PROJECT MANUAL

IHS WHITERIVER HOSPITAL

Prepared for: INDIAN HEALTH SERVICE

100% CONSTRUCTION DOCUMENTS
Project No: 14904.000
5 MARCH 2026

VOLUME 6

Specification Volume 6 is part of a larger specification set for the Whiteriver Hospital project. Volume 6 is the portion of the set which applies to the Tribally owned and operated surface water treatment plant and can be viewed as a stand-alone specification for this portion of the project.

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DOCUMENT 000107 - SEALS PAGE

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END OF DOCUMENT 000107

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SECTION 260050 - BASIC ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Electrical general provisions as indicated, specified and required for constructing a complete, ready for use electrical system as described in these Contract Documents.

B. Labor, materials, apparatus, and appliances essential to the complete functioning of systems described and indicated herein, or which may be reasonably implied as essential, whether mentioned in the Contract Documents or not, shall be furnished and installed by the Contractor. In case of doubt as to the work intended, or in the event of need for explanation thereof, Contractor shall refer to the Engineer for supplemental instructions.

C. All items not specifically mentioned in these Specifications or noted on the Drawings, or on shop drawings, but which are necessary to make a complete and satisfactory, working electrical/instrumentation installation, shall be deemed to be included herein.

D. All electrical equipment shall be capable of operating successfully at full-rated load, without failure, at an ambient air temperature of 0°C to 50°C, and specifically rated for an altitude of 1200 feet. Where these criteria cannot be met, ancillary equipment and/or special derating factors as approved by the Engineer shall be utilized.

E. The Contractor shall perform all necessary saw cutting, core drilling, excavating, removal, shoring, backfilling, etc as required for the proper installation of conduits whether inside or outside of the building(s) and structure(s). The Contractor shall repair and patch where demolition has taken place in a manner to match existing original structure.

F. All electrical equipment under Division 26 shall be furnished and installed by the Electrical Contractor.

1.2 SUBMITTALS

A. Submit documentation for review as described in individual Specification Sections for products requiring submission.

B. Submit Division 26 in one submittal, or at a maximum, the following may be submitted as a separate submittal for this project.
   1. Commodities (Sections 26 00 50-26 01 95) and Grounding (Section 26 04 50)
   2. Lighting (Section 26 05 00)

C. Documentation must be arranged in numerical sequence corresponding with each Specification Section and article of each Section. Soft copies shall be in “pdf” format with “character recognition” and shall include the following as a minimum:
   1. A cover page to identify the Contractor’s name, name of the project, date and description, i.e. “Electrical – Commodities”.
   2. An index corresponding to each specification section with all addendum updates included.
   3. A copy of each specification section shall be included in the submittal package. Each paragraph or bulleted item shall be check marked to signify compliance with each item and the information is included in the submittal package. If full compliance is not met for any reason, the non-compliance item shall be

underlined and reference to a detailed written explanation of the deviation or non-compliance shall be provided for consideration.

4. Bookmarks within each section for each major component within.
5. Complete manufacturer name and model number of each item. Listing items “as specified” without both make and model or type designation is not acceptable.
6. Descriptive Data: complete description, information, and performance data covering materials and equipment that are being proposed. Each component shall be clearly identified on each sheet. Refer to individual specification sections for additional submittal requirements.

D. Important Notice:
1. If Contractor's submittal departs from the Contract Documents, the Contractor shall make specific mention thereof on the submittal, otherwise review of such submittal by the Engineer shall not constitute review of such departure(s).
2. The Engineer’s submittal review is for the sole purpose of verifying general conformance with design intent and general compliance with Contract Documents. Approval of a submittal by the Engineer does not relieve the contractor of responsibility for correcting errors which may exist in the submittal or from meeting requirements of Contract Documents.
3. **After material or equipment has been submitted and approved, no substitutions will be allowed, unless required per Contract Documents. Any equipment installed that is different than the approved shop drawings and submittals will be removed and replaced at the Contractor’s expense.**
4. The Contractor may be charged for costs incurred by the Engineer for third and subsequent submittal reviews. Cost for Engineer’s review time shall be billed at the Engineer’s standard hourly rates.
5. Where calculations, sealed by a registered professional engineer, are required to be submitted, they will be reviewed for content and format but may not be reviewed for accuracy.

E. For control panels, motor starters and other equipment requiring multiple terminations of components and devices, the Contractor shall submit detailed shop drawings on 11” x 17” size sheets consisting of point-to-point wiring diagrams, bill of materials, interior and exterior elevations with dimensions prepared by the equipment manufacturer or a UL 508A recognized system integrator.

1.3 RECORD DRAWINGS AND OPERATION AND MAINTENANCE MANUALS

A. Record Drawings: On completion of work, Contractor shall furnish a complete set of Record Drawings and 11” x 17” size Shop Drawings which properly reflect final locations and sizes of conduit, equipment fixtures, controls, etc., as actually installed. Dimensions shall be included on the Contractor’s as-built Drawings showing exact location of underground conduits.

