to install the noted underground facilities. The location of the clearing and grubbing associated with the installation of aboveground facilities shall be designated on the Drawings or otherwise specified.

(B) Care shall be taken to leave nothing of material size or accumulated mass which thereafter may float or obstruct any pipe or waterway.

(C) The CONTRACTOR shall not cut or injure any trees or other vegetation outside the limits of the areas on which work is to be done without permission and he shall guard against like action by his employees.

#### **1.3 STRIPPING**

The CONTRACTOR shall strip areas which are designated by the ENGINEER for the proposed location of any aboveground facility. The limits of the stripping shall be within the area so designated.

#### **1.4 RIGHT TO WOOD AND LOGS**

The respective owners of the land over which an easement passes shall have the right to cut and remove logs and other wood of value in advance of the CONTRACTOR'S operations. All remaining logs and other wood removed in the course of clearing shall become the property of the CONTRACTOR.

### **PART 2 PRODUCTS**

#### **2.1 EQUIPMENT**

(A) Equipment used for clearing and grubbing shall be at the CONTRACTOR'S option.

(B) Blasting will not be permitted.

### **PART 3 EXECUTION**

#### **3.1 CLEARING**

(A) The CONTRACTOR shall cut or otherwise remove all trees, saplings, brush and vines, (except those trees and other vegetation marked for retention by the OWNER); windfalls, logs and trees lying on the ground; dead trees and stubs more than one foot high above the ground surface, but not their stumps; trees which have been partially uprooted by natural or other causes, including their stumps; and other matter such as snags, leaves, sawdust, bark and refuse.

(B) Except where clearing is done by uprooting with machinery or where stumps are left longer to facilitate subsequent grubbing operations, trees, stumps, and stubs to be cleared shall be cut as close to the ground surface as practicable, with no more than six (6") inches remaining above the ground surface in the case of small trees, and twelve (12") inches in the case of large trees. Saplings, brush, and vines shall be cut off close to the ground.

#### **3.2 GRUBBING**

The CONTRACTOR shall remove all stumps within the servitude or designated project area completely, remove all roots larger than three (3") inches in diameter to a depth of 18 inches, and remove all roots larger than 1/2 inch in diameter to a depth of six (6") inches. Such depths shall be measured from the existing ground surface or the proposed finished grade, whichever is lower.

#### **3.3 STRIPPING**

Topsoil shall be removed to its full depth where it occurs in areas to be filled or excavated and shall be stockpiled for use in finish grading. All precautions shall be taken to avoid contamination of topsoil by other excavated material and to prevent washing of topsoil by other excavated material and to prevent washing of topsoil into excavations, drainage or watercourses.

3.4 DEPRESSIONS

Except in areas to be excavated, depressions caused by grubbing operations shall be filled with suitable material which shall be compacted to conform to the surrounding ground.

3.5 DISPOSAL

(A) All material collected in the course of the clearing and grubbing that will not remain shall become the property of the CONTRACTOR and shall be disposed of in a manner satisfactory to the OWNER. Such disposal shall be carried on after removal of the materials in the clearing and grubbing operations and shall not be left until the final clean up period.

(B) Burning shall not be done except at locations and in conformity with the regulations and requirements of the governing air pollution control and fire authorities. The CONTRACTOR shall make all necessary arrangements and pay for all necessary permits. The CONTRACTOR shall take all precautions necessary to prevent the spread of fire outside the immediate areas where burning is being done.

(C) Prior to depositing surplus material at any off-site location, the CONTRACTOR shall obtain a written agreement between himself and the owner of the property on which the disposal is proposed giving permission for the CONTRACTOR to enter and deposit the material at no expense to the project OWNER. A copy of the agreement shall be furnished to the OWNER.

**PART 4 BASIS OF PAYMENT**

4.1 SITE CLEARING

Clearing, grubbing and stripping of topsoil within the identified boundaries shall be paid per acre, square foot, or shall be included within the lump sum "Site Work" pay item.

## **EROSION AND SEDIMENTATION CONTROLS**

### **PART 1 GENERAL**

#### **1.1 DESCRIPTION**

Furnish and place erosion control systems in accordance with plan requirements for use as soil retention blankets on slopes or as flexible channel liners in ditches.

### **PART 2 MATERIALS**

#### **2.1 GENERAL**

Erosion control systems shall comply with 1018.15. The manufacturer's installation plan and hardware (staples, stakes, etc.) are considered part of the system and shall be the same as that used during the evaluation for source approval.

Use the type of erosion control system shown on the plans. A higher grade system may be substituted for a lower grade system within the same application (slope protection or flexible channel liners), if there is no additional cost to the Department.

#### **2.2 ACCEPTANCE**

Pretested lots of erosion control systems will be accepted based on a Certificate of Delivery showing DOTD Lot Numbers and laboratory numbers representing the pretested material, including hardware. Sample erosion control systems that are not accompanied by a Certificate of Delivery in accordance with DOTD S613. Sample installation hardware, additives such as tackifiers, and any other component of the system not covered above at the rate of one item per type per size or one quart per manufacturer's lot in accordance with DOTD S601. Submit all samples to the Materials and Testing Section. Furnish a copy of the approved installation plan with each shipment to the project.

#### **2.3 PACKAGING**

Package materials so as to maintain the quality of the product throughout handling. Identify each package with the manufacturer's name, product name, manufacturer's lot number, by the DOTD Lot Number corresponding to that shown on the Certificate of Delivery.

### **PART 3 EQUIPMENT**

Furnish and maintain equipment necessary to satisfactorily perform the work. Equipment for hydraulically applying fiber mulch shall be equipped to eject the thoroughly wet mulch material at a uniform rate equal to the manufacturer's recommendations or as designated by the plans to provide the mulch coverage specified.

#### **PART 4 CONSTRUCTION REQUIREMENTS**

Install erosion control systems in accordance with the approved installation plan, no later than 48 hours after completion of seeding or sodding operations. Install all staples flush to the ground, penetrating all layers of overlapped or adjacent rows.

##### **4.1 SLOPE PROTECTION**

Construct slopes to the required grade, fertilize, and seed prior to application of erosion control systems. At the time of coverage, the area to be covered shall be free of ruts, clods, stones, roots, or other foreign matter that will prevent close contact of the blanket with the soil. Place rolled products or mats with netting only on one side with the netting exposed and the fibers in contact with the soil.

##### **4.2 Flexible Channel Liners**

Prepare channel slopes in accordance with 720.04.1. Place flexible channel liners beginning at the downstream end and proceeding in an upstream direction.

#### **PART 4 MAINTENANCE**

Maintain the areas on which erosion control systems have been placed until final acceptance of the project. This shall consist of the repair of damage by erosion, wind, fire or other cause. Repair such areas to reestablish the condition that existed prior to placing the erosion control systems at no direct pay. Repair may include fertilizing, seeding, mulching, or sodding as required.

**GEOTEXTILE FABRIC AND GEOCOMPOSITE SYSTEMS**

**PART 1 DESCRIPTION**

GEOTEXTILE FABRIC

1.1 General Requirements

The geotextile fabric shall be composed of at least 85 percent by weight of polyolefins, polyesters, or polyamides. The geotextile fabric shall be resistant to chemical attack, rot and mildew and shall have no tears or defects which adversely alter its physical properties. When required, the geotextile fabric shall contain stabilizers and/or inhibitors added to the base material to make filaments resistant to deterioration due to ultraviolet and heat exposure. Edges of geotextile fabric shall be finished to prevent the outer yarn from pulling away from the fabric. Fibers of other composition may be woven into the geotextile fabric for reinforcing purposes. Durability of these fibers shall be equivalent to that of the geotextile fabric.

Geotextile fabric rolls shall be furnished with an opaque, waterproof wrapping for protection against moisture and extended ultraviolet exposure prior to placement. Each roll shall be labeled or tagged with the manufacturer's name, date of manufacture, batch number, and name of product.

Unless otherwise specified on the plans or in the project specifications, the geotextile fabric shall be from the Approved Materials List.

1.2 Detailed Requirements

The geotextile fabric shall comply with the requirements in Table 31 35 19.16-1 and utilized as follows unless otherwise specified:

<u>USE</u>	<u>CLASSES</u>
1. Drainage:	
Underdrains	A, B, C or D
Pipe and Precast Manhole Joints	A, B, C or D
Weep Holes	A, B, C or D
Bedding Fabric	B, C, or D
Approach Slabs	B, C, or D
Fabric for Geocomposite Drainage Systems <sup>1</sup>	B, C, or D
2. Stabilization:	
Bulkheads	C or D
Flexible Revetments	C or D
Rip Rap	D

Section 31 35 19.16 – Geotextile Fabric and Geocomposite Systems

- Railroad Crossings D
- Base Course D
- Subgrade Layer D
- Soil Stabilization C, D, or S
- 3. Paving Fabric<sup>2</sup>: B or C (modified)
- 4. Silt Fencing:
  - Wire Supported F
  - Self-Supported G

<sup>1</sup>Refer to 31 35 19.16.02 for additional requirements.

<sup>2</sup>Refer to 31 35 19.16.03 for additional requirements.

**Table 31 35 19.16- 1 Geotextile Fabrics**

Property	Test Method	Requirements Classes						
		A	B	C	D	S	F	G
AOS, Metric Sieve, $\mu\text{m}$ , Max.	ASTM D4751	300	300	300	212	600	850	850
Grab Tensile, N, Min.	ASTM D4632	330	400	580	800	800	400	400
% Elongation @ Failure, Min.	ASTM D4632	—	—	50	50	—	—	—
% Elongation @ 200 N, Max.	ASTM D4632	—	—	—	—	—	—	50
Burst Strength, N, Min.	ASTM D3787	440	620	930	1290	1390	—	—
Puncture, N, Min.	ASTM D4833	110	130	180	330	330	—	—
Trapezoid Tear Strength, N, Min.	ASTM D4533	110	130	180	220	220	—	—
Permittivity, $\text{Sec.}^{-1}$ , Min.	ASTM D4491	1.0	1.0	1.0	1.0	0.2	0.01	0.01
Grab Tensile Strength Retained after weathering 150 h, UVA lamps, %, Min	ASTM D4632 ASTM G154	70	70	70	70	70	—	—
Grab Tensile Strength Retained after weathering 500 h, UVA lamps, %, Min	ASTM D4632 ASTM G154	—	—	—	—	—	70	70

**PART 2 MATERIALS**

**GEOCOMPOSITE DRAINAGE SYSTEMS**

2.1 The geocomposite fabric drain shall consist of a nonwoven geotextile fabric and a core as specified below with the geotextile completely enveloping the core. Fittings shall be as recommended by the manufacturer. The geotextile fabric shall be sufficiently secured to the core to prevent separation of the geotextile fabric and intrusion of the backfill material during installation. The geocomposite drainage system shall be from the Approved Materials List.

2.2 Geotextile Fabric

The fabric shall meet the requirements for Class B, C, or D geotextile fabric of 31 35 19.16.1 with the following modifications:

<u>Property</u>	<u>Test Method</u>	<u>Requirements</u>
Elongation, %, Min.	ASTM D4632	20
Sewn Seam Strength (Fabric to Fabric), kN/m width, Min.	ASTM D4437	2600

2.3 Cores for Wall Drains (Single Sided)

The core shall be a flexible, solid-backed, rectangular design made of a polyolefin material not sensitive to moisture. The geocomposite design shall allow drainage of water from one side only. The core shall consist of supports having a minimum height of 5/16 inch upon which the fabric shall be securely fastened. The cross section open area of the core which will allow the passage of water shall be a minimum of 40 percent.

The core shall meet the following requirements:

<u>Property</u>	<u>Test Method</u>	<u>Requirements</u>
Compressive Strength, kPa @ 20%		
Max. Deflection, Min.	ASTM D1621	380

2.4 PAVING FABRIC

In addition to the specifications for Class B or C geotextile fabric of 31 35 19.16.1, the paving fabric shall also comply with the following requirements:

Section 31 35 19.16 – Geotextile Fabric and Geocomposite Systems

<u>Property</u>	<u>Test Method</u>	<u>Requirements</u>
Asphalt Retention, L/sq m	AASHTO M 288	0.9
Change in Area at 135°C, %, Max.	AASHTO M 288	15.0

## RIP RAP

### PART 1 DESCRIPTION

Furnish and place rip rap in accordance with these specifications and in conformity to lines, grades, and thickness shown on the plans or as directed.

### PART 2 MATERIALS

Furnish stone or recycled concrete rip rap from an approved source. Stone rip rap shall be listed in the Approved Materials List. Stone rip rap shall not disintegrate upon exposure to the elements or be easily broken from handling, and shall be reasonably free from earth and other foreign materials. When tested in accordance with AASHTO T 85, the solid weight of stone shall be at least 155 pounds per cubic foot (based on bulk specific gravity). The least dimension of any individual stone shall be at least one-third its maximum dimension. Each shipment of stone shall be reasonably well graded within the specified limits.

Recycled concrete may be used as rip rap unless otherwise indicated in 31 37 00-2.01, provided its solid weight is at least 140 pounds per cubic foot (based on bulk specific gravity) and free of protruding reinforcement.

Stockpiles of recycled concrete shall be source approved prior to use and kept separate from other materials. Stockpiles shall be uniform and free of soil, debris, excessive amounts of asphalt materials, and foreign matter. Once a stockpile has been approved as an acceptable source of material, do not add material without further approval.

Visually inspect rip rap at the source, project site, or both to control gradation.

Any difference of opinion between the engineer and contractor will be resolved by checking the gradation of two random truckloads (or equivalent size samples). Furnish equipment, labor, and a sorting site at no direct pay.

#### 2.01 Rip rap

Rip rap shall be reasonably well graded and in compliance with Table 31 37 00-1.

Section 31 37 00 – Rip Rap

**Table 31 37 00 - 1**  
**Rip rap**

Rip rap Class <sup>1</sup>	Stone Size, lb	Spherical Diameter, foot <sup>2</sup>	Percent of Stone Smaller Than
2 lb	10	0.51	100
	4	0.38	40-100
	2	0.30	15-50
	0.75	0.22	0-15
10 lb	50	0.88	100
	20	0.65	50-100
	10	0.51	15-50
	5	0.41	0-15
30 lb	140	1.24	100
	60	0.94	42-100
	30	0.74	15-50
	10	0.51	0-15
55 lb <sup>3</sup>	275	1.50	100
	110	1.11	42-100
	55	0.88	15-50
	20	0.63	0-15
130 lb <sup>3</sup>	650	2.00	100
	260	1.46	45-100
	130	1.17	15-50
	40	0.79	0-15
250 lb <sup>3</sup>	1250	2.50	100
	500	1.83	45-100
	250	1.46	15-50
	80	1.00	0-15
440 lb <sup>3</sup>	2200	3.00	100
	900	2.23	40-100
	440	1.76	14-50
	130	1.17	0-15
1000 lb <sup>3</sup>	5000	4.00	100
	2000	2.91	45-100
	1000	2.31	10-50
	300	1.55	0-15

<sup>1</sup> The stone size used to define the Rip rap Class is the minimum median stone size for the stone class. The minimum thickness of a rip rap layer shall be no less than the spherical diameter of the maximum stone size in the Rip rap Class.

<sup>2</sup> Spherical diameters of rip rap classes up to 30 lb are based on a solid stone weight of 140 lb/cu ft. Spherical diameters of rip rap classes above 30 lb are based on a solid stone weight of 155 lb/cu ft.

<sup>3</sup> Recycled portland cement concrete shall not be used in these rip rap classes.

## 2.02 Geotextile Fabric

Geotextile Fabric shall comply with 31 35 19.16.

## **PART 3 CONSTRUCTION REQUIREMENTS**

### 3.01 Rip rap

Grade slopes or areas on which rip rap is to be placed to the required section. Place rip rap on the prepared slope or area in a manner which will produce a reasonably well-graded mass of stone with a minimum practicable percentage of voids. Place the entire mass of stone in conformance with the lines, grades, and thickness in one operation without displacing underlying material. Placing of rip rap in layers, or dumping into chutes, or by similar methods likely to cause segregation will not be permitted.

When placement in water currents is required, make drift checks and place rip rap in such manner as to compensate for drift. Furnish necessary facilities, equipment, and personnel for checking rip rap depth and distribution.

### 3.02 Filter Stone

When specified, place filter stone on the prepared slope or area before placement of rip rap. When filter stone is placed underwater, free dumping will not be permitted. Use controlled methods for underwater placement using bottom dump buckets or wire rope baskets lowered through the water to the point of placement. If placement in strong water currents is required, place rip rap promptly after placement of filter stone. Unless shown otherwise on the plans or directed, filter stone shall be Rip rap Class 10 lb or less.

### 3.03 Geotextile Fabric

When specified, place geotextile fabric on the prepared slope or area before placement of rip rap. Take care not to damage the geotextile fabric when placing rip rap. Do not place rip rap by rolling rip rap down slope, or dropping rip rap from extreme heights, or by similar methods likely to damage geotextile fabric. Repair damaged geotextile fabric or replace as directed.

**PART 4 MEASUREMENT**

Rip rap and filter stone may be measured on a square yard, cubic yard, or weight basis as specified.

When measured on a square yard basis, the quantity measured will be that actually placed to the limiting dimensions shown on the plans or as directed by the engineer. When measured on a cubic yard basis, measurement will be made in vehicles at the point of delivery on the project.

When measured on a weight basis, the pay unit will be per ton (2000 pounds). When rip rap is delivered by vehicles or railroad cars, measurement will be based on certified weight tickets furnished by the contractor. When rip rap is delivered by barge, measurement will be made by calculation from barge displacement, based on water weighing 62.4 pounds per cubic foot.

Geotextile fabric will be measured by the square yard of covered area in place. No measurement will be made for excavation or backfilling.

# **DIVISION 32**

## **EXTERIOR IMPROVEMENTS**

## CRUSHED STONE SURFACING

### **PART 1 GENERAL**

#### 1.1 DESCRIPTION

This Section covers the furnishing and installing of crushed stone surfacing over geotextile fabric in accordance with these Specifications and in conformity with the lines, grades and thicknesses shown on the Drawings or established by the ENGINEER.

#### 1.2 REFERENCED STANDARD

Work shall conform to the following Sections of the State of Louisiana, Department of Transportation and Development, "Louisiana Standard Specifications for Roads and Bridges," 2006 Edition, except as may be modified herein:

- Section 203 - Excavation and Embankment
- Section 401 - Aggregate Surface Course
- Section 1003 - Aggregates
- Section 1019 - Geotextile Fabric and Geocomposite Systems

All references made therein to measurement and payment are deleted.

#### 1.3 SUBMITTALS

Submit product data in accordance with the Special Conditions.

### **PART 2 PRODUCTS**

#### 2.1 CRUSHED STONE

All materials for crushed stone surfacing shall be "Stone" conforming to Section 1003.04(a) of the Referenced DOTD Standard.

#### 2.2 GEOTEXTILE FABRIC

Geotextile fabric shall meet the requirements for Class D geotextile fabric of Subsection 1019 of the Referenced DOTD standard.

**PART 3 EXECUTION**

**3.1 GENERAL**

All work related to this section shall conform to applicable provisions of the referenced specification. Construct all crushed stone surfacing to the lines, depth and grades as shown on the Drawings.

**3.2 SUBGRADE PREPARATION**

Subgrade preparation shall be in accordance with Section 22 03 00 - Excavation and Embankment. The subgrade shall be proof rolled with a sheepsfoot roller. The surface course shall be installed on a neat, smooth subgrade free of vegetation, mud and other objectionable material as identified by the ENGINEER.

**3.3 GEOTEXTILE FABRIC**

Geotextile fabric shall be installed beneath the crushed stone surface in accordance with Section 203.11 of the referenced DOTD standard.

**3.4 CONSTRUCTION OF CRUSHED STONE SURFACING**

The crushed stone surface shall be placed, shaped and compacted in accordance with Section 401 of the Referenced DOTD Standard which requires the use of a pneumatic tire or steel wheel roller. The surface shall be tight and smooth. The crushed stone surface shall be installed to a compacted thickness as specified within the Plans.

**PART 4 BASIS OF PAYMENT**

**4.1 CRUSHED STONE SURFACING**

The CONTRACTOR shall be compensated for material, labor to install and associated items through a per cubic yard, per square yard or lump sum "Crushed Stone Surfacing" bid item. Required construction under this specification may be included under a lump sum "Site Work" bid item.

## FENCES AND GATES

### PART 1 GENERAL

#### 1.01 DESCRIPTION

This item shall consist of chain link fence together with line posts, gates, and other appurtenances necessary to construct the fences in accordance with these specifications in conformity with the lines and grades shown on the plans.

#### 1.02 LAYOUT OF WORK

Layout of work will be performed by the Contractor as specified in these specifications and drawings. Modifications shall require Engineer's prior approval.

### PART 2 MATERIALS

#### 2.01 GENERAL

The fence shall be the product of a domestic manufacturer who has demonstrated by actual installations that its product is of the type required. The contractor shall include all supplementary parts necessary or required for a complete and satisfactory installation.

All runs of the fence shall present the same general appearance and the product of one manufacturer only will be accepted, except for items which do not influence the appearance of the completed fence. No used, re-rolled, or open-seam steel shall be permitted in posts, gate frames, rails, or braces.