B. Operation and Maintenance (O&M) Manuals: Contractor shall provide O&M manuals for equipment and materials furnished under this contract. O&M manuals must be submitted and approved before final inspection of the project so that they may be used during startup. Soft copies shall be in “pdf” format with “character recognition” and shall include the following as a minimum:
1. A cover sheet to identify the Contractor’s name, name of the project, date and description, i.e. “Electrical Equipment O&M Manual”.
2. Bookmarks within each section for each major component within.

3. Complete manufacturer name and model number of each item.
4. Descriptive data, component data sheets, wiring diagrams, control panel drawings, etc. from the approved submittals/shop drawings.
5. Complete instructions regarding the installation, operation and maintenance of equipment involved. Instructions and documentation not related to the equipment furnished must be removed or crossed out. ***O&M manuals must be individually tailored to the project and equipment as furnished.***
6. Complete nomenclature of replaceable parts, part numbers, current cost, name and address of nearest vendor of replacement parts. Information on equipment or components not related to equipment furnished must be removed or crossed out. ***O&M manuals must be individually tailored to the project and equipment as furnished.***
7. Copy of warranties issued on the installation, showing dates of expiration.

C. Hard copies, if required, shall be bound in 3-ring binders (2" max) and include all information as described above for soft copies. The binders shall include tabs corresponding to a neatly typewritten index. The binder cover and edge shall clearly identify the Contractor's name, name of the project, date and identified as "Electrical Equipment O&M Manual".

1.4 QUALITY ASSURANCE

A. The Contractor performing the electrical construction and installation shall be a reputable **licensed** Contractor in the State of Arizona to do **electrical commercial** construction.

B. The Contractor must be located within a 100-mile radius of the project and have been in that vicinity for a minimum of five (5) years.

C. The Contractor must have a minimum of five (5) years experience as a Contractor installing electrical and instrumentation systems for other projects of similar type, size and requirements. If requested, the Contractor must submit documentation and list of references of recent projects similar to this one.

D. All equipment furnished shall be new and of current design. Like equipment shall be of the same manufacturer.

E. Unless otherwise indicated, all equipment and components shall be rated for use in the environment installed. Outdoor equipment shall be weatherproof or rated for outdoor use.

F. All electrical equipment under Division 26 shall be furnished and installed by the Electrical Contractor.

1.5 SPACE REQUIREMENTS

A. Space Requirements: In the preparation of Drawings, a reasonable effort has been made to include equipment manufacturer's recommendations. Since space requirements and equipment arrangement vary according to manufacturer, the responsibility for initial access and proper fit rests with the Contractor. Final arrangement of equipment and service connections shall allow the unit to be serviced, including space to pull motors, change fuses, and operate switches. Minimum working clearances shall be as required by NEC and local codes.

1.6 COORDINATION

A. Contractor shall coordinate with all other trades to avoid conflicts and interferences. No extra compensation will be allowed for changes made necessary due to interference between work of various trades.

B. Any discrepancies noted in these contract documents or discrepancies between Drawings and actual field conditions shall be promptly brought to the Engineer for a decision. No extra compensation will be allowed for changes made by the Contractor without Engineer's consent.

C. Carefully check and coordinate each device location and elevation. Also check routing of all conduits for conflicts with structures, mechanical piping, ducts, etc. to avoid conflicts.

1.7 REGULATORY REQUIREMENTS

A. Electrical work, including connection to electrical equipment integral with mechanical equipment, shall be performed in accordance with the latest published regulations of the National Electrical Code (NEC), State and local codes, and according to the latest Institute of Electrical and Electronic Engineers (IEEE); American National Standards Institute (ANSI); American Society for Testing and Materials (ASTM); Insulated Cable Engineers Association (ICEA); National Electrical Manufacturers Association (NEMA) Standards; and the latest published regulations of the Federal Occupational Safety and Health Act (OSHA). When applicable, the material used in the performance of the electrical work shall be listed by the Underwriters' Laboratories, Inc. (UL) for the class of service for which they are intended.

B. Control panels shall be assembled and wired by a UL 508A recognized panel shop. All control panel components shall be UL recognized or ground fault protected per UL 508A fabrication standards. Each control panel assembly shall be fabricated according to UL 508A Standards and shall bear a serialized UL 508A label.

1.8 WARRANTY

A. In addition to specific warranties required by the Specifications, the Contractor shall leave the entire installation in complete working order and free from defects in materials, workmanship or finish. Contractor shall repair or replace at his own expense any part that may develop defects due to faulty material or workmanship during the tests and within a period of one year after the work is accepted by the Engineer and Owner. Contractor shall repair or replace existing equipment and work that is damaged during the repair of defective apparatus, materials or workmanship.

B. All manufacturer's warranties shall be filled out in their entirety by the Contractor for the Owner using the Owner's name and address. Unless otherwise specified, equipment warranty periods will commence on date of final acceptance.

1.9 DRAWINGS

A. Clarity and Legibility: For purposes of clarity and legibility, the Drawings are diagrammatic only. Drawings are not intended to show every fitting, junction, gasket or component necessary, nor every difficulty that may be encountered during installation. Conduit routing may be adjusted in the field. Size and location of equipment are drawn to scale wherever possible. Contractor shall refer to related data in all Contract Documents and shall verify this information on site.

B. Instrumentation and control drawings are provided to indicate the control strategy intent only. Final circuitry shall be as determined by the Contractor or his vendors. Actual wiring diagrams shall be provided by the Contractor and reviewed by the Engineer for a fully functional system as intended.

1.10 REFERENCES

A. The specifications reference known standards and codes. Each such standard referred to shall be considered a part of the Specifications to the same extent as if reproduced therein in full. The following is a representative list of such Associations, Institutes and Societies, together with the acronym by which each is identified.

AASHTO	**American Assoc of State Highway and Transportation Officials**
AIEE	**American Institute of Electrical Engineers**
ANSI	**American National Standards Institute**
ASTM	**American Society for Testing and Materials**
AWWA	**American Water Works Association**
ICEA	**Insulated Cable Engineers Association**
IEEE	**Institute of Electrical and Electronics Engineers**
IES	**Illumination Engineering Society**
NEC	**National Electrical Code**
NEMA	**National Electrical Manufacturers Association**
NETA	**National Electrical Testing Association**
NFPA	**National Fire Protection Association**
UL	**Underwriter's Laboratories, Inc.**

B. Every reference in the Specifications shall mean the latest printed edition of each in effect at the Contract Date.

1.11 ABBREVIATIONS

A. References on the Drawings to various abbreviations have been made. The following is a representative list of such abbreviations together with the acronym by which each is identified.

AFF	**Above finished floor**
AFG	**Above finished grade**
AI	**Analog input**
AO	**Analog output**
APS	**Arizona Public Service Company**
ATS	**Automatic transfer switch**
C	**Conduit**
C/B	**Circuit Breaker**
CKT	**Circuit**
CPT	**Control power transformer**
Cu	**Copper**
DI	**Digital input**
DIST	**Distribution**
DO	**Digital output**
DWG	**Drawing**
GND	**Ground**
GFCI	**Ground Fault Circuit Interrupter**
GFI/GFP	**Ground Fault Indication/Protection**

GRS	Galvanized Rigid Steel Conduit
HPS	High Pressure Sodium
IMC	Intermediate Metal Conduit
INST	Instrument
LED	Light Emitting Diode
MBJ	Main bonding jumper
MCB	Main Circuit breaker
MCC	Motor Control Center
MCP	Motor Circuit Protector
MFR	Manufacturer
MLO	Main Lug Only
NC	Normally Closed
NO	Normally Open
PC	Personal computer
PLC	Programmable logic controller
PR	Pair
REQ'TS	Requirements
RTU	Remote terminal unit
SES	Service entrance section
SPD	Surge Protective Device
RMC	Rigid Metal Conduit (GRS or IMC)
RVSS	Reduced Voltage Soft Starter
SWBD	Switchboard
TTB	Telephone Terminal Board
TSP	Twisted Shielded Pair
TST	Twisted Shielded Triad
VFD	Variable frequency drive
WP	Weatherproof

END OF SECTION

SECTION 260110 - RACEWAYS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Metallic and non-metallic wiring raceways, including cable tray.

1.2 SUBMITTALS

A. Product Data: Submit manufacturer's data demonstrating compliance with this specification including couplings, fittings, bushings, and hangers.

B. Submit on the proposed method for separating conduits in underground ductbanks.

1.3 QUALITY ASSURANCE

A. Perform work in accordance with NECA Standard of Installation and NFPA 70.

1.4 RELATED WORK

A. Specification Section 26 01 95, Electrical Identification

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Conduit:
1. Rigid metal, intermediate and EMT:
   a. Allied
   b. Republic
   c. Triangle Conduit and Cable Co.
   d. Wheatland
2. Galvanized rigid steel:
   a. Ocal
   b. Robroy
   c. Calbond
   d. Gafco Green
3. Flexible and flexible water-tight:
   a. Alflex Corp.
   b. Carlon Products Corp.
   c. Carol Cable Co., Inc.
   d. Electri-Flex
   e. Sealtite
4. Non-metallic PVC:
   a. Can-Tex
   b. Carlon
   c. PW Eagle/JM Eagle
5. Conduit supports and hangers:
   a. Caddy
   b. Thomas and Betts
   c. Appleton
   d. Crouse-Hinds
   e. B-Line Systems

6. Supporting Channel:
   a. G-Strut
   b. Unistrut
   c. B-Line
7. Cable tray:
   a. Husky Products Incorporated
   b. Robroy Industries
   c. B-Line Systems