#### 2.02 FABRIC

Unless otherwise specified, chain link fence may be fabricated of either one of the following at the option of the contractor:

1. Zinc coated steel (Class I of ASTM A392: 1.2 oz./sq. ft.)
2. Aluminum coated steel (ASTM A491);
3. Aluminum alloy (Type III LA. D.O.T.D. 1010.08)

The fabric shall be of the gauge shown on the plans or in the Special Provisions of the specifications.

#### 2.03 ZINC-COATED BARBED WIRE

Zinc-coated barbed wire shall be 2-strand twisted No. 12-1/2 ASW gauge galvanized steel wire with 4-point barbs of No. 14 ASW gauge galvanized steel wire. All wire shall

conform to Class 3 of ASTM A121. The barbs shall be spaced approximately 4 inches apart.

2.04 FENCE POSTS, RAILS, AND BRACES

- (a) GENERAL: All fence posts, rails, and braces shall be zinc-coated steel and shall be galvanized in accordance with ASTM Designation A-120.
- (b) FENCE POSTS: Posts shall be 2-3/8" O.D. standard weight pipe, 3.65 pounds per lineal foot or 2-1/4" x 2" "H" sections, 4.10 pounds per lineal foot. Corner and end bracing posts shall be 2-7/8" O.D. standard weight pipe, 5.79 pounds per lineal foot.

Gate posts for swing gates shall be standard weight pipe of the following nominal sizes and weights for single swing gates or one leaf of double gates:

<u>Gate Width (One Leaf Width for Double Gates)</u>	<u>Nominal Size Post</u>	<u>Weight of Post (Pounds Per Lineal Foot)</u>
Up to 6' Wide	2-7/8"	5.79
6' to 13'	4"	9.11
13' to 18'	6-5/8"	18.97
Over 18'	8-5/8"	24.70

Permissible variation in total weight (see Sheet 3) of posts in any one shipment shall be a maximum of 3-1/2 per cent over or under the nominal weights.

The posts shall be fabricated of hot-rolled sections meeting either of the requirements given in the following tables:

<u>Grade</u>	<u>Tensile Properties</u>	
	<u>Yield Strength Lb/Sq in (Min.)</u>	<u>Ultimate Strength Lb/Sq in (Min.)</u>
Hot-rolled carbon steel- Minimum carbon content 0.35 per cent	40,000	70,000
Hot-rolled rail steel	50,000	80,000
Method of tests: Chemical requirements - ASTM E-30 Physical requirements - ASTM A-370		

- (c) RAILS: Top rails shall be of 1-5/8" O.D. standard weight pipe, 2.27 pounds per lineal foot, provided with couplings approximately every 20 feet. The couplings shall be the outside sleeve type at least 7 inches in length.
- (d) BRACES: Braces shall be of 1-5/8" O.D. standard weight pipe, 2.27 pounds per lineal foot, provided with 3/8 inch round truss rods.

2.05 WIRE TIES AND TENSION WIRE

Wire fabric ties, wire ties, and tension wire furnished for use in conjunction with a given type of fabric shall be of the same material identified with the fabric type. The wire shall be No. 7 gauge.

2.06 MISCELLANEOUS FITTINGS AND HARDWARE

Miscellaneous fittings and hardware shall be of design standard with the manufacturer. Those items furnished for use with fences other than aluminum alloy fabric shall be zinc-coated steel, wrought iron, or malleable iron and the zinc-coated fittings shall conform to ASTM A-123.

When furnished for use in conjunction with aluminum alloy fabric, the miscellaneous fittings and hardware shall be wrought or cast aluminum alloy conforming to the minimum requirements set forth in the table below.

2.07 PHYSICAL PROPERTIES OF ALUMINUM FITTINGS

Fitting or Product	Tensile Strength		Yield Strength	Elongation
	psi min.	psi min.	psi min. (0.2 offset)	(% in 2 in.)
Rail ends & brace ends	30,000	30,000	20,000	3
Stretcher bars & bands	30,000	30,000	25,000	10
Flat band ties	20,000	20,000	17,000	5
Truss or Brace Rods	42,000	42,000	35,000	10
Turnbuckles	30,000	20,000	3	
Post Tops	*	*	*	*
Bolts	62,000	62,000	40,000	14
Nuts	42,000	42,000	35,000	10
Gate hinges, barbed wire extension arms & other fittings	30,000	30,000	20,000	3

\* Aluminum Association Alloys 356-F or 360 are acceptable.

2.08 GATES

Design of metal gates shown on the plans is of an acceptable type. Gates of any other design may be furnished if prior approval is obtained from the Engineer.

The Contractor, prior to erecting gates, shall submit to the Engineer, for approval, specifications covering design and fabrication of the type gates he contemplates furnishing, if other than the type shown on the plans. If welded steel gates are used, galvanizing shall be done after fabrication.

2.09 CONCRETE

Concrete for post anchorage, etc., shall have a minimum compressive strength of 2,500 p.s.i. at 28 days and contain not less than 5 sacks of cement per cubic yard. The water cement ratio shall not exceed 6.6 gallons per sack.

Hand mixing of concrete will be permitted where small quantities are to be mixed and when done to the satisfaction of the Engineer. No hand mixed batch shall exceed 2 of a cubic yard. All batches exceeding 2 of a cubic yard shall be machine mixed.

2.10 PADLOCKS

Padlocks supplied by the Contractor shall be solid jacket extruded brass metal with interchangeable cores and 1-3/4 inch cases. All padlocks furnished shall be keyed alike. Two keys shall be furnished for each padlock.

**PART 3 CONSTRUCTION METHODS**

3.01 CLEARING FENCE LINE

Unless the plans include an item or items for clearing and grubbing, the Contractor shall perform such clearing and grubbing as may be necessary to construct the fence to the required grade and alignment.

3.02 FENCE ERECTION

The fence shall be erected to the established lines and grades, and shall comply with the best practice for fence construction of this type.

Posts shall be spaced in line of fence not further apart than 10-foot centers, with a tolerance of minus 2 feet. At locations where breaks in a run of fencing are required, or at intersections with existing fencing, appropriate adjustments in post spacing shall be made in conform to the requirements for the type of closure indicated. Each post shall be

erected plumb and the posts shall line up longitudinally with the specified alignment with no perceptible variation.

Pull posts shall be placed approximately 330 feet apart in straight runs and at each vertical angle point of 20 degrees or more, all as directed.

Corner posts shall be placed at each horizontal angle or point of 20 degrees or more. Corner and pull posts shall have a horizontal brace and a tie rod on each side of the posts, extending and connected to the adjacent line posts.

Posts shall be permanently positioned and anchorages firmly set before fabric is placed. The ends of the fabric shall be secured by the use of stretcher bars threaded through the loops of the fabric and secured to the posts by means of clamps with bolts and nuts. The number of clamps shall be as called for on the plans.

The fabric shall be placed by securing one end and applying sufficient tension to remove all slack before making attachments elsewhere. The degree of tensioning shall be commensurate with air temperatures at the time of installation to prevent undue sagging or tensioning of the mesh because of changing temperatures. The fabric shall be fastened to each line post at approximately equal spaces and to the top rail and bottom tension wire with tie wires or bands as called for on the plans or as directed.

### 3.03 GATE ERECTION

The gate installation shall include gate frames, stretcher bars, filler fabric, latches, stops, locking device, padlocks, hinges, gate posts with braces, tie rods, turnbuckles, caps and all fittings and details for gates and gate posts, all as specified and as shown on the plans and as required to make a complete installation.

All gates shall be carefully aligned with posts vertical. Where clamps are used for attaching hardware, they shall be made up tight. The bottom of each gate shall clear the ground by at least 3 inches at all points in its swing.

The Contractor shall modify the existing grade within the area of swing, if necessary, to meet this requirement when directed. Direction of swing and location of gates will be as indicated on the plans or as otherwise directed. Stops with latches, or other approved means for holding the gate open, shall be provided for all gates and so placed as to prevent damage to the gate or fence by overswing. Unless otherwise instructed stops shall be provided also to arrest the swing of a closed gate at the centerline of the fence.

### 3.04 CONCRETE FOOTINGS

Concrete footings shall be carried down to at least the depth, and shall be not less than the dimensions, shown on the plans. The top of all footings and aprons shall extend slightly above the ground line and shall be steel troweled to a smooth finish with slope to

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drain away from the post as shown on the plans. Posts, braces, and other units shall be approximately centered in their footings.

Concrete shall be placed promptly, expeditiously, and without segregation after mixing. The Contractor shall be required to consolidate and compact the concrete satisfactorily by tamping or vibrating. Exposed edges shall be tooled. All excess excavation from footings and aprons shall be disposed of in a manner satisfactory to the Engineer.

**BROADCAST SEEDING AND FERTILIZING**

**PART 1 GENERAL**

1.1 DESCRIPTION

This Section provides for the furnishing and placing of temporary seed, and fertilizer at all areas disturbed due to construction.

1.2 REFERENCED STANDARD

Conform to the following Sections of the State of Louisiana, Department of Transportation and Development, "Standard Specifications for Roads and Bridges," 2006 Edition; except as modified herein:

Section 717 - Seeding  
Section 718 - Fertilizer and Agricultural Lime

All references made therein to measurement and payment are hereby deleted.

1.3 SUBMITTALS

Submittals shall be provided in accordance with the Special Conditions.

**PART 2 PRODUCTS**

2.1 GENERAL

Materials related to erosion control and soil stabilization shall conform to the following subsections of the Referenced DOTD Standard:

A. Seed .....	1018.18
B. Water .....	714.02
C. Fertilizer(8-8-8) .....	1018.16

**PART 3 EXECUTION**

3.1 GENERAL

The CONTRACTOR shall neatly dress and prepare area designated for erosion control work and stabilize disturbed areas as soon as practical. Seeding and fertilizer shall be installed in accordance with the referenced Standard. Contractor shall prevent sediment from leaving the site by proper maintenance of earthwork

operations, installation of structural controls and temporary seeding and fertilizing to stabilize graded areas.

**PART 4 BASIS OF PAYMENT**

**4.1 EROSION AND SEDIMENTATION CONTROLS**

The CONTRACTOR shall be compensated for construction described herein through a lump sum "Erosion and Sedimentation Controls" bid item or under a lump sum "Site Work" bid item.

# **DIVISION 33**

## **UTILITIES**

## WATER UTILITIES

### PART 1 GENERAL

#### 1.01 DESCRIPTION

This item shall consist of water pipe and fittings, together with fire-hydrants, valves, valve boxes, etc. necessary to construct the water distribution system for the project. Included shall be the furnishing and installation of all materials, testing and disinfecting, in accordance with these specifications and in conformity with the lines and grades given.

This item shall include, in the bid prices per unit requested, the cost of common excavation and backfill, the cost of furnishing and installing all trench bracing, and the material for and the making of all joints.

#### 1.02 LOCATION OF LINES

The approximate location of lines, valves, fire hydrants, etc., has been indicated on the plans as being within the street, highway or easement rights-of-way. Final location of the various items of construction shall be established in the field by the Engineer. Any location within said street, etc., may be used. All costs not specifically listed as a pay item shall be included in the price bid for the item of which the costs are a part.

#### 1.03 LAYOUT OF WORK

The Contractor shall, at his own expense layout the work. The Contractor shall coordinate his activities with the Engineer, and the location of all lines, structures, appurtenances, etc., shall be subject to his concurrence prior to beginning construction.

#### 1.04 LOUISIANA DEPARTMENT OF HIGHWAYS' PERMIT

The Contractor shall have on site a copy of the necessary permits from the Louisiana Department of Highways for laying these lines, and installing driveways and culverts. The permits shall be obtained in the name of the Owner; however, the refundable deposit for the permits shall be made by the Contractor. After completion of the project, the deposit will be returned to the Contractor subject to any limitations of the permits not complied with by the Contractor.

### PART 2 MATERIALS

#### 2.01 GENERAL

The pipe and other materials shall be of the type called for on the plans, in the Proposal and/or in the Special Conditions and shall be in accordance with the following

appropriate requirements.

## 2.02 UNIFORM MATERIAL TYPES

Each type of material, such as pipe, valves, fittings, hydrants, service assemblies, etc., shall be supplied by a single manufacturer throughout the project. Once he begins the project with material of a given type, the Contractor shall complete the project, including all change orders, with material of the original type unless otherwise approved by the Engineer.

## 2.03 PIPE SHIPPING AND DELIVERY

The pipe manufacturer shall take the necessary steps in handling and shipping the pipe as not to injure the pipe, coating, or lining. Each joint of ductile iron pipe shall be individually stacked on the truck or railroad car bed with adequate support under each joint of pipe and adequate support and protection between each layer of pipe stacked on the vehicle. The entire stack shall be adequately and securely fastened to the truck or rail bed to prevent unnecessary vibrations, movements and stresses in the pipe during transportation.

Polyvinyl chloride plastic pipe (P.V.C.) shall be stacked into bundles (sized that the Contractor can unload one bundle at a time) and the bundle shall be securely banded together with adequate wood boards around the bundle to protect it during shipment. The bundles shall then be stacked on the truck or rail bed for shipment to the job site. The load of bundles shall be securely attached to the shipping bed to prevent unnecessary stresses during transportation. Smaller sizes of P.V.C. pipe may be placed inside larger diameter pipe which is bundled as specified above.

## 2.04 HANDLING OF ALL PIPE

The Contractor shall handle all pipe with handling and hauling equipment as not to injure the pipe, pipe lining, or pipe coating. Any pipe pushed off the truck bed will be rejected. Adequate equipment shall be used by the Contractor to remove the pipe from the truck bed and string it along the trench location.

If the pipe is to be stockpiled before it is strung along the trench the Contractor shall stack the pipe on a level site in neat stacks. Ductile iron pipe shall be stacked using the timber supports which were used in transporting the pipe. P.V.C. pipe shall be stacked in the bound bundles that the pipe was shipped in and the bundles shall not be broken up until the stringing operation is started.

## 2.05 DUCTILE IRON PIPE, JOINTS, FITTINGS

(A) DUCTILE IRON WATER PIPE: Ductile iron water pipe shall conform in all respects to ANSI A21.51. The iron shall be fully annealed Grade 60-42-10. The exterior shall have standard coal tar coating. The interior shall be cement mortar

lined in accordance with ANSI A21.4. Unless otherwise indicated on the plans, Proposal Form and/or Special Conditions, the minimum thickness for the pipe shall be Class 51.

(B) PIPE JOINTS:

- 1) PUSH-ON AND MECHANICAL JOINTS: Push-on joints shall be used unless otherwise indicated on the plans, Proposal Form, and/or Special Conditions. Push-on and mechanical joints shall meet the requirements of ANSI A21.11 except as amended by ANSI A21.51.
- 2) RESTRAINED JOINTS: Restrained joints shall be "Lok-Fast" as manufactured by American Cast Iron Pipe Company or "Super-Lock" as manufactured by James B. Clow and Sons, Inc., or an approved equal.
- 3) FLEXIBLE JOINTS: Bolt-on type ball and socket flexible joints shall be as manufactured by American Cast Iron Pipe Company, or an approved equal. Bolts shall be stainless steel conforming to ASTM A296, Grade CA-15.

Boltless type ball and socket flexible joints shall be as manufactured by James B. Clow and Sons, Inc., or an approved equal. These joints shall provide a minimum of 15° deflection per joint.

- (C) FITTINGS: Fittings for ductile iron pipe may be either ductile iron or Grey iron fittings. Fittings shall conform to ANSI A21.10 and ANSI A21.11. Fittings shall be pressure rated equal to or greater than the pipe on which they are installed.

Fittings shall be cement mortar lined in accordance with ANSI A21.4.

Fittings shall be of a joint type identical to the joints of the pipe on which they are installed, except that M.J. fittings may be used with push-on joint pipe.

(D) BOLTS, NUTS, GASKETS, ETC.:

Bolts, nuts, gaskets, etc. shall be as specified by the applicable ANSI specification for bolted joints or as recommended by the pipe manufacturer; all subject to the approval of the Engineer. All bolts on flanged or mechanical joint pipe installed underground shall be made from a non-corrosive metal subject to the approval of the Engineer.

2.06 FLANGED DUCTILE IRON PIPE AND FITTINGS

- (A) FLANGED PIPE: Flanged pipe shall conform to the requirements of ANSI A21.15. Pipe thickness shall be selected to provide a minimum working pressure of 250 psig unless otherwise specified. Pipe shall be cement mortar lined in

accordance with ANSI A21.4.

- (B) FLANGED FITTINGS: Flanged fittings shall conform to the requirements of ANSI A21.10.

Fittings shall be cement mortar lined in accordance with ANSI A21.4. Fittings pressure rated at a minimum of 250 psig shall be used unless otherwise specified. Companion flanges shall be Class 125 meeting the requirements of ANSI B16.1.

2.07 PVC PIPE, JOINTS, FITTINGS (SDR) (PR)

- (A) PIPE: All polyvinyl chloride (PVC) pipe which is specified by Standard Dimension Ratio (SDR) or pressure rating class (PR) shall conform to ASTM D 2241. SDR PVC pipe shall be extruded from clean virgin resin which conforms to ASTM D 1784, Class 12454-B (PVC 1120). PVC pipe shall have an integral bell with a locked in gasket.

All pipe shall have the manufacturer's trade name, the NSF seal of approval, the SDR, the internal pressure rating, and ASTM designation D 2241 conspicuously marked on each length of pipe. Pipe shall be SDR 26 unless otherwise specified.

- 1) Class 160: SDR 26 PVC pipe shall have a minimum internal pressure rating of 160 psig @ 73°F.
- 2) Class 200: SDR 21 PVC pipe shall have a minimum internal pressure rating of 200 psig @ 73°F.

- (B) JOINTS: Unless otherwise specified, push-on type joints shall be furnished. Solvent weld joints will be allowed only where specifically shown on the plans or called for in the proposal form. Solvent weld joints on 2" Class 160 SDR 26 will not be allowed.

- 1) BELL END PUSH-ON JOINTS: Bell end push-on joints having one elastomeric gasket per joint of pipe shall comply with ASTM D3139 and ASTM F477.
- 2) PUSH-ON COUPLINGS: Pipe whose joints consist of couplings having two elastomeric gaskets per joint shall comply with ASTM D3139 and ASTM F477.
- 3) SOLVENT CEMENT COUPLINGS: Schedule 40 PVC socket couplings which comply with ASTM D 3036 may be used provided one coupling per joint of pipe is factory installed by the pipe manufacturer.

- 4) SOLVENT CEMENT BELL ENDS: Solvent cement bell pipe joints shall conform to ASTM D 2672.

(C) FITTINGS: Cast or ductile iron fittings shall be used on pipe sizes 4" and larger. PVC fittings shall be used on pipe 3" and smaller. PVC fittings shall be made from the same resin type meeting ASTM D 1784 as the pipe resin. PVC fittings shall be marked with the NSF seal of approval.

Fittings shall be pressure rated equal to or greater than the pipe on which they are installed.

The wall thickness of PVC fittings shall be such that the SDR of the fitting at any point shall not exceed the SDR of the pipe. Fittings shall be of a joint type identical to the joints of the pipe on which they are installed.

- 1) CAST OR DUCTILE IRON PUSH-ON FITTINGS: Cast iron push-on fittings shall comply with applicable portions of ANSI A21.10 and ANSI 21.11 and shall be cement mortar lined in accordance with ANSI A21.4.
  - 2) CAST OR DUCTILE IRON MECHANICAL JOINT FITTINGS: The use of cast or ductile iron mechanical joint fittings will be allowed provided the fitting is equipped with transition gaskets. The transition gaskets shall be of the type specifically recommended by and furnished by the fitting manufacturer for use on steel pipe size O.D. PVC pipe. Cast iron mechanical joint fittings shall comply with ANSI A 21.10 and ANSI A21.11 and shall be cement mortar lined in accordance with ANSI A21.4.
  - 3) PVC PUSH-ON FITTINGS: PVC push-on fittings shall comply with ASTM D3139, ASTM D 1599, and ASTM F-477.
  - 4) PVC SOLVENT CEMENT FITTINGS: PVC SOLVENT CEMENT fittings shall be SCH 40 complying with ASTM D 2466, or SCH 80 complying with ASTM D 2467.
- (D) SOLVENT CEMENT: PVC solvent cement shall comply with ASTM D 2564 and shall be recommended by and supplied by the manufacturer of the pipe on which it is used.

2.08

#### SCHEDULE 40 AND 80 PVC PIPE JOINTS AND FITTINGS

- (A) SCHEDULE 40 AND 80 PVC PIPE: PVC pipe which is specified by schedule number shall comply with ASTM D 1785. PVC pipe shall be extruded from clean virgin resin which conforms to ASTM D 1784, Class 12454-B (PVC 1120). All pipe shall be marked at intervals not less than 5 feet with manufacturer's name or trade mark, the NSF seal of approval, the schedule

number and the ASTM designation D 1785. Pipe shall be SCH 40 unless otherwise specified.

- (B) PIPE JOINTS: Pipe joints shall be as specified in paragraph 200-2.9(B) of this specification with the exception that solvent cement joints on all pipe sizes will be acceptable.
- (C) FITTINGS: Fittings shall be as specified in paragraph 200-2.9(C) of this specification with the exception that threaded PVC fittings will be acceptable. Fittings shall be pressure rated equal to or greater than the pipe on which they are installed.

Schedule 40 PVC solvent cement fittings shall comply with ASTM D 2466. Schedule 80 PVC solvent cement fittings shall comply with ASTM D 2467. Threaded fittings shall be schedule 80 and shall comply with ASTM D 2464.