2.2 MATERIALS

A. Metallic Conduit:
1. Rigid steel:
   a. Hot dipped galvanized rigid steel; meet ANSI C80.1 and ASTM A153; UL labeled and meet UL Standard No. 6.
   b. All conduit bodies and fittings shall be threaded. Threadless couplings shall not be used unless specifically approved by the Engineer.
   c. All conduit body covers shall be secured with machine screws threaded onto the conduit body. Covers secured by snaptight or wedge-nuts are unacceptable.
   d. Where PVC coated rigid steel conduit is indicated on the Drawings, the conduit shall be galvanized steel with a factory installed PVC coating. All conduit fitting, boxes, connectors, etc. shall also be PVC coated by the factory.
   e. No aluminum conduit shall be permitted unless approved by the Engineer.
2. Intermediate: Shall be same as rigid above with thinner wall.
3. Electrical metallic tubing (EMT or Thin-wall) shall be:
   a. Galvanized; meet ANSI C80.3; UL labeled; marked with manufacturer's name.
   b. Thin-wall conduit fittings for damp or wet locations shall be of the regular watertight design, with hexagonal nuts and center portions requiring the use of a wrench during installation.
   c. Setscrew type fittings are not permitted under any circumstances.
4. Flexible conduit:
   a. UL-listed flexible rubber or plastic coated metallic type with watertight ferrule and sleeve type connectors. Standard steel type flexible conduit is unacceptable.
   b. ANSI/NEMA FB1 steel connectors. Connectors must be PVC coated where installed in corrosive environments or where PVC conduit or PVC coated GRS conduit is specified.

B. Non-Metallic PVC Conduit:
1. Rigid non-metallic conduit Polyvinyl Chloride (PVC) type II PVC shall be schedule 40, suitable for use with 90 degree rated wire. Conduit shall bear UL labels for above and below ground use.
2. All PVC conduit connections shall be cleaned using primer before applying glue.
3. All PVC conduit 1-1/4 inch and larger with bends greater than 45º shall utilize factory bends.

4. Where the enclosure or raceway is subject to physical damage, conductors shall be installed in rigid metal conduit, intermediate metal conduit, Schedule 80 rigid nonmetallic conduit or equivalent.
5. Meet UL standard #651.

C. Cable tray:
1. Type: Ladder, rungs welded to side rails.
2. Material: Type 316 stainless steel or non-metallic.
3. Rung spacing: 9-inches on center, minimum.
4. Radius: As required.
5. Width: As indicated on the drawings.
6. Support span: Not to exceed 8-feet, unless otherwise shown on the drawings.
7. Loading capacity: NEMA 8C or greater.
8. Meet NEMA VE 1 or NEMA FG1 Standards.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:
1. Raceways shall be concealed, where possible, unless otherwise indicated on the Drawings. When exposed, confirm the exact routing with the Engineer prior to roughing in.
2. Sizing: Minimum conduit sizes are indicated on the Drawings. The Contractor may choose to install larger conduit for ease of installation or wiring pulling at no additional cost to the Owner. If conduit or raceway size is not indicated on the Drawings, raceways shall be sized per NEC. Unless otherwise indicated, minimum conduit size shall be ¾ - inches.
3. Unless otherwise indicated, all exposed conduits to be rigid metal conduit GRS or IMC. All direct buried or concrete encased conduits to be Schedule 40 PVC.

B. Cable tray:
1. Install cable trays in conformance with manufacturer’s instructions and recommendations as complete systems prior to the installation of cables. In addition, cables trays shall be installed per NEMA VE2 Standards.
2. Ground all steel cable tray system components.
3. Furnish all required fittings and transitions.
4. Furnish barrier strips in all required trays to isolate UV lamp cables from hydraulic cables.
5. All supports and support hardware shall be Type 316 stainless steel or non-metallic.

C. Conduit:
1. Conduit shall: Have openings temporarily plugged, using “pennies” or equal to exclude plaster or other foreign materials; be reamed after cutting; have joints cut square; have field-cut threads be coated with an approved electrically conductive , corrosion resistant compound and butt solidly into fittings; have the ends terminated in a proper bushed fitting, be rigidly supported so as to prevent undue stress or strain on the couplings and connectors; be swabbed before conductors are pulled in.
2. After installation, seal the openings of all conduits in all enclosures using Type DC duct sealing compound/putty as manufactured by O-Z/Gedney or equal.

3. Concealed conduits shall be run in a direct line with long sweep bends and offsets. Horizontal runs shall be run with a slight incline, to prevent low spots or pockets (for drainage).
4. Conduits shall be continuous from outlet to outlet, from outlets to cabinets, pull or junction boxes and shall be secured to boxes with lock nuts and bushings in such a manner that each system shall be electrically continuous throughout. Three-piece “Erickson” couplings shall be used where required. No running threads shall be cut.
5. Install conduit systems completely before conductors are pulled. Conduits shall be securely supported at proper intervals to structures with steel clamps, or conduit hangers or by special supporting assemblies when indicated on the Drawings.
6. Conduit terminations shall contain insulated bushings. Provide grounding type bushings where steel conduit is stubbed into nonmetallic enclosures, stubbed up in the base of freestanding enclosures or where locknuts cannot assure proper ground continuity between metallic enclosures and the steel conduit. Provide service entrance and transformer connection conduits with grounding type bushings.
7. Exposed conduits shall be installed parallel to walls, floor and ceilings or at right angles to the building lines. Exposed bends shall be used only where approved. Covers shall be secured to bodies with machine screws.
8. IMC: May be used in lieu of heavy wall rigid, unless otherwise indicated.
9. Electrical metallic tubing (EMT) or “Thin-wall” shall not be used except where specifically indicated on the Drawings or as directed by the Engineer.
10. Hickey bends shall not be used for 1-inch and larger conduits. Either manufactured elbows or bends fabricated in a bending machine shall be used. The radius of the inner edge of bends shall be six times the internal diameter of the conduit for conduit sizes up to 2 ½-inches and 12 times internal diameter for 3-inches conduits and larger. A run of conduit between outlet and outlet, between fitting and fitting, or between outlet and fitting shall not contain more than 360º of total bends.
11. Conduit shall not be run above or below water piping, and must be individually supported.
12. In wet locations, and in locations where walls are frequently washed, the entire conduit system, including boxes and fittings used, shall be installed and equipped to prevent water from entering conduit. Conduit shall be so mounted so that there is at least ¼-inch air space between conduit and wall or similar supporting surface.
13. On surfaces exposed to direct sunlight (such as storage tanks and reservoirs), the conduits shall be installed such that there is at least 7/8-inch air space between the conduit and surface.
14. Schedule 40 PVC conduit may be used for buried conduit installations as permitted by the NEC and local codes except where galvanized rigid steel is specified. Couplings, transition fittings, adhesives, primer and installation procedures recommended by the conduit manufacturer and all applicable codes must be strictly followed.
15. Install liquid-tight flexible metal conduit at motors, transformers and equipment which are subject to vibration or require movement for maintenance purposes.

Provide necessary reducer where equipment furnished cannot accept 3/4-inch size flexible conduit. Limit flexible conduit length to 3-foot maximum.

D. Conduit Supports and Hangers:
   1. Conduits shall be individually fastened securely in place on maximum of 8-feet intervals for 1-inch conduit or less and 5-feet intervals for conduits over 1-inch and within 3-feet of each conduit run termination. Use only supports, hangers and fasteners specifically designed for supporting electrical conduits.
   2. Where two or more conduits 1-inch or larger run parallel, trapeze hangers may be used consisting of concrete inserts, threaded solid rods, washers, nuts and galvanized “L” angle iron, or 1-5/8” strut cross members. Such conduits shall be individually fastened to the cross member of every other trapeze hangers with galvanized cast two hole straps, clamp backs, bolted with proper size cadmium machine bolts, washers and nuts. If adjustable trapeze hangers are used to support groups of parallel conduits, U-bolt type clamps shall be used at the end of a conduit run and at each elbow. J-bolts, or approved clamps, shall be installed on each third intermediate trapeze hanger to fasten each conduit.
   3. Hangers shall be made of durable materials suitable for the application involved and shall be painted with two coats of oil paint. Where excessive corrosive conditions are encountered, hanger and strut assemblies shall be protected after fabrication by sherardizing or galvanizing, special paint or other suitable preservative methods.
   4. For mounting on concrete or brick construction, insert anchors shall be installed with round head machine screws. In wood construction, round head wood screws shall be used. In brick, inserts shall be near center of brick, not near edge or in joint. Where steel members occur, drill and tap, and use round head machine screws.

E. Sleeves, Inserts, etc.: Prior to concrete floors being poured and walls being erected, install sleeves, inserts, etc. for conduit penetrations and supports as necessary. Any cutting or drilling through finished floors, walls, roofs, etc. as a result of not installing the necessary sleeves and inserts, shall be done at the Contractor’s expense include patching, sealing and painting to the satisfaction of the Engineer and Owner.

F. Installation of Underground Conduits:
   1. Install underground conduit as indicated on the Drawings. Backfill material around the conduits must be clean-fill (dirt with rocks no larger than ½-inch).
   2. Conduit bends shall have long sweep radius curves instead of standard elbows where indicated on the Drawings. All PVC conduit bends greater than 45° shall be factory-made for conduits larger than 1-inch.
   3. All underground PVC conduit shall be buried a minimum of 24-inches below finished grade, except when located below a concrete slab or freestanding electrical equipment. Conduit shall be installed deeper than 24-inches wherever required to avoid existing piping, tunnels, or other obstructions.
   4. Underground conduits in ductbanks shall be separated and supported with pre-manufactured plastic chairs, unless submitted and approved otherwise, installed at 5-foot intervals in the trench.
   5. ***After duct is in place, notify the Engineer prior to backfill for inspection.*** Failure to do so will result in removal of all backfill material to expose the conduits for inspection.