- (D) SOLVENT CEMENT: Solvent cement shall be as specified by paragraph 200-2.9(D) of this specification.

#### 2.09 AWWA PVC PIPE, JOINTS AND FITTINGS

- (A) AWWA PVC PIPE: All PVC pipe which is specified by AWWA pressure class shall conform to AWWA C900. Unless otherwise specified the pipe shall be Class 150 cast iron pipe size (CL 150 CIPS).
- (B) PIPE JOINTS: Pipe joints complying with AWWA C 900 shall be one of the following types:
  - 1) Integral wall-thickened bell
  - 2) Integral sleeve-reinforced bell
  - 3) Solvent cement bell
  - 4) Solvent cement coupling, provided that one coupling per joint of pipe is factory installed by the pipe manufacturer.
- (C) FITTINGS: Fittings shall be cast or ductile iron push-on type or mechanical joint type complying with ANSI A21.10 and ANSI A21.11.

Fittings shall be cement mortar lined in accordance with ANSI A21.4. Fittings shall be pressure rated equal to or greater than the pipe on which they are installed.

- (D) SOLVENT CEMENT: Solvent cement shall comply with ASTM D 2564 and shall be recommended by and supplied by the pipe manufacturer.

#### 2.10 POLYETHYLENE PIPE (P.E.) 2"-inches thru 12-inches

P.E. water main pipe shall conform to AWWA C906. It shall be designated PE 4710 of ductile iron outside diameter with a dimension ratio of 11 and pressure class of 150 psi.

- (A) The P.E. pipe shall be approved by the National Sanitation Foundation (NSF). The pipe shall be marked as prescribed by AWWA C906 and NSF which will include nominal size, OD base, dimensional ratio, pressure class, working pressure rating, AWWA C906 and the manufacturer's name.

The pipe shall be Driscopipe 4000 as manufactured by Phillips Driscopipe, Inc., Plexco HDPE, polypipe as manufactured by Dura-line or approved equal.

Pipe joints shall be by heat fusion using equipment specifically designed for the pipe size specified.

- (B) FITTINGS: All fittings used in conjunction with P.E. pipe (12-inches in diameter and less) shall be mechanical joint fittings restrained using a mechanical joint adapter kit, Iron Pipe Size for 1 ½" to 3" diameter and Ductile Iron Pipe Size for 4" to 12", with an integral stainless steel stiffener referred to as a "Harvey" adapter or mechanical joint adapter as manufactured by Phillips Driscopipe, Inc., Plexco HDPE, or approved equal.
- (C) TRANSITIONS: A pack joint-x-pack joint coupling, PVC by P.E., may also be used for 2-inch transitions from P.E. to PVC. To restrain P.E. pipe at a threaded fitting or valve (2" or 3"), a P.E.-x-male threaded (Double "O" Seal) transition fitting with internal and external epoxy coating shall be used.

For transitions from P.E. to PVC pipe, the above joint restraint devices should be used utilizing a mechanical joint solid sleeve fitting.

## 2.11 POLYETHYLENE SERVICE PIPE AND TUBING 3/4" AND 1"

Service pipe and tubing size 3/4" and 1" shall be polyethylene (P.E.) type 4710 and shall comply with AWWA C901. The P.E. pipe shall be approved by the National Sanitation Foundation (NSF). The pipe shall be marked as prescribed by AWWA C901 and NSF which will include nominal size, OD base, dimensional ratio, pressure class, working pressure rating, AWWA C901 and the manufacturer's name.

- (A) I.D. BASE P.E. PIPE: Unless otherwise shown on the plans and/or called for on the proposal form, 3/4" and 1". Service lines shall be I.D. base P.E. pressure pipe, DR 7.0, pressure Class 160 psi.
- (B) O.D. BASE P.E. TUBING: Where specifically shown on the plans and/or called for on the proposal form, 3/4" and 1" service lines shall be P.E. pressure tubing, DR 9.0, pressure Class 160 psi.
- (C) INSERT STIFFENERS: Service pipe and tubing ends to be installed with

compression type fittings and connections shall be fitted with a stainless steel insert stiffener of the correct size for the service pipe or tubing.

2.12 SERVICE ASSEMBLY THRU 1"

The service assembly shall consist of the service saddle, corporation stop, meter stop, meter, meter coupling, and meter box.

- (A) SERVICE SADDLES: Service saddles shall be all bronze and shall be the following or an equal approved by the Engineer:

<u>Main Size &amp; Type</u>	<u>Mueller</u>	<u>Other</u>
SDR PVC 2"-6"	S 13420 thru S 13431	Ford S71, Design A
SDR PVC 8"	S 13433	Ford S71, Design A or Design C
D.I., or DIPS PVC 4"-8"	S 13478 thru S 13483	Christy 1022

- (B) CORPORATION STOPS: Corporation stops shall be of the conventional plug valve type, shall have corporation stop threads, shall comply with AWWA C800 and shall be Mueller "Insta-Tite" #H 15005 or Ford "Pack-Joint" #F 1000, or an equal approved by the Engineer.
- (C) METER STOPS: Meter stops shall be of the permanently lubricated plug or ball valve type and shall be Mueller #H 14331 or Ford #BM63-332(3/4") or Ford #BM63-444(1"), or an equal approved by the Engineer.
- (D) WATER METER: All water service meters shall comply with AWWA C 700, except where amended hereby.

The meter shall be of the magnetic drive hermetically sealed register with disc or piston type design. The register shall be of the odometer type reading in U.S. gallons, complete with test index circle with a heat treated glass. The meter shall have an all bronze housing with bronze housing bolts, and a bronze hinged register cover. When the meter furnished requires special keys to remove the register, two keys shall be furnished to the Owner.

All meters shall be accurate when operating at the following flow rates:

<u>Meter Size (inches)</u>	<u>Safe Operating Capacity (G.P.M.)</u>
5/8 x 3/4	20
3/4	30
1	50

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1 x 1¼	50
1½	100

All meters furnished for this project shall be of the same make and manufacture.

(E) METER COUPLINGS: Meter couplings shall be Mueller #H 10890 or Ford #SPM-2 (3/4") or SPM-3 (1"), or approved equal.

(F) METER BOX: Meter boxes shall be one of the following types at the option of the Contractor unless otherwise specified in the special provisions. Meter box lids shall be furnished without locks.

1) CAST IRON METER BOX: Cast iron meter boxes shall be Ford Meter Box Company, Mueller Co., or an approved equal as follows:

<u>Meter Size</u>	<u>Cast Iron Meter Box</u>
5/8" x 3/4"	Ford "Yokebox" #YL161-233 Mueller H-1455-5N
3/4"	Ford "Crescent Box" #3 Mueller H-1455-5N
1"	Ford "Crescent Box" #4 Mueller H-1455-5N

2) CONCRETE METER BOX: Concrete meter boxes shall be as manufactured by Hollifield Water Works Machinery Company, Inc., or an approved equal as follows:

<u>Meter Size</u>	<u>Concrete Meter Box</u>
5/8" x 3/4"	Hollifield #5/8 x ¾ J & R Concrete, W3
3/4"	Hollifield #5/8 x ¾ J & R Concrete, W3
1"	Hollifield #1 J & R Concrete, W4

Concrete meter boxes shall have a reinforced concrete cover with a cast iron reading lid hinged to cover with a brass pin.

3) PLASTIC METER BOX: Plastic meter boxes shall be as manufactured by Polyfoam Industries, Greenville, Texas, or DFW Plastics, Inc. Fort Worth, TX, or an approved equal as follows:

<u>Meter Size</u>	<u>Plastic Meter Box</u>
5/8" x 3/4"	Polyfoam "Mark II" with cast iron reading lid DFW Plastics 1500.12.1
3/4"	Polyfoam 17" w/C.I. cover DFW Plastics 1500.12.1
1"	Polyfoam 17" w/C.I. cover DFW Plastics 1500.12.1

2.13 SERVICE ASSEMBLY LARGER THAN 1"

Service assemblies larger than 1" shall be as detailed on the Drawings, Special Conditions or Proposal Form.

2.14 TAPPING SLEEVES

Tapping sleeves shall be cast iron 200 psig working pressure as follows:

	<u>Mueller</u>	<u>Clow</u>
For CI or CIPS PVC	H 600 Series	F 5205
For SDR PVC	H 600 Series	F 6342
or an approved equal.		

2.15 SERVICE ASSEMBLIES WITH REGULATOR

The service assemblies with regulator shall consist of the service assembly, curb stop, close nipple, service regulator with wye strainer, adaptor, saddle support and meter box.

1. Service Assemblies with Regulator (Thru 1"):
  - (a) Service Assembly: The service assembly shall be as specified in paragraph 2.13.
  - (b) Curb Stops: Curb stops shall be Mueller #H-15171 or Ford #BM61-333(3/4") or #BM61-444 (1"), or an equal approved by the Engineer.
  - (c) Close Nipple: Close nipples shall be Schedule 40 galvanized iron.
  - (d) Service Regulator with Wye Strainer: Service regulator shall be Mueller #H-9300 No. 2 with #H-9330 galvanized iron strainer, Crane #988 or an equal approved by the Engineer.
  - (e) Adaptor: Adaptor shall be male I.P.T. X Compression Mueller #H-15429, Ford C86 Series or an equal approved by the Engineer.
  - (f) Meter Box: Meter box shall be as specified in paragraph 200-2.13(F) and shall be the same type furnished for the service assembly.
2. Service Assemblies With Regulator (Larger Than 1"): Service assemblies with regulator larger than 1" shall be as detailed on the Drawings, Special Conditions, or Proposal Form.

2.16 GATE VALVES AND TAPPING VALVES

- (A) GENERAL: All gate valves and tapping valves shall be manufactured in compliance with the "Standard Specifications for Gate Valves for Ordinary Water Works Service", Designation C509 of the American Water Works Association, or the latest revision thereof.

The disc shall be designed so that they shall be forced against the seats by wedges or other suitable device after the valve is closed. All gate valves shall operate so that the valve will open when turning the operating nut in a counter-clockwise direction. All gate valves buried underground shall have a non-rising stem with operating nut and cast iron valve box. All gate valves shall be designed for a minimum working pressure of 150 pounds per square inch and shall be capable of withstanding an internal hydrostatic pressure of 300 pounds per square inch. Buried gate valves shall have stems equipped with the standard (2" square) wrench nut. Gate valves installed above ground shall be equipped with hand-wheels. One (1) valve wrench suitable to open and close all gate valves in this project shall be supplied to the Owner.

- (B) GATE VALVE 1-1/2" AND SMALLER: Gate valves 1-1/2 inches or smaller shall be iron body, with bronze trim or bronze body. The valves shall be of the screwed end type.
- (C) GATE VALVES 2 TO 14 INCHES: Gate valves 2 to 14 inches inclusive shall be installed in an upright position and shall have mechanical joint or push-on ends unless otherwise specified. The valves shall be iron body, with bronze trim, double disc, parallel seat, and shall have "O" ring seals.

## 2.17 CHECK VALVES

- (A) GENERAL: All check valves shall be of the type shown on the plans and shall conform to the following specifications.
- (B) STANDARD SWING CHECK VALVE: All standard swing type check valves shall be equipped with an external lever and weight unless otherwise specified. All standard swing type check valves shall be Mueller A-2600 series, Clow F-5382, or approved equal.
- (C) AIR CUSHIONED SWING CHECK VALVE: All air cushioned swing check valves shall be furnished with a lever and weight unless otherwise specified. The swing check valve shall be constructed with heavy cast iron or cast steel body with a bronze or stainless steel seat ring, a non-corrosive shaft for attachment of weight and lever, complete non corrosive cushion chamber, and shall allow removal of all internal parts without removing the valve body from the line.

The cushion chamber shall be attached to the side of the valve body externally and so constructed with a piston operating in a chamber that will effectively

permit the valve to be operated without any hammering action. The cushioning shall be by air, and the cushion chamber will be so arranged that the closing speed will be adjustable to meet the service requirements.

The valve disc shall be of cast iron or cast steel and shall be suspended from a non-corrosive shaft which will pass through a stuffing box and be connected to the cushion chamber on the outside of the valve.

- (D) HYDRAULICALLY OPERATED GLOBE CHECK VALVE: All hydraulically operated check valves shall be diaphragm-actuated, and hydraulically operated by line pressure. It shall be spring-loaded, single seat globe type valve having a renewable seat ring. All necessary repairs other than replacement of the valve body shall be possible without removing the valve from the line. External packing glands or stuffing boxes are not permitted, and the diaphragm cannot be used as a seating surface. The disc shall be made of a resilient material.

The valve shall contain auxiliary controls which permit adjustment of the opening and closing speeds. The valve shall be Clayton 81C as manufactured by the Cla-Val Company, or #273D as manufactured by Golden-Anderson, or approved equal.

## 2.17 BUTTERFLY VALVES

All valves 16 inch and larger shall be butterfly valves and shall be manufactured in accordance with AWWA Standard C-504.

Valve shafts may be of one piece or two piece construction; however, in either case, the disc shall be of uniform thickness at the shaft axis. The steel shaft shall be of 18-8 stainless steel or 304 stainless steel. The valve shafts shall be designed as to provide permanent centering of the disc and shall have permanent self-lubricating shaft bushings.

The valve disc shall be manufactured of cast Ni-resist or some corrosion-resistant material approved by the Engineer. The valve seat shall be of rubber and may be applied to the valve body or disc. In either case, the mating seat surface shall be 18-8 stainless steel, 304 stainless steel, or Ni-resist Type 1.

Unless otherwise stated on the Plans, and/or Proposal Form, all butterfly valves shall be manufactured for a working pressure of 150 psi. All valves shall be tested to 300 psi by the manufacturer. The valve body shall be of cast iron with mechanical joint or flanged ends as indicated on the plans. All M.J. and flanged joints shall meet the applicable portions of Section 2.7 of these specifications.

All butterfly valves shall be designed for underground service. Valves to be used below ground shall be furnished with a 2 inch operating nut while valves to be used

in above ground installations shall be furnished with a standard operating wheel.

Below ground valves shall be furnished with a suitable cast iron valve box complete with indicator and an indicator shall be attached to above ground installations.

The Contractor shall furnish the Owner with one (1) valve wrench to fit the operating nut furnished.

2.19

AIR RELEASE; AIR AND VACUUM; AND COMBINATION AIR AND VACUUM AND AIR RELEASE VALVES

- (A) GENERAL: All air release valves and combinations air and vacuum and air release valves shall be guaranteed not to blow shut under normal operating conditions with air flowing into the pipeline or being exhausted from the pipeline via the valve. Certifications may be requested of complete test results to substantiate the above requirements.
- (B) AIR RELEASE VALVES: Air release valves shall be so designed to permit small quantities of air to escape automatically from pipelines under pressure. Air release valves shall be 1" NPT inlet unless otherwise specified and shall be Crispin Model DL5 or Golden-Anderson Model GH4-150, or equal.
- (C) AIR AND VACUUM VALVES: Air and vacuum valves shall be so designed as to release a large quantity of air from an empty pipeline or water well during the filling process. The valve shall also permit air to enter the pipeline or water well. The valve size shall be as shown on the Plans, Special Conditions or Bid Form and shall be Crispin Series D or Golden-Anderson Figure GH-21-K, or equal.
- (D) COMBINATION AIR RELEASE AND AIR AND VACUUM VALVES: Combination air and vacuum and air release valves shall include a small orifice valve for exhausting small quantities of entrained air and a large orifice valve for inducting as well as exhausting large quantities of air. The size of the required orifice shall be as specified on the plans.

Combination valves shall be Golden-Anderson's Figure GH-21-K combined with Figure GH-4 or Crispin's "Dual Valve" (Crispin Series A/M - Combination of Type "A" and "Midget" air valves).

2.20

VALVE BOXES

Valve boxes shall be cast iron of the two-piece screw type with an inside diameter not less than 5 ¼". The valve boxes shall be adjustable in length and the lid shall have the word "water" embossed on the top.

The box shall be installed flush with the ground or street surface and shall be

supported by a 2' diameter concrete foundation as shown on the drawings. The box shall be suitable for the depth-of-bury of the valve on which it is installed. Contractor's compensation will not be based on length of the valve box.

The valve box shall be Mueller #H-10360, Clow #F-2454, or an approved equal.

## 2.21 FIRE HYDRANTS

Fire hydrants shall be cast iron bodied, fully bronze mounted, suitable for a working pressure of 150 psi and shall meet all requirements of AWWA C-502. Each hydrant shall be factory tested to 300 psi hydrostatic pressure.

Each hydrant shall have a 6 inch connection to street main, two 2-1/2 inch brass nozzles with threads for hose connections, and one 4-1/2 inch brass nozzle with threads for steamer coupling, together with caps fastened securely to each hydrant and threaded to fit nozzles.

The threads for hose and steamer connections shall be as specified on the plans or by the Engineer. Hydrants shall be opened by turning in a counter-clockwise direction and the direction of opening shall be cast on the head of the hydrants.

The Contractor shall confirm the thread spacing with the applicable authority having fire-fighting responsibility in the area before ordering the hydrant.

The bottom valve of the hydrant, unless otherwise specified, shall not be less than 5-1/4 inches in diameter and 7 inches minimum inside diameter riser barrel.

The hydrant main valve shall be of the compression type, closing with pressure. The valve shall be faced with heavy impregnated waterproof balata or other approved equal material.

Drain valves shall be automatic and positive acting. When the main valve is closed, they shall automatically open insuring rapid and complete drainage of the hydrant riser. They shall close automatically when the main valve is opened.

The hydrant shall be so constructed to permit withdrawal of internal working parts without disturbing the barrel or casing.

All hydrants shall have a safety "Breakable" section located above the ground line. The hydrant shall be so constructed so that the main valve, when shut shall be tight when the upper portion of the barrel is broken off.

A standard depth hydrant shall be defined as a hydrant suitable for connection to water mains with thirty (30) inches of cover from the top of the pipe to natural ground. All hydrants shall be standard depth unless otherwise specified on the plans, Proposal Form, and/or Special Conditions.

Hydrants shall be accurately set in place such that the breakable flange shall be four (4) inches above finished grade. Where standard depth hydrants are not suitable the contractor shall furnish and install hydrant extensions to adjust the hydrant to the proper setting.

2.22 CASING PIPE

- (A) CORRUGATED METAL PIPE: Corrugated metal pipe shall be A.R.E.A. Specification pages 1-4-4 thru 1-4-10 and shall be asbestos bonded in accordance with LDOTD Specification 1007.03. The size and gage shall be as specified on the plans.
- (B) WELDED STEEL PIPE: Steel casing pipe shall be in accordance with AWWA Specifications C 200, minimum grade B. The size and wall thickness shall be as specified on the plans. The interior and exterior of all casing pipe shall be cleaned, primed and lined with two coats of asphalt in accordance with AASHTO Designation: M 190, Type A. All steel casing shall be butt-welded and all welds shall be full penetration single butt-welds in accordance with AWWA Specification C206 and AWS D7-0-62.

2.23 CONCRETE

Concrete shall be in accordance with Section 03 00 00 of these specifications.

2.24 COPPER CONDUCTOR

The Contractor shall furnish and install #12 AWG Type TW insulated solid copper wire where required to facilitate the use of electronic pipe locating equipment for locating non-electrically- conductive pipes, mains and service lines. Copper wire shall be installed with all non-conductive mains. Copper wire shall be installed with all non-conductive service lines located within highway rights-of-way. Wire splices shall be made using splice kits similar or equal to Model DRB by 3M or Dry-Conn DBSR #63315 by King Innovation.

Copper wire is not required to be installed with non-conductive service lines located on private property or private rights-of-way. No separate payment will be made for installation of copper conductor. The cost of copper conductor shall be included in the unit price per foot of pipe installed.

2.25 INSULATION

Unless otherwise designated on the plans, all outdoor piping, above grade, shall be insulated using Owen's Corning 25 ASJ/SS fiberglass, Johns Manville Micro-Lock 650 Ap fiberglass, or approved equal. Outdoor piping insulation shall be covered with an aluminum jacket 0.016 inch thick. Insulation thickness shall be as follows:

<u>Pipe Size</u>	<u>Insulation Thickness</u>
Over 2"	1 1/2"
2" and less	1"

All insulation shall be installed in accordance with manufacturer's recommendation and as approved by the Engineer.

2.26 PIPING SUPPORTS

The Contractor shall furnish and install a system of piping supports to prevent excess stress on above grade piping. The location of piping supports shall be as shown on the plans and/or as approved by the Engineer. Pipe supporting hardware such as pipe rings, pipe clamps, beam clamps, brackets, hangers, rods, clevises, pipe saddles, u-bolts, straps, hooks, etc. shall be as manufactured by Grinnell Company, Inc., B-line by Eaton, Inc., or approved equal. Piping supports bearing on floor slabs shall be attached to floor flanges and anchored by approved expansion bolts.

2.27 LOW LEAD REQUIREMENTS

The Contractor shall note that all pipes, fittings, and fixtures shall be "no lead" as defined by Act 362 of 2011 of the Louisiana State Legislature.

All applicable piping, fixtures, pipe-related products and materials that join or seal pipes shall be evaluated and listed as conforming with *NSF/ANSI 372-Drinking Water System Components, Lead Content*, or shall be certified to be lead-free by an independent ANSI-accredited third party testing laboratory.

**PART 3 EXECUTION**

3.01 GENERAL

This part of the work includes installation of water mains, fittings, valves, valve boxes and appurtenances; excavation and backfill of trenches; cutting and replacing walks and roadway surfacing; and other miscellaneous items necessary to complete and make ready for operation a complete water distribution system.

3.02 COOPERATION WITH UTILITY OFFICIALS

The Contractor's attention is directed to the fact that his work will be performed in the close proximity of existing utilities, streets, drainage structures, etc. The Contractor shall at all times cooperate with the various utility and street officials and shall notify the appropriate personnel prior to excavation in areas where known utilities are located.

3.03 CLEARING OF RIGHT-OF-WAY

The Contractor shall clear the right-of-way provided for the main of all objectionable debris and obstructions that will interfere with the installation of the mains. Wooded areas shall be cleared and grubbed, and surface obstructions to remain shall be protected in accordance with paragraph 3.6 of these specifications.

3.04 EXCAVATION OF TRENCH AND BACKFILL

Excavations, preparation of trenches, and backfill shall be in accordance with AWWA C600, except where amended by these Specifications. Excavation shall be such that the pipe will have no less than 30 inches of minimum cover (measured from top of trench to top of the barrel of the pipe). Trench bedding and standard backfill shall be as specified for each individual pipe material and detailed on the "Standard Details for Water Distribution Systems" plan sheets.

A minimum horizontal separation of six feet shall be maintained between all water mains and services and any sewer mains and/or manholes. All water mains and services crossing sewer mains shall have a minimum vertical separation of 18 inches. All distances shall be measured from outside of pipe to outside of pipe.

3.05 OBSTRUCTION OF STREETS, PREMISES, ETC.

All material shall be placed so as to interfere as little as possible with public travel. At street crossings and other points as directed by the Engineer, trenches shall be bridged in a manner so as to prevent any serious interruption of public travel; the closure of both sides of a double roadway to vehicular traffic will not be permitted except by special permission. Special care must be taken to give free access at all times to all fire hydrants, water valves, fire alarm boxes and Police Department and Fire Department driveways.

In case the Contractor shall fail to keep open streets, sidewalks, approaches to premises, etc., and shall refuse or neglect to open them within twelve (12) hours after written notification by the Owner; or shall the Contractor fail to afford proper and necessary access to fire hydrants, water valves, fire alarm boxes or Police Department or Fire Department driveways, and shall neglect or refuse to afford such access within one (1) hour of receiving oral or written notice to do so, the Owner shall be and is hereby authorized and empowered to put on such force as may be necessary and to do this work, deducting the actual cost thereof from any money which may be due or may become due the Contractor.

3.06 CONFLICT WITH SURFACE OBSTRUCTION

All shade trees, shrubbery, utility poles, etc., within the right-of-way provided shall be protected and any building or structure which may be endangered during the work shall be shored up and otherwise protected. Any properties disturbed or damaged by the Contractor shall be restored to its original conditions. No additional

compensation will be made for this corrective work.

3.07

CONFLICT WITH SUBSURFACE OBSTRUCTIONS

The Contractor shall anticipate all underground obstructions such as waterlines, gas lines, sewer lines, utility lines, concrete and debris. Any such lines or obstructions indicated on the plans show only the approximate location and must be verified in the field by the Contractor. Neither the Owner nor the Engineer implies or guarantees the exact location of any existing underground utility; however, the Owner and Engineer will endeavor to familiarize the Contractor with all known underground obstructions.

The Contractor shall take the necessary precautions not to injure any gas or water pipe, sewer, drain or service pipes connected therewith or conduits or other underground structures, and the Contractor must repair or have repaired at once, at his own cost, any public or private structure or pipe damaged by or in the course of his work. Should the Contractor fail to repair or have repaired such damage or injury within a reasonable time, the Owner may after 24 hours written notice, have such repairs made and deduct the cost thereof from any amounts due or to become due the Contractor.

The Contractor shall assume all risks and be responsible for all expense and damage attending the presence or proximity of any gas or water pipes, sewers, drains, conduits, or other underground structures where such pipes or other structures cross the trench or appear in the trench in such a manner as not to demand their rearrangement or realignment. The Contractor's risks and responsibilities shall also apply to such structures as are approximately parallel with or adjacent to but outside of said trench.

The Contractor shall uncover known subsurface obstructions in advance of construction so that the method of avoiding same may be determined before pipe laying reaches the obstruction.

Should any pipe or other obstruction (so located as to interfere with the work) be encountered, the Contractor shall at once notify the Engineer of the locality and circumstances and the place shall be passed over until satisfactory arrangements are made.

Should the obstruction parallel the trench the Engineer may require the Contractor to offset or realign his pipeline to miss the obstruction. This realignment may be made by the use of fittings, pipe deflection and/or manholes as the case may dictate.

When the pipeline is offset to miss an obstruction no claim for damages or extra compensation shall accrue to the Contractor from the presence of such pipe or other obstruction or from any delay due to its presence. However, should there be a change in quantity of any established pay item due to this relocation; the Contractor shall be paid for these changes at the unit price bid.

Where subsurface obstructions cross the trench, the Contractor will be permitted to lay pipe above the obstruction if a minimum amount of cover can be maintained while providing a cushion between the bottom of the pipe and the top of the obstruction at least 6 inches thick. Where this minimum cover cannot be obtained, the Contractor will be required to lay the pipe under the obstruction and maintain a 6 inch cushion between the top of the pipe and the bottom of the obstruction. No additional payment will be made for additional depth or over depth mains required to miss an obstruction. Should the location or position of such obstruction within the limits of the trench be such, in the opinion of the Engineer, as to require removal, realignment or change of the obstruction in order that the work may proceed, such removal, realignment or change shall be without expense to the Contractor. When, however, such obstruction shall come within the limits of the excavation for the work as located by the Engineer, such pipe, conduit, or other obstruction shall be stripped or uncovered by the Contractor, at his own expense, as constituting a part of his work in excavating. No claim for damages or extra compensation shall accrue to the Contractor for any delay due to the presence and adjustment of the obstructions.

The Engineer will in all cases be the judge of the necessity or expediency of any change or re-arrangement of any underground structures which may interfere with the construction of the work under this contract.

3.08

SPECIAL CROSSINGS - CANALS, RAILROADS, HIGHWAYS, ETC.

- (A) GENERAL: Special crossings for which drawings have been made and on which a special price has been asked, whether a lump sum bid or otherwise, will be paid for according to the special specifications governing said crossings. Otherwise, no additional compensation will be paid for the construction of any utility line because of its crossing under or over any natural or man-made obstacle, provided the route of the waterline as bid has not been changed so as to produce a crossing not to be anticipated by the bidder.
- (B) PERMITS: The Contractor shall secure the necessary permit from the controlling agency for laying these lines. The permit shall be obtained in the name of the Owner; however, the refundable deposit for the permit shall be made by the Contractor. After completion of the project, the deposit will be returned to the Contractor subject to any limitations of the permit not complied with by the Contractor.
- (C) COOPERATION WITH CONTROLLING AGENCY: The Contractor shall submit to the Engineer and the representative of the controlling agency, all details concerning the method of construction and materials to be used at least 10 days before beginning construction.

3.09

HANDLING AND DISPOSAL OF WATER

The Contractor shall pump, bail, or otherwise remove any water which may be found or may accumulate in the excavations, trenches, etc., and shall perform all work necessary to keep them clear of water while the work is in progress. The cost of removing water by pumping or otherwise shall be included in the prices bid for the various items of the work; unless a specific bid item is asked for such. The Contractor shall keep his completed work reasonably free of water and shall completely remove all of it for the purpose of installations, inspections, etc.

The Contractor shall prevent any of his work from obstructing any drainage ditch, canal, etc., unless special permission is obtained.

### 3.10 SHEETING AND BRACING

Wherever necessary for protection of workmen, for security of adjacent utilities or structures, for stability of trench, or for proper installation and operation of water pipe, the Contractor shall secure the trench to his satisfaction, to the extent of requiring close sheeting, or sheet piling and suitable bracing, including all nails, spikes and other fastenings.

Where the sheeting for a pipe is driven no lower than the top of the pipe, such sheeting may be withdrawn, provided that no sheeting is withdrawn until the trench has been refilled as hereinafter provided to a point not less than two (2) feet above the crown of the pipe. Where it is necessary to drive sheeting below the top of the pipe, such sheeting shall be driven down to a point not less than two (2) feet below the bottom of the pipe and properly braced. Bracing above the pipe shall be placed as to allow at least one (1) foot clear space between the bottom of the bracing and the top of the pipe. All sheeting and bracing may be removed after the trench has been backfilled at least two (2) feet above the top of the pipe.

The Contractor will be paid by separate pay item for all sheeting and bracing left in place at the written direction of the Engineer. The cost of all sheeting and bracing not required to be left in place shall be included in the price bid for pipe of each size and depth, and the Contractor will receive no additional compensation therefore.

### 3.11 LOCATION OF AND CONNECTION TO EXISTING WATER SYSTEMS

- (A) GENERAL: The attention of the Contractor is directed to the fact that existing water mains or service lines will have to be tapped, cut, "killed," relocated, tied together and otherwise adjusted to completely perform all work required for this project.

These lines presently serve the residents of the area, and the Contractor shall not be permitted to indiscriminately shut off service in these lines. The Contractor shall cooperate with the Owner in order that lack of service will be reduced to a minimum. The Contractor shall arrange with representatives of the Owner and the Engineers for a mutually acceptable time when service

can be discontinued in the various sections of the system.

The general location, size and type of existing utilities have been taken from existing maps and/or surveys.

The size of pipe indicated is the nominal diameter and the Contractor shall be responsible for obtaining the correct outside diameter of the pipe before ordering any valves, fittings, tapping sleeves, etc., to assure a proper fit.

- (B) LOCATION OF EXISTING UTILITIES: The approximate location of all of all existing utilities has been shown on the drawings and the final location of all tie-ins, taps, etc. shall be approved by the Engineer.

The Contractor shall be responsible for physically locating all existing pipe and appurtenances. No additional compensation shall be paid for such work, but shall be included in the various pay items established for such work.

- (C) TAPPING OR CONNECTING TO EXISTING MAINS: Where tapping sleeves and valves are called for on the plans the connection shall be effected without interrupting service of the existing mains.

Where plans call for "connect (size) to existing (size)" mains the Contractor may cut-in to the existing main. The Contractor shall prosecute the work in such a manner as to minimize the interruption of service to the Owner's customers.

These two items of work are separate and independent, with no duplication between them. (i.e. installation of a tapping sleeve and valve does not qualify in addition as "connecting to existing main").

The Contractor shall notify the Owner and the Engineer at least 24 hours in advance and shall obtain prior approval before proceeding with the work.

- (D) CONNECTING EXISTING SERVICE LINES TO WATER MAINS OR OTHER SERVICE LINES: Where indicated on the plans, the Contractor shall tie existing service lines, regardless of type, to the water main or service line as indicated.

This work shall include all necessary labor, field taps, adaptors, unions, dresser couplings, or other incidental devices required to connect the existing service line to the distribution main. Any gate valves or service pipe required to complete the installation shall be paid for separately.

### 3.12

#### INSTALLING DUCTILE IRON PIPE

Ductile iron water pipe shall be installed in accordance with AWWA C600 (latest

revision). Thrust blocks shall be required at all bends, tees, and other fittings and at water hydrant installations.

"Type I Standard Pipe Foundation" as detailed on the "STANDARD DETAILS FOR WATER DISTRIBUTION SYSTEMS" plan sheet shall be used for the installation of all ductile iron water mains, unless another type is specified on the plans.

When specified in the Special Conditions, Proposal Form and/or Plans, the Contractor shall encase all ductile iron mains in polyethylene encasement. The installation of all polyethylene encasement shall be in accordance with AWWA C105.

### 3.13 INSTALLING PLASTIC PIPE

All plastic water mains shall be installed in strict accordance with the manufacturer's recommendation and thrust blocks shall be installed on all fittings 2 inches in size and larger.

The manufacturer of the type of pipe furnished shall furnish a qualified factory representative for a minimum of three full working days to observe and instruct the Contractor on the proper method of installing every size pipe to be used on the job. The Contractor and the factory representative shall coordinate these days in order to assure that the representative is on the job at the start of the laying of each different size pipe by the Contractor.

Where plastic pipe lines are larger than two inches, valves and fittings will be anchored by tie rods and clamps to concrete anchors. See details on plans.

Solvent cement joints shall be made in accordance with ASTM D2855.

Solvent weld plastic pipe shall be snaked in the trench. Backfill shall not be placed on any plastic pipe while it is in a heated condition. Cooling of the pipe by some method approved by the Engineer will be required, if necessary.

Set time for newly assembled solvent weld joints shall be as follows:

30 Minutes minimum @ 60°F to 90°F

1 Hour minimum @ 40°F to 60°F

2 Hours minimum @ 25°F to 40°F

### 3.14 FIELD CUTTING OF PIPE

Field cutting of all pipe shall be accomplished by a method approved by the Engineer. Any section of pipe which is damaged during the cutting operation (including cement mortar lining) will be rejected.

3.15           SETTING OF VALVES AND FITTINGS

Setting of valves and fittings shall be in accordance with Section 4.2.6 of AWWA C600.

3.16           SETTING OF FIRE HYDRANTS

Setting of fire hydrants shall be in accordance with Section II of AWWA C600 and the "Typical Installation for Fire Hydrants" on the "STANDARD DETAILS FOR WATER DISTRIBUTION SYSTEMS" plan sheets. Hydrant mains will be classed as mains and will be paid for as such.

3.17           INSTALLING SERVICE ASSEMBLIES

The Contractor shall furnish and install service assemblies where shown on the plans or as directed by the Engineer. Service assemblies shall be installed according to the size and type designated on the plan sheets, and the Contractor shall furnish all necessary material, labor, and equipment to completely install the assembly according to this detail. Service pipe shall be a separate item and paid for as such.

The Contractor shall not set the water meters until after all the mains have been hydrostatically tested and disinfected and approved by the Engineer and the State Department of Health.

3.18           THRUST BLOCKS AND ANCHORING DEVICES

The size of the thrust blocks shall be in accordance with details on the "STANDARD DETAILS FOR UNDERGROUND UTILITY CONSTRUCTION". The sizes indicated in these tables were based on an undisturbed soil bearing pressure of 2,000 pounds per square foot. The Engineer shall be the sole judge as to the bearing pressure the soil encountered will be able to sustain. If in his judgment the soil allowable bearing pressure is other than the 2,000 pounds per square foot specified, the size of the thrust block shall be adjusted accordingly.

When indicated on the plans and/or approved by Engineer, the Contractor may install special tie-rods or other locking devices in lieu of installing concrete thrust blocks. In all cases where special thrust devices are utilized only standard items recommended by the pipe manufacturer will be accepted without the specific approval of the Engineer. No separate payment will be made for concrete thrust blocks or special thrust devices.

The cost of these shall be included in the price of other pay items.

The Contractor shall provide and remove any temporary thrust blocks needed to complete the testing of the system. No additional compensation will be made for such temporary thrust blocks but the cost of such shall be included in the various

items for which a price has been established.

3.19 INSTALLING PIPE - BORING AND JACKING METHOD

When permitted by the specifications, certain street, highway, and/or railroad crossings by utility mains may be made by the jacking and boring method. The installation of utility pipe and the boring and jacking method shall be in accordance with A.R.E.A. Specification 1-4-19 thru 1-4-24.

The excavation of all approach pits and trenches within the right-of-way of the highway or railroad shall be of sufficient length from the street or railroad tracks to permit traffic to pass without interference. All backfill on the approach pits and trenches within the right-of-way shall be tamped in layers a maximum of six (6) inches thick for the entire length and depth of the trench or pit. The backfill shall be compacted to 90% of maximum density obtained at optimum moisture as determined by AASHTO T 180-57, Method A. Mechanical tampers may be used after a cover of six (6) inches has been obtained over the top of the barrel of the pipe.

The boring operation shall be accomplished using a commercial type boring rig and the hole made by the installation shall be of the same diameter (within two (2) inches) as the largest outside joint diameter of the pipe installed. The pipe shall be installed in the hole immediately after the bore has been made and in no instance shall the hole be left open while unattended.

In the event sub-surface operations result in injury or damage to the pavement, repairs to this pavement shall be made by the Contractor, at no additional cost to the Owner. In the event paving cracks on either side of the pipeline, or is otherwise disturbed or broken due to the Contractor's operations, he shall repair or replace same at his own expense without further compensation.

3.20 INSTALLING CASING PIPE

When specified on the plans, the Contractor shall furnish and install all utility mains parallel to and under railroad tracks and highways in a casing pipe. This casing shall be complete with end seals, vent pipe, and other specials required to install the main in the casing. All installations shall be in accordance with these Specifications and the requirements of the railroad or highway, as applicable.

Unless otherwise specified the casing pipe shall be installed by the boring and jacking method in conformance with Paragraph 3.19.

3.21 FIELD HYDROSTATIC AND LEAKAGE TESTS

The hydrostatic testing of all lines shall conform to the requirements of AWWA C605, Section 13, or AWWA C600, Section 5.2, except as modified below.

(A) The maximum allowable leakage shall be 10 gallons per inch of pipe

diameter per mile of pipe for 24 hours. The test pressure shall be 150 psi and shall be maintained for a minimum of four (4) hours.

- (B) The test shall be applied to the whole or individual valved-off sections of the mains either before or after the trench is backfilled, as directed by the Engineer.
- (C) The Contractor shall furnish gauges, meters, water, tools, labor, equipment, and all other materials necessary to conduct the tests. The Engineer will be notified at least 48 hours in advance of the hydrostatic test.
- (D) The test pressure shall be 150 psi. The test pressure will be based upon the elevation of the lowest point of the line or section under test and corrected to the elevation of the test gauge. Gauges shall have an operating range of twice the testing pressure and be severe service liquid dampened, and liquid lubricated type.

Should the amount of leakage exceed that specified, the Contractor shall, at his expense, locate and repair the defective joints until the leakage is within the specified limits.

### 3.22 WITNESSING OF TESTS

The costs of witnessing a test by the Engineer shall be borne by the Owner one time. The cost of witnessing re-tests of sections which fail the initial test will be deducted from Contractor payments for compensation of the Engineer.

### 3.23 DISINFECTION

All bacteriological testing shall be conducted by a State certified laboratory.

All new water lines, including appurtenances, shall be disinfected following the acceptance of the hydrostatic test in accordance with AWWA C651. Prior to disinfection, mains shall be filled to eliminate air pockets and shall be flushed with a minimum flushing velocity of 2.5 ft/s.

Disinfection shall be according to AWWA C 651 and the State Sanitary Code LAC 51: XII. Section 245.

While the disinfectant is being applied to any section of the system, the water will be allowed to escape at all extremities of this section until the presence of chlorine is evident by measuring with an orthotolidin test kit furnished by the Contractor.

Once the water mains have been disinfected, flushed and are ready for bacteriological testing, the Contractor shall contact the operator for collection of a sample. If bacteriological tests indicate insufficient disinfection at the completion of

the test and flushing of the system, the procedure shall be repeated on that part of the system at no additional compensation. In no event will water from mains which have not been bacteriologically tested, or which have failed the test, be furnished for use as potable water until such mains have passed the test. The cost of disinfection shall be included in the price bid per foot of testing.

The Contractor shall take whatever steps necessary to prevent the backflow of the strong chlorine solution into any existing water distribution system.

3.24 INSTALLING COPPER WIRE OVER PLASTIC WATER PIPE

The Contractor shall install #12 AWG Type TW insulated solid copper wire directly over and on the center of all P.V.C. water mains. This wire shall be installed on all mains. This wire shall be continuous on all P.V.C. mains and shall be connected to all fixtures and appurtenances.

The Contractor shall install copper wire directly over and on the center of all P.E. service pipe located on or tapped into water mains located on L.D.H. right-of-ways. The wire need not be installed on P.E. service pipe located entirely on and tapped into water mains located on Parish or private right-of-ways.

Installation of the wire shall be as detailed on the standard detail sheets. No special payment will be made for installation of the wire or tape. The cost of such shall be included in the unit price bid for water pipe.

3.25 SPECIAL BACKFILL

Certain areas requiring special backfill shall be as specified on the plans, Proposal Form, and/or Special Conditions. The special backfill shall be of non-plastic granular backfill conforming to Unified Soil Class SW or SP with maximum aggregate size being 3/8 of an inch. The degree of compaction shall be as specified for the various pipe materials.

3.26 SPECIAL FOUNDATION (TYPE III STANDARD PIPE FOUNDATION)

Where indicated on the plans, Proposal Form and/or Special Conditions, all pipe shall be supported by a special lumber foundation and gravel bedding detailed as Type III on the plans. The lumber shall be Southern yellow pine S.P.I.B. Grade No. 2, dimension rough, creosote coal-tar treated, with a minimum net retention of preservative of 16 pounds full cell per cubic foot of wood. The Contractor shall furnish a notarized manufacturer's certificate that the lumber meets specifications both in grade and treatment.

The gravel shall be clean, free from clay, sticks, or other deleterious substances, meeting the following gradation:

<u>Sieve</u>	<u>Percent Passing by Weight</u>
3/4	100
5/8	95-100
No. 4	0-7

3.27 TRENCH BACKFILL AND COMPACTION

(A) Outside Street Surface and Shoulders: The backfill in the trench above the pipe shall be placed in layers and compacted to prevent settlement of the trench. Prior to the final acceptance of the pipeline, the trench shall be level with the surrounding natural ground.