6. Contractor shall label all conduits in underground ductbanks with a black marker before calling for an inspection.
7. During backfill, provide plastic warning tape at 12-inches below finished grade over underground electrical installations which reads, “Caution - Buried Electrical Line Below”.
8. PVC conduits are permitted to be stubbed up into freestanding electrical enclosures. Where conduit stubs up out of the earth and is exposed, the buried elbow and riser shall be PVC coated rigid metal conduit up to 6” above finished grade, minimum.
9. Where terminating PVC conduit in a freestanding enclosure, underground junction box, manhole/handhole or other similar locations, provide each termination with a bell end.
10. Rigid metal conduit terminations shall contain insulated bushings. Provide grounding type bushings where steel conduit is stubbed into nonmetallic enclosures, stubbed up in the base of freestanding enclosures or where locknuts cannot assure proper ground continuity between metallic enclosures and the steel conduit. Install grounding type bushings on all service entrance and utility transformer connection conduits.
11. Spare conduits shall be capped with an approved plug.
12. Before pulling cables into underground conduits, pull a mandrel ¼-inch smaller than the conduit inside diameter and pulled through each conduit, and if any concrete or obstructions are found, the Contractor shall remove them and clear the conduits. Underground conduits shall be swabbed before cables are pulled in.
13. After duct runs are completed and set, backfill the trenches and tamp thoroughly to 90 percent compaction. Tamp to 95 percent compaction where conduits are located under a roadway. Compaction shall be witnessed by the Engineer.

3.2 CONDUIT MARKERS

A. All conduits with conduit designations indicated on the Drawings shall be identified at each termination. See Section 26 01 95 - Electrical Identification for conduit tag requirements.

END OF SECTION

SECTION 260120 - WIRE AND CABLES (600V OR LESS)

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Wire and cables rated 600 volts or less, as specified, including wiring of all devices.

1.2 SUBMITTALS

A. Product Data: Submit manufacturer's data on all power, signal and communication cables demonstrating compliance with this Specification.

1.3 QUALITY ASSURANCE

A. Comply with the following Codes and Standards:
   1. NFPA 70 (NEC)
   2. UL listing for materials.
   3. ICEA S-66-524
   4. NEMA WC-7
   5. ASTM B-3 or B-8

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Cable:
   1. General Cable
   2. Okonite
   3. Southwire
   4. Encore
   5. Belden
   6. South Wire

B. Connectors:
   1. Ideal
   2. Burndy Corp.
   3. Thomas and Betts Co.
   4. O.Z. Gedney
   5. Minnesota Mining & Manufacturing (3M)

2.2 MATERIALS

A. Conductors for wire and cable shall be stranded copper with 98 percent conductivity and shall be tinned or untinned in accordance with established standards for the type of insulation around the conductors. Solid conductors are not acceptable.

B. Wire and cable shall be stamped approximately every two feet to indicate voltage, type, temperature rating, and other significant data or warnings.

C. Conductors for general purpose wiring shall meet the following requirements:
   1. Power: Type XHHW-2. Minimum conductor size for power shall be No.12 AWG.
   2. Power (direct buried): PVC outer jacket with individual copper conductors with XHHW-2 insulation. Conductor sizes shall be as indicated on the Drawings.

3. Control: Type XHHW-2 for conductors run in conduit, minimum size No.14 AWG. Type MTW for conductors contained in control panels, minimum size No.14 AWG or No.16 AWG when protected by an overcurrent device of 10A or less.
4. Analog Signal: Twisted shielded pair (TSP) or triad (TST) with #18 AWG drain wire and an overall PVC jacket rated 600V and rated for wet locations, minimum conductor size No.16 AWG. Where required, analog signal cables shall be Type TC-ER for exposed cables installed in cable tray in outdoor locations.
5. FIBER OPTIC CABLES
   a. Fiber optic cables shall meet the following specifications:
      1) Fiber Type: Multimode
      2) Core Diameter: 50 µm or 62.5 µm
      3) Cladding Diameter: 125 µm
      4) Maximum Attenuation: 3.5 dB/km at 850 nm, 1.0 dB/km at 1300nm
      5) Buffer Type: Loose tube
      6) Quantity of Fibers: 6 fibers minimum with 2-fibers spare
      7) Operating Temperature Range: -40°C to 70°C
      8) All fiber optic cables installed in underground ductbanks shall be rated for wet locations. Fiber optic cables shall be of sufficient length to be installed between patch panels without splicing.
      9) All fiber connectors utilized on this project shall be the same. This includes terminations to fiber patch panels and Ethernet/Fiber switches.
      10) Fiber optic jumpers and pigtails shall meet the specifications listed above and shall include factory installed connectors.

D. Wire Pulling Lubricant: Lubricant shall be UL listed and be of a consistency that will not leave an obstruction or tackiness that prevents pulling out wires in the future. No soap flakes or vegetable soaps will be permitted. Lubricant in shall be Ideal Wire Lube or equal.

E. Cable Ties: Wiring in panels, cabinets, etc. shall be neat and tied with “Ty-Rap” T&B “TY-5418” series, or Panduit Co. “Cable Wrap”. Cable ties used in outdoor locations shall be UV stabilized.

F. Terminations:
   1. 3-M Scotchlok lugs and connectors - copper.
   2. O-Z solderless connectors, grounding devices, power connectors, armored cable fittings, and cable terminations.
   3. Burndy - copper - all types as appropriate for cable size and configuration.