(B) Inside Street Surfaces, Other Paved Areas and Street Shoulders: The backfill in the trench above the pipe zone shall be placed in lifts not to exceed six inch compacted layers and compacted to the approximate density of the surrounding ground. The maximum density shall be determined in accordance with L.D.H. Designation TR 418 and the in-place density determined by L.D.H. Designation TR 401.

The trench shall be compacted for a depth of 2'-0" above the top of the pipe using hand tamps or hand mechanical tamps before the use of a wheel type device or a hydro-hammer shall be used for compaction purposes.

The top six (6) inches shall be compacted to 95% of standard density when measured by AASHO - T99.

3.28 REPLACING STREET SURFACING AND SIDEWALKS

In all paved or unimproved streets, the surface of the trenches shall be finished without any needless delay and in the best workmanlike manner with the same kind of roadway or sidewalk improvement that was removed in excavating the trench.

Should the Contractor fail or refuse to repair any such damage, the Owner may after twenty-four (24) hours written notice, employ such personnel and furnish such materials as may be necessary and do the work, deducting the actual cost thereof from any amounts due or to become due to the Contractor.

The Contractor shall be obligated to maintain and keep in good condition any replacement of base, street surfacing or sidewalks from the time of installation until final acceptance of the work.

3.29 CLEANING UP, REMOVING SURPLUS EARTH, ETC.

As soon as the backfilling of any excavation is completed, the Contractor must at once begin the initial cleanup, grading, shaping and removal of all surplus dirt

except that actually necessary to provide for settlement of the filling. He shall also remove all pipe and other material placed or left on the street or right-of-way by him except material needed for the replacement of the paving. The street shall be opened and made passable for traffic.

The Contractor shall maintain all areas disturbed by construction until such time that all testing, pavement repairs and final restoration are completed. Testing, pavement repair and final restoration shall begin as promptly as possible or as otherwise required by the Special Provisions.

Any surplus earth which may be left on the street or right-of-way after the excavations have been completely refilled shall be removed as soon as possible at his own expense except that in ungraded streets, it shall be optional with the Engineer whether surplus material shall be removed or deposited on the surface and graded for the convenience of traffic.

Final restoration and cleanup shall include grading and shaping ditches disturbed by construction and removing siltation from all drainage pipes and structures.

Final acceptance will not be made until the Contractor has cleaned up the project to the satisfaction of the Engineer and Owner.

### 3.30

#### WARRANTY REPAIRS

Any defects repaired by the Contractor during the construction or warranty periods shall be performed in such a manner that the repaired work shall meet the specifications for original construction. The use of non-standard fittings such as full circle repair clamps shall not be allowed in lieu of standard cast or ductile iron fittings.

## WATER WELLS

### PART 1 GENERAL

- 1.1 GENERAL: This item shall consist of the installation of one or more water wells. The Contractor shall register each water well with the Louisiana Department of Natural Resources within thirty (30) days after completion of the well.
- 1.2 LAYOUT OF WORK: The Contractor shall be responsible for any layout of work and shall locate each well within the boundaries of the site as directed by the Engineer. The Engineer will establish the appropriate boundaries of the site and/or construction easements (if provided).
- 1.3 WATER FOR DRILLING: It shall be the Contractor's responsibility to furnish, haul, or deliver to the site the water required for drilling the well. All water for well drilling and development shall be potable.
- 1.4 TEMPORARY UTILITIES: It shall be the Contractor's responsibility to provide any utilities, including temporary electrical power, required for the work.
- 1.5 LOCAL CONDITIONS: It shall be the Contractor's responsibility to satisfy himself, by personal investigation, of the conditions which may affect the work. Should the Owner or the Engineer furnish any information regarding previous wells or test wells, such as reports, electric logs, driller logs, etc., it shall be understood that such information is not guaranteed as to its accuracy nor that such information is necessarily indicative of conditions which may be encountered in constructing the well to be installed hereunder.
- 1.6 RESTORATION OF THE SITE: The Contractor shall protect all structures such as walks, pipelines, underground utilities, trees, shrubbery and lawns during the progress of his work. The Contractor shall remove from the site all drilling mud, drill cuttings, debris and unused materials.
- Water from the well shall be conducted to a place where it will not cause flooding, damage to property or creation of a nuisance.
- The Contractor shall, upon completion of the work, restore the site as nearly as possible to its original condition including the repair or replacement at the Contractor's sole expense any damage to facility or landscaping.
- 1.7 SANITATION: During all phases of the work, the Contractor shall maintain the premises in a sanitary condition. The Contractor shall exercise all reasonable precautions to prevent the water bearing formations from becoming contaminated.
- 1.8 GROUNDWATER SOURCE TESTING: The approval of these plans and specifications which include a new well water source was contingent that the quality

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of water from the finished well shall comply with the National Primary Drinking Water Regulations promulgated by the U.S. EPA as well as the National Secondary Drinking Water Regulations. The tables below list the constituents that must be tested for by a LDH-OPH certified laboratory for Drinking Water Analysis – Chemistry. A list of certified laboratories is provided in the Appendix. A copy of the results shall be submitted to the Engineer and the Office of Public Health, Attn: Sean Nolan for review and approval. (sean.nolan@la.gov) The following analysis shall be performed:

TABLE 1. INORGRANIC CONTAMINANTS (IOCs), NITRATES/NITRITES, AND CYANIDE

IOC CONTAMINANTS		ANALYTICAL CODE	MCL (mg/L)
1	Antimony	1074	0.006
2	Asbestos	1094	7MFL (> 10um)
3	Arsenic	1005	0.01 – as of Jan 23, 2006
4	Barium	1010	2
5	Beryllium	1075	0.004
6	Cadmium	1015	0.005
7	Chromium	1020	0.1
8	Lead	1030	AL=0.015
9	Copper	1022	AL=1.3
10	Cyanide	1024	0.2
11	Fluoride	1025	4.0
12	Mercury	1035	0.002
13	Nitrate	1040	10 (as Nitrogen)
14	Nitrite	1041	1 (as Nitrogen)
15	Selenium	1045	0.05
16	Thallium	1085	0.002

TABLE 2. SYNTHETIC ORGANIC CONTAMINANTS (SOCs)

SOC CONTAMINANTS		ANALYTICAL CODE	MCL (mg/L)
1	Alachlor	2051	0.002
2	Atrazine	2050	0.003
3	Benzo [a] pyrene (PAHs)	2306	0.0002
4	Carbofuran	2046	0.04
5	Chlordane	2959	0.002
6	Dalapon	2031	0.2
7	2, 4-D	2105	0.07
8	Di [2-ethylhexyl] adipate	2035	0.4
9	Di [2-ethylhexyl] phthalate	2039	0.006
10	Dibromochloropropane [DBCP]	2931	0.0002
11	Dinoseb	2041	0.007
12	Dioxin (2, 3, 7, 8-TCDD)	2063	0.00000003
13	Diquat	2032	0.02
14	Endothall	2033	0.1
15	Endrin	2005	0.002
16	Ethylene Dibromide [EBD]	2946	0.00005

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17	Glyphosate	2034	0.7
18	Heptachlor	2065	0.0004
19	Heptachlor epoxide	2067	0.0002
20	Hexachlorobenzene	2274	0.001
21	Hexachlorocyclo-pentadiene	2042	0.05
22	Lindane	2010	0.0002
23	Methoxychlor	2015	0.04
24	Qxamyl [Vydate]	2036	0.2
25	Pentachlorophenol	2326	0.001
26	Picloram	2040	0.5
27	Polychlorinated biphenyls [PCBs]	2383	0.0005
28	Simazine	2037	0.004
29	Toxaphene	2020	0.003
30	2,4,5-TP [Silvex]	2110	0.05

TABLE 3. VOLITILE ORGANIC CHEMICALS (VOCs)

CONTAMINANTS		ANALYTICAL CODE	MCL (mg/L)
1	Benzene	2990	0.005
2	Carbon tetrachloride	2982	0.005
3	o-Dichlorobenzene	2968	0.6
4	para-Dichlorobenzene	2969	0.075
5	1,2-Dichloroethane	2980	0.005
6	1,1-Dichloroethylene	2977	0.007
7	cis-1,2-Dichloroethylene	2380	0.07
8	trans-1,2-Dichloroethylene	2979	0.1
9	Dichloromethane	2964	0.005
10	1,2-Dichloropropane	2983	0.005
11	Ethylbenzene	2992	0.7
12	[Mono]chlorobenzene	2989	0.1
13	Styrene	2996	0.1
14	Tetrachloroethylene	2987	0.005
15	Toluene	2991	1
16	1,2,4-Trichlorobenzene	2378	0.07
17	1,1,1-Trichloroethane	2981	0.2
18	1,1,2-Trichloroethane	2985	0.005
19	Trichloroethylene	2984	0.005
20	Vinyl chloride	2976	0.002
21	Xylenes [total]	2955	10

TABLE 4. RADIONUCLIDES

RADIONUCLIDE		ANALYTICAL CODE	MCLs
1	Gross alpha particle	4109	15 pCi/L
2	Combined radium 226/228	4010	5 pCi/L
3	Uranium [as of 12/8/03]	4006	30 ug/L
4	Beta particle and Photon emitters	4101	4 mrem/yr <sup>1</sup>
5	Gross Beta	4100	4 mrem/yr <sup>1</sup>

<sup>1</sup> Speciation for Strontium and Tritium is required when Gross Beta exceeds 8 pCi/L.

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Ions:

	Copper	mg/l as Cu
	Silver	mg/l as Ag
	Calcium	mg/l as CaCO <sub>3</sub>
	Magnesium	mg/l as CaCO <sub>3</sub>
	Sodium	mg/l as CaCO <sub>3</sub>
	Potassium	mg/l as K
*	Iron (Total & Dissolved)	mg/l as Fe
	Manganese	mg/l as Mn
	Bicarbonate	mg/l as CaCO <sub>3</sub>
	Carbonate	mg/l as CaCO <sub>3</sub>
	Hydroxide	mg/l as CaCO <sub>3</sub>
	Chlorides	mg/l as Cl
	Sulfates	mg/l as SO <sub>4</sub>
	Lead	mg/l as Pb
	Zinc	mg/l as Zn

Other:

*	Total Hardness	mg/l as CaCO <sub>3</sub>
	Phenolphthalein Alkalinity	mg/l as CaCO <sub>3</sub>
	Methyl Orange Alkalinity	mg/l as CaCO <sub>3</sub>
*	Free Carbon Dioxide	mg/l as CO <sub>2</sub>
*	Hydrogen Sulfide	mg/l as H <sub>2</sub> S
	Silica	mg/l as SiO <sub>2</sub>
	Suspended Solids	mg/l
	Dissolved Solids	mg/l
*	Specific Conductance	micromhos @25°C
*	Temperature	°F
	Color	
	Turbidity	
*	pH	
*	Dissolved Oxygen	mg/l

\*To be chemically analyzed in field immediately upon collection of sample.

The Contractor shall reference the “New Groundwater Source Requirement” document attached to this specification for further requirements.

1.9

LOUISIANA OFFICE OF PUBLIC WORKS STANDARDS: All work under this contract shall be performed in accordance with the applicable rules, regulations, and standards of the State of Louisiana, Department of Natural Resources.

A. OPW WATER WELL CONTRACTOR'S LICENSE: The Contractor shall possess a valid water well contractor's license issued by OPW.

- B. WELL CONSTRUCTION AND REGISTRATION: The well shall be constructed in accordance with the OPW requirements and as specified herein. The Contractor shall register the well in accordance with OPW requirements. The Contractor shall furnish copies of the completed registration form to the Owner and to the Engineer.
- C. PLUGGING AND ABANDONMENT REPORT: Abandoned holes and wells shall be plugged in accordance with the OPW requirements and as specified herein. The Contractor shall report abandonments in accordance with OPW requirements. The Contractor shall furnish copies of the completed report to the Owner and to the Engineer.

**The contractor shall complete the Water Well Plugging and Abandonment Form (DNR-GW-2) if applicable.**

## **PART 2 TEST HOLE**

- 2.1 GENERAL: Each test hole shall be drilled by the hydraulic rotary method for the purpose of obtaining geologic and hydrologic information concerning water bearing formations at the site and for construction of a water well at the site.
- 2.2 DEPTH: The depth of each test hole shall be as shown on the plans or as called for in the proposal form or as directed by the Engineer.
- 2.3 SIZE: The diameter of the test hole shall be not more than 7-7/8 inches and drilled to a reasonably plumb alignment and specified depth.
- 2.4 DRILLING MUD: The type of drilling mud to be used shall be approved by the Engineer prior to its use by the Contractor. Drilling fluids and additives must be non-toxic. Unless otherwise specified, a commercial type drilling mud shall be used during the drilling operations of the test hole only. A record of the type and amount of drilling mud or mud additives during each eight hour tour and the time at which it was added shall be recorded on each tour progress report.

The Contractor may be required to maintain laboratory equipment for the control of drilling mud during all drilling operations. If required by the Engineer, mud weight, viscosity, water loss, pH, sand content and mud cake thickness shall be measured and recorded at least twice during each eight hour tour. These tests shall be run in accordance with the American Petroleum Institute Specifications (Code RP29) for drilling mud testing. The Contractor shall control the mud characteristics so that good drill cutting samples can be obtained and a minimum of time will be required for removal of the mud cake when developing the well.

- 2.5 TEMPORARY CASING: Twenty (20) feet of minimum 10 inch diameter casing shall be set in the top of the test hole. The top of the casing shall extend

approximately 2.5 feet above natural ground. A flow line which extends from the casing to a cutting sample box shall be welded into the casing about one foot below the top of the casing.

- 2.6 DRILL CUTTING SAMPLES: Drill cutting samples shall be collected at intervals of ten (10) feet from sand encountered. Samples may be required at intervals of less than ten (10) feet as directed by the Engineer. During the drilling of sands, collection of samples shall be by the following method:

The penetration of the bit shall stop when the top of the sampling interval is reached and circulation of drilling fluid shall be continued for such time as is required for all the cuttings to move from the last drilled section of the hole to the top of the ground. The zone selected for sampling shall be stopped and circulation of drilling fluid continued for such time as is required for all cuttings to move from the selected zone to the top of the ground. A cutting sample shall then be carefully collected from the cutting sample box. The cutting sample box shall be thoroughly cleaned before and after each sample is taken.

The cutting sample box and method of collecting the samples shall be approved by the Engineer. The principle of the cutting sample box is to divert a representative portion of the flow of mud and drill cuttings through the box continuously during the drilling. The box shall be 24 inches wide, 18 inches deep, and 48 inches long.

Three one-pint portions of each sample taken shall be preserved in cloth sample bags and marked as to depth and well number. One set of samples shall be retained on the job for inspection. The Contractor shall deliver one set of the samples to the Engineer. The third set of samples shall be retained by the Contractor for mechanical analysis.

- 2.7 DRILLER'S LOG: During the drilling of the test hole, a detailed driller's log shall be recorded. The driller's log shall give a complete description of each formation encountered along with accurate measurements of the depths and intervals of each.

- 2.8 ELECTRIC LOG: A minimum of one electric log of the test hole shall be obtained. The electric log shall be of the conventional resistivity type and shall include one spontaneous potential and three resistivity curves. The electric logging equipment shall be as manufactured by Schlumberger Well Surveying Corporation, or approved equal.

The log scales shall be selected by the Engineer. The Contractor shall notify the Engineer 24 hours prior to running the log.

When the required depth is reached, circulation shall continue until all drill cuttings have been removed from the pilot hole. The electric log shall be obtained immediately after removal of the drill pipe from the hole.

The field prints of the electric log shall be approved by the Engineer before the logging service is released from the site by the Contractor.

Six field prints, six finished prints and the original of the log shall be delivered to the Engineer.

2.9 MECHANICAL ANALYSIS OF DRILL CUTTINGS: The Contractor shall have standard mechanical (sieve) analysis performed on each sand sample obtained from the pilot hole. The laboratory and method selected for analysis shall be approved by the Engineer. Results shall be reported in both tabular and graphic form for each sample. Graphic results shall show cumulative percent retained versus sieve size plotted on linear scales.

2.10 TEST WELL:

Test well shall comply with La. State Sanitary Code 51:XII 69 F.

Yield and Drawdown Tests shall:

- a. be conducted in accordance with a protocol pre-approved by the reviewing authority;
- b. be performed on every production well after construction or subsequent treatment and prior to placement of the permanent pump;
- c. utilize methods clearly indicated in the project specifications;
- d. be performed with a test pump with a capacity at least 1.5 times the flow anticipated at maximum anticipated drawdown;
- e. shall provide, as a minimum, for continuous pumping for at least 24 hours at the design pumping rate or until stabilized drawdown has continued for at least six hours when test pumped at 1.5 times the design pumping rate, or as required by the state health officer;
- f. provide the following data to be submitted to the Engineer & state health officer:
  - i. test pump capacity-head characteristics;
  - ii. static water level;
  - iii. depth of test pump setting;
  - iv. time of starting and ending each test cycle; and
  - v. the zone of influence for the well or wells;
- g. provide a report which details recordings and graphic evaluation of the following at one hour intervals or less as may be required by the Engineer or state health officer:
  - i. pumping rate;
  - ii. pumping water level;
  - iii. drawdown; and
  - iv. water recovery rate and levels;
- h. at the discretion of the Engineer and/or the state health officer, more comprehensive testing may be required.

2.11 WATER SAMPLE: If test hole water samples are required, the basis of payment shall be as indicated on the proposal form.

The water bearing sands to be sampled and the number of water samples to be obtained shall be as directed by the Engineer.

The size of temporary casings and screen to be installed and the methods employed by the Contractor in obtaining water samples shall be approved by the Engineer.

Not less than ten (10) feet of screen equipped with a back pressure valve and with approved slot openings shall be set opposite the selected sand intervals as directed by the Engineer.

The casing and screen shall be placed in the hole and development started as soon as possible after the electric log is obtained to preclude drilling mud intrusion into the sampling interval.

After the screen is set, clear water will be pumped through the screen back-pressure valve to remove drilling mud, cuttings and fine sand from around the screen. The above will be modified if clear water is used to wash the screen into a clean sand after drilling to top of sand or under-reaming with clear water and gravel-packing. Additional development shall continue until the water is clear and the well produces a sustained yield of not less than 20 gallons per minute, and at least 0.5 gallons per minute per foot of drawdown.

The method of sampling shall produce a representative water sample from the test interval and shall not allow water from other sands or drilling mud to contaminate the water sampling interval.

The Contractor shall provide a test pump, of a type other than air lift or jet and approved by the Engineer, having a minimum capacity of 20 gallons per minute. The tail pipe of the pump shall be equipped with a foot valve. Provision for water level measurements by electric tape will be made for measuring before, during, and after pumping as often and for a period as specified by the Engineer.

A small diameter drop pipe will be required for electric tape water level measurement if the water surface cannot be continuously determined between the casing and pump column. The well will be allowed to flow or be pumped at a constant sustained rate of 20 gallons per minute for not less than six hours and until the water is of constant chemical quality, clear, free of drilling mud and fine sand. The Contractor shall obtain, in an approved container, a sample of the water for chemical analysis.

2.12 CONTRACTOR'S REPORT: Immediately upon completion of each test hole, the Contractor shall prepare and present to the Engineer a written report in duplicate which shall include the following:

1. Detailed driller's log
2. Electric log
3. Mechanical analysis of formation sand samples

4. Contractor's recommendations for completion of a permanent water well including:
  - a. Screen, casing, and liner settings
  - b. Screen slot size
  - c. Gravel pack material
5. Mechanical analysis of recommended gravel pack materials.
6. Chemical analysis of each water sample

2.13 OBLIGATION OF CONTRACTOR: A satisfactory test hole acceptable under these specifications shall be completed to the depth designated. If the Contractor fails to sink a test hole to the depth ordered by the Engineer, the hole shall be declared abandoned. Any hole in which the Contractor voluntarily stops work and/or fails to complete in a satisfactory manner within the overall time limit set by this contract shall be considered as abandoned by him and no payment will be made for any part of the drilling.

2.14 PLUGGING ABANDONED HOLE: Any test hole which has been abandoned by the Contractor or if successfully completed but not to be immediately further utilized for completion of a permanent water well shall be plugged as specified herein.

The Contractor shall remove if possible all temporary casings and screen. The test hole shall then be plugged upward from the bottom of the hole to within 6 feet of the ground surface with cement slurry in one continuous operation. The remaining hole shall be filled with native soil. Cement slurry shall consist of a mixture of cement, water, and other additives in the approved and proper water ratio. If the ratio of water exceeds (5) gallons per sack of cement (94 lbs.), bentonite or other additives shall be used to avoid free water in the slurry. A maximum of ten (10) gallons of water per sack of cement and eight (8) percent gel shall not be exceeded. Additives may be used to accelerate or retard the setting time, if required. The cement shall be placed by the circulation or pump down method. In no case shall cement be poured or dropped into the hole.

The well shall be abandoned in accordance with LAC 56, Part I.

### **PART 3 WATER WELL CONSTRUCTION**

3.1 GENERAL: The Contractor shall install one or more water wells of the size and type as shown on the plans and/or as indicated on the proposal form.