G. Connector material shall be compatible with conductor material to prevent corroding, differences in coefficients of expansion or electrolysis.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install wires and cables in NEC approved raceways (Section 26 01 10). All wire and cable must be installed in a raceway, unless otherwise indicated on the Drawings.

B. Branch circuit and feeder conductors shall have insulation with the following color. Phase tape is unacceptable.
   1. Grounding conductor-Green

2. 120VAC Neutral - White
3. 120/208VAC Phase A - Black
4. 120/208VAC Phase B - Red
5. 120/208VAC Phase C - Blue
6. 277VAC Neutral – Gray
7. 277/480VAC Phase A - Brown
8. 277/480VAC Phase B - Orange
9. 277/480VAC Phase C - Yellow

C. 6-inch minimum loops shall be provided at each outlet, device or luminaire. Unused wires in outlet boxes, shall be rolled up, connected together and taped or capped with wire nuts. Mark bundled, unused spare wires as “SPARE FROM [origination]”.

D. Branch circuit sizing: Where wire size is not indicated on the Drawings, NEC and local codes shall govern. However, minimum branch circuit conductor size shall be No. 12 AWG.

E. Pulling Cables: Wires and cables shall be carefully handled during installation. Lubricant used for pulling in wires and cables shall be used. Use a dynamometer when pulling conductors by mechanical means.

F. Communication and signal cables shall be run in separate raceways from power wiring. Keep separated from power wiring in control panels, wireways and junction boxes. Keep separated from power wiring raceways by a minimum of 12-inches.

G. Bending radius: Do not exceed the manufacturer’s maximum bending radius.

H. Direct buried conductors and cables emerging from the ground shall be protected by enclosures or raceways extending from the minimum cover distance 24-inches below grade to a point at least 8-feet above finished grade.

3.2 SPLICES AND TERMINATIONS

A. Splices:
1. Splices in conductors shall not be used unless otherwise indicated on the Drawings or approved by the Engineer.
2. Where splices are allowed or necessary, they shall be mechanically strong and well made so that the electrical resistance of a joint shall not exceed that of 2-feet of the conductor.
3. Splices shall be made only in junction boxes and never in conduit.
4. Shielded analog conductor splices shall utilize Raytech Soldershield splice kit or equal.
5. Above Grade Splices:
   a. Utilize wing nut solderless connectors for splicing No. 8 AWG and smaller conductors. Follow manufacturer’s recommendations for sizing, stripping, twisting, etc.
   b. Utilize insulated butt connectors crimped end-to-end for splicing No. 6 AWG and larger conductors. Follow manufacturer’s recommendations for sizing, stripping and crimping.
6. Below Grade Splices:
   a. Utilize listed splice kits or listed wing nut solderless connectors with cast-resin waterproofing for splicing No. 8 AWG and smaller conductors. Splices shall be listed for direct burial applications and identified as “sealed wire

connector system". Follow manufacturer's recommendations for sizing, stripping, twisting, etc.

b. Utilize insulated butt connectors crimped end-to-end with cast-resin waterproofing for splicing No. 6 AWG and larger conductors. Splice kits shall be listed for direct burial applications and identified as "sealed wire connector system". Follow manufacturer's recommendations for sizing, stripping and crimping.

I. Motor terminations: Ring type, crimped connectors shall be installed on all conductors and bolted together back-to-back. For terminations with No.6 and smaller wire, use 10-24 bolts. Use bolts that match the connector bolthole size for all other motor terminations. Apply one layer of cambric tape followed by three layers of rubber tape and finally, top with one layer of black vinyl tape.

J. Non-motor terminations: Use ring or fork type, crimped connectors for all screw-on terminations. Wrapping wire around a binding post is unacceptable.

K. Where special tools are required to properly install the particular connector the special tools must be used.

3.3 WIRE MARKERS

A. All conductors shall be labeled at each termination and splice. See Section 26 01 95 - Electrical Identification for wire marker requirements.

END OF SECTION

SECTION 260130 - BOXES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Outlet boxes, pull and junction boxes and underground junction boxes.

1.2 SUBMITTALS

A. Product Data: Submit manufacturer's data for standard outlet boxes up to six gang, including floor type demonstrating compliance with specification requirements and Drawings.

B. Shop Drawings: Submit drawings for special pull, outlet, and junction boxes demonstrating compliance with NEC and specification requirements. Drawings shall indicate box dimensions and locations in building.

1.3 QUALITY ASSURANCE

A. Comply with the following Codes and Standards:
   1. NEMA 250
   2. NFPA 70
   3. UL listing for materials.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Appleton Electric

B. Crouse-Hinds

C. Killark

D. Raco

E. Hoffman Engineering Co.

F. O.Z. Gedney Co.

G. Steel City

H. Hubbell

I. Rittal

2.2 MATERIALS

A. Outlet boxes for concealed conduits and flush-mounted wiring devices shall meet the following requirements:
   1. Stamped, one piece, galvanized steel.
   2. Proper size and shape for conduits entering them.
   3. UL listed for their application.
   4. ANSI/NEMA OS-1 for galvanized steel; ANSI/NEMA OS-2 for non-metallic.