The Contractor may, where appropriate, utilize the test hole as the pilot hole for the permanent water well. Based on the Contractor's written report of test hole results the Engineer will select the depth to which surface casing shall be set and the depths and lengths of blank liner or interior casing and screen. If the Engineer's selections differ from the Contractor's recommended material settings and if the Contractor objects to the Engineer's selections, he shall immediately present to the Engineer, in writing, his objections and reasons therefor and shall discontinue work until a decision is reached in this regard. Otherwise, the Contractor shall construct the

required well in the test hole, meeting all the provisions and guarantees of these specifications and other contract documents.

3.2 PLUGGING OF TEST HOLE BELOW BOTTOM OF WELL: If a test hole has been drilled appreciably deeper than the total depth selected for the water well, the Contractor shall plug the test hole immediately below the bottom of the water well in a manner acceptable to the Engineer. The Contractor shall satisfactorily assure the Engineer that the test hole has been plugged.

3.3 SURFACE CASING:

- A. REAMING: The test hole shall be stage test reamed to a minimum diameter of four inches larger than the diameter of the surface casing.
- B. ALIGNMENT SURVEY: The Contractor shall run a casing alignment survey. The alignment of the casing shall be checked by an Eastman self-checking mechanical drift indicator as manufactured by the Eastman Oil Well Survey Company, Houston, Texas, or approved equal. The plumbness and alignment of the well shall be in accordance with AWWA standards.

The Contractor shall double punch a printed paper disc and furnish a copy to the Engineer. At no point shall the casing be out of alignment more than  $\square$  1.0 degrees.

The operation and use of the drift indicator shall be in strict accordance with the manufacturer's instructions.

A positive means shall be employed to mechanically center the drift indicator along the axis of the casing.

Should the alignment not be in the prescribed limits, the Contractor shall, at his own expense, correct the alignment within the limits or abandon and plug the hole and drill another hole at this site.

- C. CASING: All casing installed shall be new, Steel A.P.I. 5L, Grade B line pipe with plain ends beveled for welding and shall conform to the following:

<u>O.D.</u> <u>(inches)</u>	<u>Wall</u> <u>Thickness</u> <u>(inches)</u>	<u>Weight</u> <u>Per Ft.</u> <u>(lbs.)</u>
4.5	.237	10.79
6.625	.280	18.97
8.625	.322	28.55
10.75	.365	40.48
12.75	.375	49.56
14.00	.375	54.57

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16.00	.375	62.58
18.00	.375	70.56
20.00	.375	78.60
22.00	.500	114.81
24.00	.500	125.49
26.00	.500	136.17
28.00	.500	146.85
30.00	.500	157.53
32.00	.500	168.21
34.00	.500	178.89
36.00	.500	189.57

The casing shall conform to LAC 56:I.325.

The lower end of all wells with surface casing exceeding 250 feet in length shall be fitted with a standard combination float and guide shoe. The talley of casing to be set shall be approved by the Engineer prior to placement in the well. The surface casing shall be equipped with centralizers with the first one located four feet above the bottom of the casing and then one approximately every 80 feet above that to the surface to hold the casing in the center of the hole. The top of the casing shall extend two feet above land surface or above 100-year flood elevation whichever is greater.

- D. WELDING: Welding shall be done in accordance with the American Welding Society specifications and the American Petroleum Institute Specifications. All welding shall be done by a qualified welder, using adequate equipment, rods compatible with the casing material, with full penetration, avoidance of slag inclusion, and complete filling of the weld space with weld metal. The casing shall be spaced and aligned before the first bead is run. A minimum of four aligning straps a minimum of four feet in length shall be used to align the casing. Proof of the welder's qualifications may be requested by the Engineer prior to any welding.
- E. CEMENTING: The surface casing shall be cemented in place with a minimum of two inches of cement grout around the outside of the casing from bottom to top. The cement shall be placed by a standard Halliburton cementing method, involving pumping from the bottom of the casing up the outside of the casing, and by a well cementing company approved by the Engineer.

The hole and casing shall be circulated prior to beginning any cementing operations.

The viscosity of the drilling mud shall be reduced prior to circulation to a minimum to keep the hole open.

Cementing shall meet standard set in LAC 56.329 "Methods and Standards

for Cementing the Annular Space”. The following regulations shall apply to all water wells, regardless of use or type.

1. Annular space shall be sealed with cement bentonite slurry, which is a mixture of cement, bentonite and water, consisting of not more than 8 percent bentonite by dry weight of the cement, and a maximum of 10 gallons of water per sack (94 pounds) of cement. Additives, in the approved and proper ratio, may be added to the slurry if required. If the slurry is to be prepared in the field, it is recommended that the bentonite be added after cement and water are thoroughly mixed. Sodium bentonite with a minimum porosity of 10-8 may also be used.
2. Neat cement, which is a mixture of cement and water consisting of not more than 5 gallons of water per sack (94 pounds) of cement, may be used in lieu of cement bentonite slurry.
3. Cement-bentonite slurry shall be placed in the annular space in a continuous operation from bottom of the space to be cemented, up to the ground surface. Slurry shall be placed by the circulation or pump-down method unless specified otherwise. The pump-down method may include the "Halliburton" method, inner string cementing, or positive placement-exterior method. The selected method should ensure uniform coverage of slurry throughout the annular space.
4. A suitable cement retainer, packer, shale trap, boot or plug shall be secured to the casing at the appropriate depth to prevent leakage or migration of the slurry into the bottom of the well.
5. The cement-bentonite slurry shall fill a minimum annular space of 1 1/2 inches for 4-inch and smaller wells, and a minimum of 2 inches for 6-inch and larger wells. For cementing methods using a "tremie" or "grouting pipe" placed in the annular space, sufficient space should be provided to accommodate the tremie pipe.
6. If a conductor pipe is used, it shall be cemented in place and the annular space between the well casing and the conductor pipe shall be made watertight by grouting with cement-bentonite slurry from bottom of the conductor pipe to the ground surface.
7. If one or more sands between the ground surface and the production sand contain saline water and/or water of objectionable quality, the annular space between the well casing and the hole shall be sealed with cement-bentonite slurry, at a minimum, to a depth of not less than 20 feet below the deepest sand containing the water of objectionable quality unless full depth cementing is required by §329.C.

3.4

UNDERREAMED HOLE BELOW THE SURFACE CASING:

- A. METHOD OF REAMING AND DIAMETER: The hole below the surface casing shall be underreamed to a minimum diameter of 14 inches larger than the O.D. of the screen. The underreaming shall be done with a Baker hydraulic or spring loaded underreamer, or approved equal. After the hole has been underreamed to the total depth of the screen setting, the wall of the underreamed hole shall be scraped through its entire length with a Baker hydraulic underreamer, or approved equal.
- B. ORGANIC DRILLING MUD: Prior to drilling and underreaming of the water-bearing aquifer any clay-based, bentonite-based or similar drilling mud shall be removed from the circulation system and disposed of.

If it is necessary to use a drilling mud during the underreaming and gravel packing operation, the drilling mud shall be an organic, self destructing, bio-degradable material. The organic drilling mud shall be "Revert" as manufactured by Johnson Division UOP, Inc., or approved equal.

The Contractor shall remove the organic drilling mud from the well immediately after gravel packing the well. Before the underreaming operation is begun, the Contractor shall advise the Engineer of his proposed schedule of operations and method of removal of drilling mud from the well. All equipment necessary for the removal of the drilling mud shall be available at the site prior to commencement of underreaming operations. The well shall not be allowed to stand idle with organic drilling mud in the hole. All traces of drilling mud shall be removed from the well as soon as possible after gravel packing the well.

The well will not be accepted until all traces of organic drilling mud are removed from the well.

3.5

LINER:

- A. MATERIAL SETTINGS: The lengths of the several components of the liner and the positions at which the several components of the liner shall be set in the well have been estimated as shown by the base lengths given in the proposal and contract drawings. The exact material settings will be selected after the test hole has been completed.
- B. STEEL LINER: The steel liner shall be API 51, Grade B plain end beveled for welding and shall conform to the requirements for surface casing, paragraph 33 11 13-3.3(c).
- C. STAINLESS STEEL LINER: The stainless steel liner shall be seamless or welded pipe, plain end beveled for welding, Schedule 40S, Type 304 and

shall conform with ASTM A312.

- D. SCREEN: The screen shall be of the continuous slot, wire wound, all welded design. Unless shown otherwise on the drawings, the screen shall be iron pipe size O.D. The screen and all end fittings and attachments shall be Type 304, 18-8 stainless steel. End fittings shall be welded to the screen body. The screen shall be as manufactured by Johnson Division of U.O.P., Inc.

The screen slot size shall be selected on the basis of a mechanical sieve analysis of the gravel pack material. The screen column strength and collapse strength shall be as recommended by the screen manufacturer for the conditions of the well design. It shall be the responsibility of the Contractor to submit samples of the water bearing aquifer formation(s) to the screen manufacturer for analysis and recommendations.

The screen shall be provided with a bottom plate or wash down bottom fitting of the same material as the screen.

The Contractor shall submit his recommendations and those of the screen manufacturer to the Engineer for approval, prior to ordering the screen.

The screen shall meet the requirements of LAC 56.327. Screen entrance velocity shall not exceed 0.1ft/s at final design flow rate.

- E. GUIDES: Groups of three centering fins shall be placed on the outside of the blank liner or interior casing in the lap between the liner and the surface casing. The first group of centering fins shall be five feet above the bottom of the surface casing, and the next group shall be five feet below the top of the blank liner. Centering guides shall also be used on the screen at approximately 50 foot intervals with one at the top and bottom, between the screen and the underreamed hole. The fins and guides to be used shall be steel, and their positions shall be approved by the Engineer.
- F. WELDING: Welding of stainless steel screen shall be done in accordance with the American Welding Society Specifications and the American Petroleum Institute Specifications.

### 3.6 GRAVEL WALL:

- A. GRAVELING OPERATION: The annular space between the screen and the face of the underreamed hole and between the lap pipe and the surface casing shall be filled with selected gravel to within five feet of the top of the lap pipe. The gravel shall be placed in the well through a gravel line which shall first be set at the bottom of the well and gradually withdrawn as the gravel rises. The gravel shall be pumped with water from the surface through this line. The well shall be washed continuously through the back-

pressure valve during the graveling operation to insure that no bridging of the gravel occurs. The volume of gravel placed in the well shall not be less than the calculated volume of the annular space between the underreamed face of the well and the outside of the line and screen plus the annular space between the line and the surface casing. A quantity of gravel amounting to at least 30 percent more than this computed annular space shall be stocked on location before the graveling operation is started. After development, testing, and completion of the well, the gravel level shall be checked and returned to five feet below the top of the liner.

- B. GRAVEL TYPE: The type and size of gravel to be used shall be determined and selected by the Contractor from the character and mechanical analysis of the water-bearing formation. The gravel selected by the contractor shall be equal to Gifford-Hill, Texas Construction material, or approved equal. The gravel shall be washed, screened, and without sharp edges. The gravel shall be free of all dirt, trash, clay, or other foreign substances. Crushed gravel shall not be used. A sample of the gravel and the mechanical analysis of the gravel shall be delivered to the Engineer for approval at the time the Contractor submits his evaluation of the test hole.
- C. STERILIZING GRAVEL: The gravel shall be sterilized by mixing 100 pounds of granulated 70 percent calcium hypochlorite with the gravel as it is placed in the well.
- D. STORING GRAVEL: The gravel shall be protected in a manner approved by the Engineer when stockpiled on the job.

3.7

WELL DEVELOPMENT:

- A. METHODS AND PURPOSES: The well shall be developed by mechanical methods consisting of agitation and washing with a tandem agitator under pressure and backwashing and pumping with test pump equipment specified in Paragraph 221-2.8 to remove the mud cake from the face of the waterbearing formation and any mud material that has penetrated the waterbearing formation, and to orient and stabilize the waterbearing materials and gravel pack. The methods and procedures used for development shall be approved by the Engineer. The Contractor shall follow LAC 51:XII.169.F.1 and LAC 51:XII.169.F.3.

Geological data shall:

- a. be determined from samples collected at 5-foot intervals and at each pronounced change in formation;
- b. be recorded and submitted to the Louisiana Department of Natural Resources, Office of Conversation (DNR-OC) and the state health officer.

- c. be supplemented with a driller's log, accurate geographical location such as latitude and longitude or GIS coordinates, and other information on accurate records of drill hole diameters and depths assembled order of size and length of casing, screens and liners, grouting depths, formations penetrated, water levels, and location of any blast charges.

During development, the Contractor shall provide the Engineer with yield and water level measurements (through drop pipe) at specified times to determine the increase in specific capacity. Development shall continue until, in the opinion of the Engineer, the specific capacity cannot be increased by additional development.

During development the Contractor shall provide means for pumping at a rate that will carry all sand passing through the screen to the surface.

3.8

DISINFECTION:

- A. METHODS AND PURPOSES: The well shall be disinfected by the contractor. Disinfection shall comply with LAC 51:XII. 245 for water mains and 169 for water well.
- B. BACTERIOLOGICAL SAMPLE: The Contractor shall arrange for a bacteriological sample from the well. Such sample shall be tested by a LDH approved laboratory and shall be 'negative' for bacteria.

**WATER WELL EQUIPMENT  
SUBMERSIBLE VERTICAL TURBINE PUMPS**

**PART 1 GENERAL**

- 1.1 DESCRIPTION: This item shall consist of furnishing, installing, and testing pumps, electric motors and motor controls, column pipes, discharge heads with sanitary well seal and appurtenances, complete in the well at the site as shown on the plans.
- 1.2 LAYOUT OF WORK: The Contractor shall be responsible for any layout of work as directed by the Engineer. The Engineer will establish the appropriate boundaries of the site and/or construction easements (if provided).
- 1.3 TEMPORARY UTILITIES: The Contractor shall make his own arrangements for electrical power to be used in the permanent pump test.

**PART 2 WELL EQUIPMENT**

2.1 GENERAL: The equipment herein specified and as shown on the plans shall be furnished and installed complete, tested and approved in accordance with these specifications and as shown on the plans. Following are specifications for vertical turbine and submersible type pumping equipment. The type equipment shown on the plans and proposal form shall determine which is applicable.

2.2 PUMP OPERATING CONDITIONS:

The official production rate of the well shall be the water measurements made during the test, and shall not be less than the required capacity, at the required delivery conditions. The Contractor warrants the well(s) for this capacity for a period of one year from the date of acceptance by the Owner, as evidenced by a written final acceptance.

The water well pump shall meet the following requirements:

Water Level	=	(TBD) Feet
Drawdown	=	(TBD) Feet
Capacity (Q)	=	240 GPM
Total Head	=	121 Feet
Well Size	=	12" I.D. Casing
Motor Size (min.)	=	15 Hp
R.P.M. (max)	=	3500
Efficiency (pump min.)	=	70%
Pump Setting (Approx.)	=	75
Column Pipe	=	6" Diameter

2.3 VERTICAL TURBINE PUMP: The pump to be furnished and installed shall be water lubricated as shown on the plans and/or specified in the bidding documents. Pump shall be as manufactured by Aurora Pump Company, Layne & Bowler, Inc., Goulds Pumps, Inc., or approved equal, and shall be in accordance with ASA B58.1 Standards.

The pump shall be designed to deliver 240 GPM against 121 feet (TDH) discharge head. Contractor shall provide a pump and motor selection such that the wire to water efficiency is equal to the best generally available in this type of application. Pump performance curves and data shall be submitted to the Engineer by Contractor.

2.4 PUMP DISCHARGE HEAD: A suitable pump head of high grade cast iron ASTM A48, class 30, shall be provided for mounting the motor and supporting the pump column, bowls and suction pipe. The discharge shall be flanged, above ground type and shall be drilled to match ANSI class 125 cast iron connections and of the size as indicated on the plans. The discharge flange shall have a 1/4" NPT connection for a pressure gauge. The motor drive shaft shall couple to the head or line shaft above the stuffing box.

On water lubricated pumps, a cast iron, ASTM A48, class 30, stuffing box shall be provided with a minimum of 5 rings of packing and a split type bronze or brass packing gland. Connections for grease inlet and pressure relief shall be provided. The packing gland shall be secured in place with stainless steel or brass studs and bronze or brass nuts. The stuffing box bushing or bearing shall be bronze or brass.

On oil lubricated pumps, a cast iron tube tension box designed to maintain proper tension in the shaft tubing at all times when locked in position, shall be provided with a grooved bronze tension bushing or bearing. A lubricator shall be mounted on the head equipped with a five (5) quart oil reservoir and solenoid operated on voltage as shown on plans.

2.5 COLUMN PIPE: The column pipe shall be the standard full weight steel pipe and shall conform to ASTM A53 specifications. The following shall be minimum dimensions for column pipe:

Nominal Diameter	Weight/Foot	Wall Thickness
3"	7.58 lbs.	.216"
4"	10.79 lbs.	.237"
6"	18.97 lbs.	.280"
8"	28.55 lbs.	.322"
10"	40.48 lbs.	.365"

The size of the column pipe shall be as required to handle the design flow of water without excessive friction loss and shall be as approved by the Engineer. The pipe

shall be machine threaded and faced parallel to butt when coupled together to assure perfect alignment. Intermediate section shall not exceed 10 feet in length and shall be interchangeable. The top and bottom section shall not exceed 5 feet in length.

- 2.6 LINE SHAFT: The line shaft shall be of ASTM A108, Grade 1045 (AISI C1045) steel ground and polished. The top line shaft section or head shaft section shall be of ASTM A582, Type 416, stainless steel. The intermediate sections of line shaft shall be furnished in interchangeable sections not to exceed 10 foot in length. The shaft shall be of adequate size to operate the pump without distortion or vibration and shall be capable of carrying the maximum thrust that may be generated by the motor and shall be left hand threaded to tighten during pump operation. Shaft couplings shall be machined from solid bar steel of the same type as the shaft. On water lubricated pumps, the shafting shall be fitted with stainless steel sleeves or chrome faced sections (Rockwell #76) at the points where lineshaft bearings are installed.
- 2.7 LINE SHAFT BEARINGS: The line shafts shall have bearing assemblies installed every 10 feet or as approved by the Engineer. In water lubricated pumps, the line shaft bearings shall be of synthetic rubber and of the fluted type designed to flush sand and grit rapidly. The bearing retainer shall be cast bronze construction and shall hold the bearing without use of auxiliary collars or rings. Replacement bearings shall be capable of being installed by hand without special tools. The aligning spiders may be cast integrally with the column pipe couplings or of the "drop-in" type as approved by the Engineer. In oil lubricated pumps, the lineshaft bearing shall be cast of continuous cast bronze alloy, machined, threaded and grooved for positive lubrication.
- 2.8 SHAFT ENCLOSING TUBE: The shaft enclosing tubing to be furnished under this section shall be of sufficient diameter to provide lubrication under any operating condition. The tubing shall be black, Schedule 80, ASTM A120, Grade B, continuous weld prime line pipe. The lengths shall be interchangeable with the exception of the top section. The tubing shall be centered in the discharge column with rubber spiders or cast integral, cast iron spiders at not more than 10-foot intervals.
- 2.9 BOWL ASSEMBLY: The pump bowls, suction and discharge cases shall be of close grained cast iron equivalent to ASTM A48, Class 30. The bowls shall be porcelain enamel coated. The pump impeller shaft shall be 410 stainless steel with a bearing on each side of every impeller. Bowl bearings shall be fully lubricated at all times. The impellers shall be of cast bronze and shall be either enclosed or semi-open type locked to the shaft by tapered collets and threaded lock nuts. The suction case bearing shall be grease packed with a provision for grease circulation from a reservoir in the hub. A sand collar of rubber, brass or bronze shall be provided. In oil lubricated pumps, a tube adaptor of extra heavy steel tubing with epoxy coating shall be located in the discharge case to provide a means of

connecting the oil tubing to the bowl assembly by use of an adaptor bearing or bushing.

2.10 SUCTION PIPE & STRAINER: Contractor shall furnish a suction pipe of at least 10 feet in length of black steel pipe, ASTM A53, Grade B, threaded for attachment to the pump. The size of the pipe and strainer shall be as approved by the Engineer.

2.11 PRE-LUBRICATION AND LUBRICATION: For water-lubricated pumps, a heavy duty continuous-flow lubricating device complete with piping isolating valves shall be installed. A system which does not pre-lubricate the water lubricated shaft bearings shall not be acceptable. The system shall be suitably sized for the necessary pump column size and anticipated water level. Piping shall be tapped into the discharge pipe at a point beyond the check valve and insulated to minimize exposure to freezing.

Oil lubricated pumps shall be equipped with a heavy duty automatic solenoid operated drip feed five (5) quart oiler mounted on the pump head or motor frame.

2.12 ELECTRIC MOTOR: The motor shall be of the vertical shaft, squirrel cage, induction type, drip proof, and shall be of the NEMA Type 1, weather protected and furnished with windings for protection in moist atmosphere. NEMA Class "B" insulation, moisture and non-hygroscopic. Motor shall be standard vertical hollow- shaft for operation not to exceed 1800 RPM at no load. The motor shall be of the normal torque, low starting current type designed for across-the-line starting and shall be capable of carrying full load continuously for operation in a 40°C ambient. The thrust bearing shall be of ample capacity to carry the maximum hydraulic thrust load of the pump plus the total weight of all rotating assembly. The motor shall be equipped with a ratchet to prevent backspin of the motor shutdown. The motor shall run on 3 phase., 60 hertz, 240 volt with a minimum horsepower rating of 15 HP.

2.13 SUBMERSIBLE TURBINE PUMP:  
The pump and motor furnished and installed shall be completely water cooled and water lubricated and shall be capable of delivering the required GPM at the conditions set forth in the Special Conditions. The pump shall be as manufactured by Red Jacket, Grundfos, or approved equal and shall have a speed of not more than 3,600 RPM.

2.14 PUMP CONSTRUCTION:(a) Bowl Assembly: The pump bowl assembly shall meet the requirements of specification paragraph D1-4.2a. A suitable column check valve shall be installed immediately above the bowl assembly.

(b) Column Pipe: The column pipe shall be schedule 40 steel pipe with threaded sleeve type steel couplings and shall be in random lengths each approximately twenty (20') feet long.

(c) Cable: The power cable to the motor shall be impervious to moisture in addition to having high abrasion resistance. The cable shall be protected with a steel guard where it passes by the bowl assembly to prevent damage from contact with the well casing. A cast iron or welded steel weatherproof terminal box shall be furnished and installed on top of the base plate. The cable terminations at the terminal box shall be provided with terminal lugs. The cable size shall be such that the voltage drop does not exceed three percent (3%) between the starter and the motor. Stainless steel cable clamps shall be provided to support the cable along the column pipe at intervals of not more than twenty (20') feet.

(d) Discharge Ells: The discharge elbow shall be of close grained cast iron having a minimum tensile strength of 35,000 psi or shall be of fabricated steel. It shall be provided with 125# American Standard flange, faced and drilled or threaded for standard pipe thread of the same diameter as the column pipe. The supporting base plate shall be of ample size to carry the complete weight of the suspended parts plus the hydraulic load with a good margin of safety. The base plate shall be provided with eyebolts of suitable size to support the suspended equipment safely during installation and servicing operations. Two IPS tapped openings shall be provided to permit the installation of an air line and to allow the well to "breathe" properly during starting and stopping the pump.

2.15

SUBMERSIBLE MOTOR: The motor shall be of the vertical, submersible squirrel cage, 3-pole induction type designed for continuous duty under-water operation on 3-phase, 60-cycle, (220) (440) volt alternating current. The motor shall be designed with normal starting torque and low starting current for cross-the-line starting. The motor shall have a 1.15 service factor. The motor shall not be loaded in excess of 100 percent of its nameplate rating within normal operating range of the pump. Motor and pump shall be manufactured by the same manufacturer in order to assure properly integrated design, and have single responsibility for the whole unit under warranty. The manufacturer shall state whether or not special baffling is required to direct the flow around and past the motor for adequate cooling of the motor. Any such baffling shall be designed so that it will be part of the pump and motor assembly. The motor shall be enclosed in a water filled housing. Means shall be provided for circulating the water within the motor for adequate heat distribution and heat transfer. A suitable seal shall be provided to limit interchange of well water with the water in the motor. A protective sand collar shall be provided over the seal to protect it from sand and abrasives in the well water, and flushing ports provided to prevent accumulation of abrasives around the seal when the unit is stopped. Any difference in pressure between the well water and water in the motor shall be equalized through the action of a neoprene diaphragm at the bottom of the motor. The use of a check valve for the equalizing of pressures will not be permitted. The motor shall be designed in accordance with the latest standards of the A.S.A. and N.E.M.A. for the class of insulation used. The motor shall be provided with a pivot-shoe type thrust bearing of ample size to carry the hydraulic thrust of the pump under all

operating conditions. An adequate upthrust bearing arrangement shall be provided.

All parts of the motor in contact with the well water shall be stainless steel and/or bronze.

2.16

MISCELLANEOUS:

(a) WATER LEVEL INDICATOR: Brass tubing (1/4 inch i.d.-minimum) with the necessary connections, gauges and hand air pump shall be furnished for determining static and pumping water levels. The tubing shall extend to the top of the pump bowl and shall be strapped to the column pipe with bands spaced at 20-foot intervals. Plastic tubing shall not be permitted. If sufficient annular space is available, an electrode sounder may also be furnished if required in special conditions.

(b) AIR VENT ASSEMBLY: A one-inch screened air vent assembly shall be incorporated in the well as shown on plans.

(c) PRESSURE GAUGE: The well Contractor shall furnish and install a minimum 2 1/2" diameter glycerin-filled pressure gauge on the pump discharge flange. This gauge shall be rated for pressure range 0 to 100 psi.

(d) DISCHARGE PIPING: The pump discharge piping shall include the items as shown on the plans. Contractor shall paint all above ground pipe work with two (2) coats of bituminous paint acceptable to the Engineer and shall be insulated as required.

(e) TECHNICAL DATA AND DESCRIPTIVE LITERATURE: Four (4) copies each of the technical data and descriptive literature shall be furnished the Engineer by the successful bidder prior to use on the job. This data must meet the approval of the Engineer before any of the material or equipment may be used for the installation.

Data thus required must include, but not be limited to the, following items: Motor, pump, pump column, pump head, screen, motor control, valves, meters, gauges, etc. Characteristic curves of motor and pump and the calculated wire to water efficiency must also be included.

Contractor shall furnish Engineer, upon acceptance and contract completion, four (4) copies of operation and maintenance data for all equipment used. Contractor shall also include a schematic of the completed electrical system as installed by the electrical contractor, if this work was performed under this contract.

(f) **WARRANTY AND GUARANTEE COVERING PRODUCTION WATER WELL:** Should it be decided to construct a production water well based on test well results and information provided by the Contractor, warranty and guarantee covering the production water well shall be as follows:

1. **Mechanical Warranty:** The Contractor shall warrant all components of the production water well to be free from defects in both materials and workmanship for a period of one (1) year after acceptance by the Owner, except that any warranties by the manufacturer of materials longer than one (1) year shall be transferred to the Owner.

2. **Operational and Yield Guarantee:** The Contractor shall guarantee that the production water well shall produce the specified capacity for one (1) year from date of final acceptance; unless an additional well or wells are later installed with a radius of influence overlapping into that of this well, at which time the capacity shall be reduced by the net effect, if any, of such well as determined by acceptable groundwater hydrology methods.

(g) **CLEAN-UP:** The Contractor shall, after acceptance of the various items of work, neatly clean all his work area, including any access areas, such that after clean-up, the areas shall be in a neat manner and shall be in at least an equal condition as when the Contractor started his operations.

(h) **WATER WELL REGISTRATION:** Contractor shall register the production well in accordance with requirements set forth in Chapter 1, Water Well Rules and Regulations, State of Louisiana. Contractor shall furnish Engineer with copy of completed registration form.

2.17 **OFFICIAL TEST:** When the Contractor has completed the installation of the permanent pumping equipment & has operated the same ready for test, the installation shall be tested in the presence of the Owner or his representative for a period of twelve (12) hours. Reasonable stops, not to exceed a total of one hour, for the adjustment of the equipment and measuring devices shall be allowed during this period. The capacity of the pump shall not be less than 300 gallons per minute as measured at the discharge flange of the pump and at a discharge pressure of 15 pounds per square inch, at any time during the test. The amount of water flowing from the pump shall be measured by an orifice test. All testing and measuring devices shall be furnished by the Contractor. It shall be the Contractor's responsibility to provide a means for removing the discharge water away from the well location.

### **PART 3 METHOD OF MEASUREMENT & PAYMENT:**

3.1 **TEST HOLE:** The final depth of the test hole shall be from the ground surface to the maximum depth measured by the electrical and gamma ray logs. The test hole shall be measured as a unit as indicated on the proposal form, including sand sample, logging service, Contractor's evaluation and abandonment if so required.

Section 33 11 37 – Submersible Centrifugal Well Pumps

Should the total depth indicated by the E-log differ from the original proposal, an adjustment to the lump sum amount will be made.

- 3.2 TEST WELL: The test well shall be measured and paid for lump sum as per bid proposal and shall include reaming, setting temporary casing and screen, setting of temporary casing, installation, and removal of test pump, development of well, and taking of one water sample and other work as described in the specifications relative to this test well. Should the Engineer direct that additional water samples from other depths be obtained, this lump sum price will be adjusted accordingly.
- 3.3 WATER WELL: The final production well shall be measured per each completed and accepted based on setting casing of the size and length specified with a minimum of 2 inches of grout, underreaming, setting the specified length of all stainless steel screen of the size specified, inner casing of size and length specified, gravel packing, development, test pumping, sterilization, installation of pump foundation and slab, and any other work necessary to provide the Owner with a complete and acceptable well ready for installation of a pump and motor. Any variation of approved installed lengths of outer casing, inner casing or screen from those specified shall be reflected by a change in the bid price using the price adjustments shown on the bid proposal.
- 3.4 VERTICAL TURBINE PUMP: This payment unit shall be measured per each completed and accepted furnishing and installing of a vertical turbine pump, including approved pump size, number of stages, column pipe as specified, 10 foot suction pipe with strainer, one electric motor of horsepower, voltage and phase specified including furnishing of one complete motor control adequately sized for motor specified. The payment shall be made for a complete and accepted installation of the pump and motor and any variance of the column pipe length shall result in an adjustment of this bid price using the adjustment unit price indicated on the proposal form.
- 3.5 SUBMERSIBLE TURBINE PUMP: This payment unit shall be measured per each completed and accepted furnishing and installing of a submersible turbine pump, including approved pump size, number of stages, column pipe as specified, one discharge ell and one pump bowl assembly capable of delivering the specified number of gallons per minute against the required head at an efficiency of not less than 75%, one electric motor of horsepower, voltage and phase specified including furnishing of one complete motor control adequately sized for motor specified. The payment shall be made for a complete and accepted installation of the pump and motor and any variance of the column pipe length shall result in an adjustment of this bid price using the adjustment unit price indicated on the proposal form.

# **DIVISION 40**

## **PROCESS INTERCONNECTIONS**

**VARIABLE FREQUENCY DRIVE (VFD)**

**PART 1 GENERAL**

- 1.01 GENERAL: This specification defines the minimum requirements for Variable Frequency Drives (VFD) and accessories for speed control of constant and variable torque loads.
- 1.02 REFERENCES:
- A. UL 508C
  - B. CE
  - C. NEC
  - D. Canadian Underwrites Laboratory (CUL)
  - E. ISO 9001
  - F. IEEE519-1992

**PART 2 PRODUCTS**

- 2.01 ACCEPTABLE MANUFACTURERS:
- A. Danfoss VLT® AQUA Series VFD (Variable Frequency Drive) or prior approved equal.
- 2.02 GENERAL:
- A. Furnish complete VFD as specified herein or in the equipment schedule for loads designated to be variable speed. VFD's shall be user-selectable for either constant or variable torque loads.
  - B. The VFD shall convert incoming fixed frequency single-phase or three-phase AC power into a variable frequency and voltage for controlling the speed of three-phase AC induction motors. The VFD shall be a six-pulse input design, and the input voltage rectifier shall employ a full wave diode bridge; VFD's utilizing controlled SCR rectifiers shall not be acceptable. The output waveform shall closely approximate a sine wave. The VFD shall be of a PWM output design utilizing current IGBT inverter technology and voltage vector control of the output PWM waveform.
  - C. The VFD shall include a full-wave diode bridge rectifier and maintain a displacement power factor of near unity regardless of speed and load.
  - D. The manufacturer of the VFD shall demonstrate a continuous period of manufacturing and development of VFD's for a minimum of 40 years. VFD's that are brand-labeled are not acceptable.

- E. The VFD shall produce an output waveform capable of handling maximum motor cable distances of up to 1,000 ft. (unshielded) without tripping or derating.
- F. The VFD shall utilize VVC<sup>PLUS</sup>, an output voltage-vector switching algorithm, or equivalent, in both variable and constant torque modes. VVC<sup>PLUS</sup> provides rated RMS fundamental voltage from the VFD. This allows the motor to operate at a lower temperature rise, extending its thermal life. VFD's that cannot produce rated RMS fundamental output voltage or require the input voltage to be increased above motor nameplate value to achieve rated RMS fundamental output voltage are not acceptable. VFD's that utilize Sine-Coded PWM or Look-up tables shall not be acceptable.
- G. The VFD selected must be able to source the motor's full load nameplate amperage (fundamental RMS) on a continuous basis, and be capable of running the motor at its nameplate RPM, voltage, current, and slip without having to utilize the service factor of the motor.
- H. The VFD shall offer a programmable motor parameter that allows the total number of poles of a motor to be programmed to optimize motor performance.
- I. VFD shall automatically boost power factor at lower speeds.
- J. The VFD will be capable of running either variable or constant torque loads. In variable torque applications, the VFD shall provide a CT-start feature and be able to provide full torque at any speed up to the base speed of the motor. In either CT or VT mode, the VFD shall be able to provide its full rated output current continuously and 110% of rated current for 60 seconds.
- K. An Automatic Energy Optimization (AEO) selection feature shall be provided in the VFD to minimize energy consumption in variable torque applications. This feature shall optimize motor magnetization voltage and shall dynamically adjust output voltage in response to load, independent of speed. Output voltage adjustment based on frequency alone is not acceptable for single motor VT configurations.
- L. For multi-motor variable torque configurations, user-selectable load profile curves including VT-High, VT-Medium, and VT-Low shall be provided to ensure easy commissioning and improved energy efficiency. VFD's requiring the operator to assign load torque data-points to create a V/Hz profile, are not acceptable.
- M. An initial ramp function shall be available to provide a user-selectable ramp, up to 60 seconds, for applications requiring a faster or slower ramp than the normal ramp.
- N. A Dual Ramp Down feature shall include a Check Valve Ramp Down and a final Ramp feature. The Check Valve Ramp Down shall be programmable to gently seat a check valve and reduce the potential of damage from excess pressure while shutting-down the system. Both time and end speed shall be programmable. On the Final Ramp, the VFD shall be programmable to

quickly stop the motor after seating of a check valve or for a more rapid stopping than the normal ramp down setting.

- O. VFD shall offer up to 4 separate PID controllers. One controller shall operate the drive in closed loop, while the other 3 provide control signals to other equipment. VFD's with PI controllers only are not acceptable.
- P. An Autotuning PI controller output feature shall provide automated PI controller settings. Once the user accepts the settings, the VFD will save the settings to memory.
- Q. An empty pipe fill mode shall be available to fill an empty pipe in a short period of time, and then revert to the PID controller for stable operation. Pipe fill mode shall have a programmable time to reduce water hammer in the system or fill the pipe at a unit per time rate.
- R. VFD shall offer a motor spinning test that will run the motor at 5 Hz until the OK button is pressed. This feature will allow the user to determine if the motor is running in the correct direction.
- S. An embedded cascade pump controller shall be included to provide lead pump alternation and provide control for up to 3 total pumps. The VFD Pump and 2 other pumps can be controlled either by a starter or softstarter.
- T. Switching of the input power to the VFD shall be possible without interlocks or damage to the VFD at a minimum interval of 2 minutes.
- U. Switching of power on the output side between the VFD and the motor shall be possible with no limitation or damage to the VFD and shall require no additional interlocks.
- V. An Automatic Motor Adaptation (AMA) function shall measure motor stator resistance and reactance to optimize performance and efficiency. It shall not be necessary to spin the motor shaft or de-couple the motor from the load to accomplish this optimization. Additionally, the parameters for motor resistance and motor reactance shall be user-programmable.
- W. The VFD shall have temperature controlled cooling fans for quiet operation, minimized internal losses, and greatly increased fan life.
- X. VFD shall provide full torque to the motor, given input voltage fluctuations of up to +10% to -10% of the rated input voltage (525 to 690VAC, 380 to 480VAC, or 200 to 240VAC). Line frequency variation of  $\pm 2\%$  shall be acceptable.

2.03

HARMONICS:

- A. The VFD shall provide internal DC link reactors to minimize power line harmonics and to provide near unity power factor. DC Link reactor shall be installed so that power fluctuations to the DC Capacitors shall be reduced to increase Capacitor life. VFD's without a DC link reactor shall provide a 5% impedance line side reactor and provide spare capacitors.

2.04

PROTECTIVE FEATURES:

- A. VFD shall have input surge protection utilizing MOV's, spark gaps, and Zener diodes to withstand surges of 2.3 times line voltage for 1.3 msec.
- B. VFD shall include circuitry to detect phase imbalance and phase loss on the input side of the VFD.
- C. VFD shall auto-derate the output voltage and frequency to the motor if an input phase is lost. This result will maintain operation without decreasing the life expectancy of the VFD. The use of this feature shall be user selectable and export a warning during the event.
- D. Printed Circuit boards shall be conformal coated to reduce the corrosion effect from environmental gases and other conditions. The conformal coating must meet IEC 61721-3-3, Class 3C2 as standard and the VFD shall have an optional 61721-3-3, Class 3C3 coating available.
- E. Automatic "No-Flow Detection" shall be available to detect a no-flow situation in pump systems where all valves can be closed. This shall be functional in closed loop control or when controlled by an external signal.
- F. Dry-pump detection shall be available to detect if the pump has run dry. If this condition occurs, the drive will be safely stopped. A timer shall be included to prevent nuisance tripping.
- G. End-of-Pump curve detection shall stop motor when the pump is operating outside of its programmed pump curve.
- H. VFD shall provide a flow compensation program to reduce energy by adjusting the Setpoint to match changes in flow (friction loss). Flow compensation shall also operate in Cascade control mode.
- I. VFD shall include current sensors on all three-output phases to detect and report phase loss to the motor. The VFD will identify which of the output phases is low or lost.
- J. VFD shall auto-derate the output voltage and frequency to the motor in the presence of sustained ambient temperatures higher than the normal operating range, so as not to trip on an inverter temperature fault. The use of this feature shall be user-selectable and a warning will be exported during the event. Function shall reduce switching frequency before reducing motor speed.
- K. VFD shall auto-derate the output frequency by limiting the output current before allowing the VFD to trip on overload. The speed of the load can be reduced, but not stopped.
- L. The VFD shall have the option of an integral RFI filter. VFD enclosures shall be made of metal to minimize RFI and provide immunity.
- M. The VFD shall have a motor preheat function with the ability to be programmed to induce a small amount of current to the motor whenever it is at rest. This will prevent condensation inside the motor and help to extend its life without the need for space heaters or other external equipment.

- N. The VFD shall be provided with an optional enclosure that is IP-66/Nema 4X rated. A VFD that is mounted in a separate enclosure will not be acceptable. The enclosure shall be suitable for installations that require protection against windblown dust and rain or splashing water. All cast aluminum parts shall be powder-coated with a durable epoxy that is capable of withstanding harsh environments. All circuit boards shall be conformally coated to meet the requirements of the IEC61721-3-3, Class 3C2 specification.

2.05

INTERFACE FEATURES:

- A. VFD shall provide an alphanumeric backlit display keypad (LCP) which may be remotely mounted using a standard 9-pin cable. VFD may be operated with keypad disconnected or removed entirely. Keypad may be disconnected during normal operation without the need to stop the motor or disconnect power to the VFD.
- B. VFD Keypad shall feature an INFO key that, when pressed, shall display the contents of the programming manual for the parameter that is currently viewed on the display. The description shall explain the feature and how the settings can be made by the operator.
- C. VFD shall display all faults in plain text; VFD's which can display only fault codes are not acceptable.
- D. The keypad shall feature a 6-line graphical display and be capable of digitally displaying up to five separate operational parameters or status values simultaneously (including process values with the appropriate engineering unit) in addition to Hand/Off/Auto, Local/Remote, and operating status.
- E. Two lines of the display shall allow "free text programming" so that a site description or the actual name of the equipment being controlled by the VFD can be entered into the display.
- F. Keypad shall provide an integral H-O-A (Hand-Off-Auto) and Local-Remote selection capability, and manual control of speed locally without the need for adding selector switches, potentiometers, or other devices.
- G. All VFD's shall be of the same series, and shall utilize a common control card and LCP (keypad/display unit) throughout the rating range. The control cards and keypads shall be interchangeable through the entire range of drives used on the project.
- H. VFD keypad shall be capable of storing drive parameter values in non-volatile RAM uploaded to it from the VFD, and shall be capable of downloading stored values to the VFD to facilitate programming of multiple drives in similar applications, or as a means of backing up the programmed parameters.
- I. VFD Display shall have the ability to display 5 different parameters pertaining to the VFD or the load including: current, speed, DC bus voltage, output voltage, input signal in mA, or other values from a list of 92 different user-selectable parameters.

- J. VFD display shall indicate which digital inputs are active and the status of each relay.
- K. It shall be possible to toggle between three status read-out screens by pressing the [Status] key. Various operating variables, even with different formatting, can be shown in each status screen.
- L. VFD display shall indicate the value of any voltage or current signal, including the engineering units of measurement, connected to the analog input terminals.
- M. VFD display shall indicate the value of the current at the analog output terminals, including the engineering units of measurement.
- N. A red FAULT light, a yellow WARNING light and a green POWER-ON light shall be provided. These indications shall be visible both on the keypad and on the VFD when the keypad is removed.
- O. Two-level password protection shall be provided to prevent unauthorized changes to the programming of the VFD. The parameters can be locked via a digital input and/or the unit can be programmed not to allow an unauthorized user to change the parameter settings.
- P. A quick setup menu with factory preset typical parameters shall be provided on the VFD to facilitate commissioning. Use of macros shall not be required.
- Q. A digital elapsed time meter and kilowatt hour meter shall be provided in the display.
- R. VFD shall offer as standard an internal clock. The internal clock can be used for: Timed Actions, Energy Meter, Trend Analysis, date/time stamps on alarms, Logged data, Preventive maintenance, or other uses. It shall be possible to program the clock for Daylight Saving Time / summertime, weekly working days or non-working days including 20 exceptions (holidays, etc.). It shall be possible to program a Warning in case the clock has not been reset after a power loss.
- S. A battery back-up option shall be provided to maintain internal clock operation during power interruptions. Battery life shall be no less than 10 years of normal operation.
- T. VFD shall provide full galvanic isolation with suitable potential separation from the power sources (control, signal, and power circuitry within the drive) to ensure compliance with PELV requirements and to protect PLC's and other connected equipment from power surges and spikes.
- U. All inputs and outputs shall be optically isolated. Isolation boards between the VFD and external control devices shall not be required.
- V. There shall be six fully programmable digital inputs for interfacing with the systems external control and safety interlock circuitry. Two of these inputs shall be programmable as inputs or outputs.

- W. The VFD shall have two analog signal inputs. Inputs shall be programmable for either 0 -10V or 0/4-20 mA.
- X. One programmable analog output shall be provided for indication of the drive status. This output shall be programmable for output speed, voltage, frequency, motor current and output power. The analog output signal shall be 0/4-20 mA.
- Y. The VFD shall provide two user programmable relays with 75 selectable functions. Two form 'C' 230VAC/2A rated dry contact relay outputs shall be provided.
- Z. Floating point control interface shall be provided to increase/decrease frequency in response to external switch closures.
- AA. The VFD shall accept a N.C. motor temperature over-temperature switch input, as well as possess the capability to accept a motor thermistor input.
- BB. The VFD shall store in memory the last 10 faults with time stamp and recorded data.
- CC. Run permissive circuit shall be provided to accept a "system ready" signal to ensure that the VFD does not start until isolation valves, seal water pumps or other types of auxiliary equipment are in the proper state for VFD operation. The run permissive circuit shall also be capable of sending an output signal as a start command to actuate external equipment before allowing the VFD to start.
- DD. The VFD shall be equipped with a standard RS-485 serial communications port and front-of-drive accessible USB port. Danfoss FC or ModBus RTU communications shall be integrally mounted.
- EE. A Windows® compatible software program to display all monitoring, fault, alarm, and status signals shall be available. This software program shall allow parameter changes, storage of all VFD operating and setup parameters, and remote operation of the VFD.

2.06

ADJUSTMENTS:

- A. The VFD shall have an adjustable output switching frequency.
- B. Four complete programming parameter setups shall be provided, which can be locally selected through the keypad or remotely selected via digital input(s), allowing the VFD to be programmed for up to four alternate control scenarios without requiring parameter changes.
- C. In each programming set up, independent acceleration and deceleration ramps shall be provided. Acceleration and deceleration time shall be adjustable over the range from 0 to 3,600 seconds to base speed.
- D. The VFD shall have four programmable "Bypass frequencies" with adjustable bandwidths to prevent the driven equipment from running at a mechanically resonant frequency. The feature shall offer a Semi-Automatic program to simplify the set-up.

- E. VFD shall include an automatic acceleration and deceleration ramp-time function to prevent nuisance tripping and simplify start-up.
- F. In each programming setup, independent current limit settings, programmable between 50% and 110% of the drives output current rating, shall be provided.
- G. PID parameter settings shall be adjustable while the VFD is operating, to aid in tuning the control loop at start up. The VFD will also be capable of simultaneously displaying set-point reference and feedback values with appropriate engineering units, as well as output frequency, output current, and run status while programming the PID function.
- H. The VFD will include a “loss of follower” function to detect the loss of process feedback or reference signals with a live-zero value and a user-selectable choice of responses (go to set speed, min speed, max speed, stop, and trip).
- I. A Sleep Mode function shall be provided to reduce wear and heating of the pump and other equipment in periods where system demand is minimal. This function will operate in both open and closed loop modes:
  - 1. In closed loop process control, when the output speed drops to a user-programmed minimum value (“sleep frequency”) for a specified time (“sleep mode timer”), the drive will enter a sleep mode and either go into standby, or boost mode before entering standby. The drive shall automatically restart the motor once the output of the PID processor exceeds a programmable value “wake up frequency”.
    - a. Boost mode shall prevent short-cycling of the motor by temporarily adjusting the set-point by a user-programmable percentage. Upon reaching this value, the unit will go into standby.
  - 2. In open loop, the drive shall be capable of entering sleep mode if the input reference drops below a user-programmable value. When the input reference increases above a user-programmable reference, the drive will automatically start.
- K. An integral motor alternation function shall be provided to enable the output of the drive to alternate between two motors. The alternation interval shall be user-programmable in hours. This function shall operate external relays as required to control the motor alternation sequence. A dwell time shall be integral to the function and can prevent damage to the motor contactors.
- L. The VFD will include a user-selectable Reset function, which enables the selection of between zero and twenty restart attempts after any self-clearing fault condition (under-voltage, over-voltage, current limit, inverter overload, and motor overload), or the selection of an infinite number of restart attempts. The time between restart attempts shall be adjustable from 0 through 600 seconds.
- M. An automatic “on-delay” function may be selected from 0 to 120 seconds.

- N. The VFD will include a user-selectable Auto-Restart function that enables the VFD to power up in a running condition after a power loss, to prevent the need to manually reset and restart the VFD.
- O. VFD shall catch a rotating motor operating either in forward or reverse at up to full speed.

2.07

SERVICE CONDITIONS:

- A. The ambient operating temperature of the VFD shall be -10°C to 50°C (14 to 122°F), with a 24-hour average not to exceed 45°C. Storage temperatures shall be -13° F (-25° C) to 149/158° F (65/70° C).
- B. 0 to 95% relative humidity, non-condensing.
- C. Elevation to 3,300 feet (1000 meters) without derating.
- D. VFD's shall be rated for line voltage of 525 to 690VAC, 380 to 480VAC, or 200 to 240VAC; with +10% to -10% variations. Line frequency variation of ± 2% shall be acceptable.
- E. No side clearance shall be required for cooling of the units.

**PART 3**

**EXECUTION**

3.01

SUBMITTALS:

- A. Submit manufacturer's performance data including dimensional drawings, power circuit diagrams, installation and maintenance manuals, warranty description, VFD's FLA rating, certification agency file numbers, catalog information and catalog cut-sheets for all major components.
- B. All drawings shall be in an 8.5 X 11" reproducible format, and incorporate the manufacturer's title block on the drawing.
- C. This specification lists the minimum VFD performance requirements for this project. Each supplier shall list any exceptions to the specification. If no departures from the specification are identified, the supplier shall be bound by the specification.
- D. Three copies of all submittals shall be provided.
- E. Submit a computer generated Harmonic Distortion Analysis for the jobsite location.

3.02

QUALITY ASSURANCE:

- A. The manufacturer shall be both ISO-9001 and ISO-14001 certified.
- B. All products shall be CE marked; UL labeled, and meet the requirements of UL-508C and maintain ULc.
- C. To ensure quality and minimize infant-mortality failures on the jobsite, each VFD shall be completely tested by the manufacturer. The VFD shall operate a dynamometer at full load and speed under elevated temperature conditions.
- D. All optional features shall be functionally tested at the factory for proper operation.
- E. Factory test documentation shall be available upon request.

3.03

EXAMINATION:

- A. Contractor to verify that job site conditions for installation meet factory recommended and code-required conditions for VFD installation prior to start-up, including clearance spacing, temperature, contamination, dust, and moisture of the environment. Separate EMT conduit installation of the motor wiring, power wiring, and control wiring, and installation per the manufacturer's recommendations shall be verified.
- B. The VFD is to be covered and protected from installation dust and contamination until the environment is cleaned and ready for operation. The VFD shall not be operated while the unit is covered.

3.04

START-UP AND WARRANTY:

- 1. A factory-authorized service technician shall perform start-up on each drive. ("Start up" shall not include installation or termination of either power or control wiring.) The service technician shall perform start-up on up to 8 drives per day. Start-up costs provided with the bid shall include time and travel for the estimated number of visits required, but shall not be less than at least one half-day with travel. Additional labor or return trips to the site shall be billed at Danfoss' published straight-time rates. Upon completion, a start up service report shall be provided.
- 2. A 6-year on-site warranty shall be provided such that the owner is not responsible for any warranty costs including travel, labor, parts, or other costs for a full 6 years from the date of manufacture of the Drive. The cost of the warranty shall be included in the bid.

**DIVISION 46**

WATER AND WASTEWATER EQUIPMENT

## CHLORINE GAS FEED EQUIPMENT

### PART 1 GENERAL

- 1.01 DESCRIPTION: The work covered by this section consists of furnishing all plant, labor, equipment, and materials, and performing all operations in connection with the installation of a water chlorination system at the location indicated on the plans.
- 1.02 LOCATION OF FACILITIES, SUPPLY LINES, ETC.: The approximate location of the chlorination facilities, supply line, ejector, and other items are shown on the plans.
- 1.03 HOUSING AND STORAGE: The chlorination equipment shall be installed in facilities shown on the plans. These facilities shall be as detailed on the plans and the material and workmanship on these structures shall conform to the applicable sections of the specifications covering that work.

### PART 2 MATERIALS

- 2.01 (a) CHLORINATOR AND CHLORINE INJECTOR: There shall be provided a chlorinator and chlorine injector. These units shall be designed and manufactured to operate together and each shall be of a combination unit which will be compatible with each other.

The chlorinator shall be a Regal Model 216, Hydro 900 Series, or prior approved equal. The chlorinator shall have a range of 0.5 pounds per 24 hours to 100 pounds per 24 hours.

The manufacturer of the chlorinator shall furnish the following equipment that will be designed to operate with his chlorinator, all subject to the approval of the Engineer. The equipment furnished shall not necessarily be limited to this list.

1. Close coupled ejector open end diffusers equipped with a check valve.
2. Automatic switchover module
3. Y-strainer
4. Pressure gauges
5. Miscellaneous piping, valves, hose and fitting
6. A standard spare parts kit
7. Multi-purpose wrench
8. Twelve (12) lead gaskets

The chlorinator assembly shall be as shown on the plans.

(b) VARIABLE RATE CHLORINE VALVE: The variable rate chlorine valve specified on the plans shall be a Regal Series 7000 Smartvalve, or approved equal, and must meet the following specifications:

1. A maximum gas feed of:
  - a. 10-2,000 PPD for Chlorine
2. Power Requirements - Field Selectable 115/230 VAC  $\pm$  15%, single phase with operating frequency of 50/60 Hz.
3. Fusing - 1/4A @230V, 1/2A @ 115V (time delay, 250V)
4. Power Consumption - 45 Watts absolute maximum
5. Input signals - 4-20 milliamps DC (unpowered)
6. Input Impedance – 250 Ohms.
7. Output Signal – 4-20 milliamps DC. 12 Volt compliance (600 Ohms) isolated and powered
8. Micro-Controller – MC9S12 with 128kB FEEPROM, 2kB EEPROM, 8kB SRAM, 16 Bit
9. Display – 20-character, 2-line, Polymer LED(PLED)
10. Relays – Three (3) each. 10A 250 VAC
11. Environmental Limits – 32°F to 120°F (0°C to 50° C)
12. Calibration Accuracy -  $\pm$ 0.25% from zero
13. Speed of Response – Variable and field selectable between 0.5 and 10.0 seconds per revolution of motor
14. Operating Range – 10:1
15. Pushbuttons – Four key array – integrated into the overlay
16. Control Modes – Automatic, electric manual, manual
17. Dosage Ratio – 4:1, keypad adjustable
18. Serial Communications – OPTIONAL. Isolated RS232/RS422/RS485 (2/4-Wire) module
19. Step Rate Inputs – Active, designed for 100 ft., 20 AWG minimum. Remote contact closure with a voltage drop of no more than 0.8 Volts at the valve terminals. Less than 5 mA flows through the contact.
20. Stepper Motor – Unipolar (5/6-Wire). 12 Volt, 1A/winding (Size 23)

(c) FREE CHLORINE ANALYZER: Contractor shall provide a HACH CL17 Free Chlorine Analyzer, or approved equal, together with a 1-month supply of DPD indicator and Free Chlorine indicator and buffer solutions, an installation kit, a sample conditioning kit, a maintenance kit, and a user manual. The Free Chlorine Analyzer must meet the following specifications:

1. Accuracy:  $\pm$  5 % or  $\pm$ 0.03 mg/L (ppm) as CL2, whichever is greater
2. Air Purge: 0.1 cfm (0.17 m<sup>3</sup>/h) instrument quality air at max. 20 psig (ca. 1.4 bar) with ¼" OD tube, quick disconnect fitting
3. Alarm: Two alarms selectable for sample concentration alarm, Analyzer system warning, or analyzer system shut-down alarm.

- Each must be equipped with an SPDT relay with contacts rated for 5A resistive load at 230 V AC
4. Certification: Must be North America certified
  5. Communication Capabilities: 4-20mA output
  6. Cycle Time: 2.5 min
  7. Dimensions (HxWxD): 454mm x 314 mm x 179 mm
  8. Display: LCD, 3-1/2" digit measurement readout and six character alphanumeric scrolling text line
  9. Drain: 1/2" ID flexible hose, hose barb
  10. Enclosure Construction: ABS plastic, two clear polycarbonate windows, IP62-rated with the gasketed door latched
  11. Enclosure Rating: IP62
  12. Inlet: 1/4" OD polyethylene tube, quick-disconnect fitting
  13. Inlet Pressure: 1 to 5 psi (0.07 to 0.34 bar), 1.5 psi (1.03 bar) is optimum
  14. Light Source: Class 1 LED (light emitting diode) with a peak Wavelength of 520 nm, 50,000 hours estimated minimum life
  15. Lower Limit of Detection (LOD): 0.03 mg/L (ppm)
  16. Mounting: Wall mount
  17. Operating Humidity: Up to 90% at 40°C (104°F) maximum
  18. Operating Temperature Range: 5 to 40°C (41 to 104°F) maximum
  19. Power Requirements (Amps): 2.5A
  20. Power Requirements (Hz): 50/60 Hz
  21. Power Requirements (Voltage): 100-115/230V AC
  22. Pressure Range: Inlet Pressure to Sample Conditioning: 1.5 to 75 psi (0.1 to 5.2 bar)
  23. Range: 0 to 5mg/L free or total residual chlorine
  24. Recorder Outputs: One 0/4-20 mA with an output span programmable over any portion of the 0 to 5mg/L range. Recommended load impedance 3.6 to 500 ohms, 130 V isolation from earth ground
  25. Repeatability: 0.01 mg/L or 3.0%, whichever is greater
  26. Resolution: 0.01 mg/L
  27. Sample Flow Rate: 200 TO 500 Ml per minute minimum
  28. Sample Temperature: 5 to 40°C (41 to 104°F)

2.02 PIPING: The various pipe specified on the plans shall meet the following standards and shall be as sized on the plans.

(a) Galvanized Iron: Galvanized iron pipe and fittings shall conform to ASTM A 120 and shall be "Standard Weight".

(b) Rigid Plastic Pipe: All rigid plastic pipe shall be P.V.C. pipe furnished in the 160 p.s.i. @ 73.4F working pressure class and shall have a solvent welded type joint. The P.V.C. pipe shall conform to CS256, ASTM D-2241, and shall meet the quality standard of the National Sanitation Foundation and bear its seal of approval

as safe for potable water service. Polyvinyl chloride pipe shall be manufactured from a virgin polyvinyl chloride resin conforming to Type I, Grade 1 resin of ASTM D1784.

(c) Flexible Plastic Pipe: All flexible plastic service line shall be manufactured from ultra-high molecular weight polyethylene defined by ASTM D1248 65T as P.E. Type III (PE3306). Pipe shall be made of all virgin material and conform to the standards of the National Sanitation Foundation. The pipe shall have a working pressure of 160 p.s.i. @ 73.4F and shall be capable of maintaining pressure of 330 p.s.i. @ 73.4F for 1,000 hours.

All connections shall be made in a manner approved by the Engineer and no heating of the pipe shall be permitted. The pipe may be furnished in the iron pipe or copper tubing size.

2.03 VALVES: The chlorination facility shall be provided with the necessary valves as specified on the plans. The various valves shall be as those specified below, or an approved equal.

(a) Gate Valves: All gate valves shall be "U" valves with screwed ends and shall be NIBCO #T-23, or approved equal.

(b) P.V.C. Ball Valves: All P.V.C. ball valves shall be Wallace and Tiernan, catalog number 140.070, or approved equal.

(c) Check Valves: Check valves shall be Powell #249, or approved equal.

2.04 CHLORINE BOOSTER PUMP: Where required on the plans, the Contractor shall furnish and install a turbine type chlorine booster pump. The pump shall be installed with the proper suction and discharge piping, contact, disconnect, and controls as detailed on the plans. The pump shall be a Goulds 25GBC10 or 25GBC15, high pressure multi-stage booster pump, or approved equal, and shall be constructed of the following materials (final pump shall be determined based upon connection point pressure):

- |     |                      |   |
|-----|----------------------|---|
| (a) | Motor Adapter:       | Cast Iron or Cast 304 Stainless Steel                                 |
| (b) | Mechanical Seal:     | 0-Carbon/Ceramic/BUNA<br>3-Carbon/Silcar/EPR<br>4-Carbon/Silcar/Viton |
| (c) | Shaft Coupling:      | Stainless Steel   |
| (d) | Impeller/Diffuser:   | Engineered Composite  |
| (e) | Bowl:                | 304 Stainless Steel   |
| (f) | Discharge Head       |   |
|     | 304 Stainless Steel: | Cast Iron or Cast 304 Stainless Steel                                 |
| (g) | Hex Shaft:           | Stainless Steel   |
| (h) | Casing:              | 304 Stainless Steel   |

and shall have the following specifications:

(a) Pump:

1. Maximum suction inlet pressure: 75 PSI
2. Maximum Liquid Temperature: 160° F (71° C)
3. Rotation: Clockwise when viewed from motor end
4. Maximum lift with foot valve: 10 ft., check NPSH curve

(b) Motor:

1. NEMA standard 56J frame
2. Open drip proof or totally enclosed fan cooled enclosures available as standard.
3. 60 Hz, 3500 RPM. Single phase (115/230V), three phase 208-230 (3HP, 230 V) or three phase (208-230/460 V)
4. Single phase motors have built-in capacitor and over-load with automatic reset

2.05 SOLENOID VALVE: When required on the plans, the Contractor shall furnish and install an electrically operated solenoid valve. This valve shall be wired into the various controls as indicated on the plans.

2.06 HYDRAULIC SCALES: When required on the plans, the Contractor shall furnish and install chlorine scales. The scales shall be a CHLOR-SCALE 150 with TUF-COAT coating, as manufactured by FORCE FLOW, or approved equal. The scales must meet the following specifications:

(a) SCALE PLATFORM: Each scale platform shall be constructed of non-corrosive PVC plastic and sized to accept one (1) 150 lb cylinder from 10-1/4" – 10-1/2" (260mm – 267mm). Platform scale coating system shall be a minimum dry thickness of 80 mils and resistant to moisture, chemicals, abrasion, impact and UV light. Load cell tubing length shall be a minimum of 10 feet. A wall mounted cylinder restraining bracket with integral tool rack shall be provided.

Scale shall carry a Full Five (5) Year Factory Warranty. "Limited" warranties shall be considered unacceptable. Full scale accuracy shall be better than 1%. Scale shall be CHLOR-SCALE 150 with TUFF COAT Environmental Armor as manufactured by FORCED FLOW, of Concord, CA or prior approved equal.

2.07 AUXILIARY EQUIPMENT:

(a) Chlorine Cylinders: The Contractor shall furnish four full 150 pound chlorine cylinders (per site) for use in testing the chlorination system and initial operation.

- (b) Parts List - Operating Manual: The Contractor shall furnish the Owner three (3) copies of the complete parts list and operating manual of all equipment furnished in the chlorination facility.
- (c) Scales: The required scales (if any) shall be as detailed on the Plans.

2.08 PRESSURE GAUGES: Pressure gauges shall be provided both upstream and downstream from the ejector and on the suction side of the booster pump if a booster pump is provided. Pressure gauges shall be liquid filled, 2" face, 0-200 psi with phenolic case. Gauges shall be U.S. Gauge 580UL Marsh J7154, or approved equal. All gauges shall be protected by liquid filled PVC diaphragm gauge guards, Model GGMV200-PV by Plast-O-Matic, or approved equal.

### **PART 3 EXECUTION**

3.01 CHLORINATION EQUIPMENT: The Contractor shall install all chlorination equipment in strict accordance with the manufacturer's recommendations.

3.02 ELECTRICAL WORK: Electrical construction shall be in strict accordance with the National Electrical Code and Section 26 00 00 of these specifications as they are applicable.

3.03 CONCRETE: All concrete work shall be in accordance with Section 03 30 00 of these specifications.

### **PART 4 METHOD OF MEASUREMENT**

4.01 CHLORINATION EQUIPMENT MEASURED AS A SINGLE UNIT: When so specified on the plans or in the proposal form, the chlorination unit(s) shall be measured as a separate unit, in which case all items necessary to complete the chlorination unit in accordance with the plans and specifications will be measured per each.

4.02 CHLORINATION EQUIPMENT MEASURED AS PART OF ANOTHER LUMP SUM ITEM: When so specified on the plans or in the proposal form, the chlorination unit(s) shall be measured as part of another lump sum item. In such case, all components necessary to complete that item in accordance with the plans and specifications will be measured lump sum.

# APPENDIX