B. Outlet boxes for exposed conduit systems and exterior locations shall be of the threaded-hub, cast-metal, conduit type fitting suitable for the wiring devices to be installed. Covers (blank, switch, receptacle, etc.) shall be the type specifically designed to fit the specified boxes.

C. Above grade electrical junction and pull boxes shall be sheet metal with an ANSI 61 gray color with size and type as indicated on the Drawings. NEMA rating shall be as indicated on the Drawings. Where a NEMA rating is not indicated, outdoor boxes shall be NEMA 3R. Box sizes shall be as indicated on the Drawings. Where sizes are not indicated or larger size is required to meet code, the box size shall be increased as required by the National Electrical Code.

D. Wireways and troughs:
   1. Wireways shall be sized as indicated on the Drawings or as required by the National Electrical Code. Where sizes are not indicated or larger size is required to meet code, the wireway shall be sized such that the cross-sectional area of the wireway at any one point does not exceed 40% per the National Electrical Code.
   2. Cover: Hinged with removable latches where feasible.
   3. UL listed for steel enclosed wireway or auxiliary gutter.
   4. Furnished complete with covers, elbows, tees, junction boxes, end covers, connectors and hangers.
   5. Unless otherwise indicated, wireways shall be NEMA 1 for indoor applications and NEMA 3R for outdoor and NEMA 4X for corrosive atmospheres.
   6. Wireways in outdoor locations shall be fully gasketed.

E. Underground junction boxes:
   1. Construction: Electric underground junction boxes shall be precast concrete and size as indicated on the Drawings. Underground junction boxes shall have precast concrete extensions.
   2. Covers: Covers shall be rectangular, reinforced concrete and have the text “ELECTRIC” cast into the cover.
   3. Approved Manufacturer: Christy, or equal.

F. Fittings, hangers, fastenings, etc., shall be of material that will prevent chemical reaction between itself and conduit or device it is fastening or supporting.

PART 3 - EXECUTION

3.1 BOX LOCATIONS

A. Location of Boxes: In order that boxes may be placed in proper locations, the Contractor shall familiarize himself with the details of these spaces and carefully lay out boxes so that the equipment or piping of other trades passing under, over, across or in close proximity to same, will not cause these boxes to be inaccessible for use or maintenance. Contractor shall consult with other Contractors and trades on the project and obtain details of the project to locate outlet boxes properly.

B. Contractor shall be responsible for the exact and proper location of the various portions of his work. Consult the Drawing and details.

C. Mounting Heights: The exact mounting height of each switch, receptacle, light fixture outlet, etc., shall be confirmed on the premises in conference with the Engineer. Unless otherwise indicated, receptacles to be mounted at 18-inches and light switches to be mounted at 42-inches above finished floor/grade.

3.2 INSTALLATION

A. No thru-boxes shall be permitted.

B. Boxes shall meet the following requirements:

1. Proper size and shape for conduits entering them.
2. Installed so that device and/or cover plates shall be tight and plumb with wall finish.
3. Have unused openings closed with knock-out closures.
4. Securely fastened to building or structure.

C. Surface-mounted outlet boxes shall meet the following requirements:
   1. Outdoor boxes shall be cast steel or cast aluminum with threaded hubs.
      a. Fastened with not less than two Paine, Phillips, Ackermann-Johnson, or equivalent, screw anchors and round head machine screws on brick and concrete walls or ceilings.
      b. Under no circumstances will drilling of cast boxes be allowed.
      c. PVC coated boxes shall be used for installations with PVC coated rigid steel conduit.
      d. Be provided with a vapor-proof gasket in wet locations or where indicated as “WP” (weatherproof) on the Drawings.
      e. Install a weatherproof-while-in-use cover on all outdoor receptacles.
   2. Bell boxes may be used for indoor applications where rigid steel or IMC conduit is required.

D. Bracket outlets shall be level and centered on columns or above doors when installed in these locations.

E. Flush-mounted outlet boxes shall:
   1. Be solid ganged boxes for more than two devices.
   2. Contain a plaster ring to bring the wiring device attachment points within ¼-inch of the finished wall surface.
   3. Be installed so that device covers are tight and plumb with wall finish.
   4. Be installed as close as possible to the lock side of door trim for light switches.

F. Pull boxes and junction boxes shall be:
   1. Installed in runs of conduit more than 100-feet in length or the equivalent of four 90-degree bends.
   2. Entirely accessible.
   3. Securely mounted to building structure independent of the conduits connected to them.

END OF SECTION

SECTION 260140 - WIRING DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Wiring devices such as but not necessarily limited to power receptacles and light switches.

1.2 SUBMITTALS

A. Product Data: Submit manufacturer's data for each wiring device including device covers demonstrating compliance with these Specifications and UL labeling.

1.3 QUALITY ASSURANCE

A. Comply with the following Codes and standards:
   1. NEMA
   2. UL listing
   3. NFPA 70

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Hubbell

B. Leviton

C. Bryant

D. Crouse-Hinds

E. Pass & Seymour

2.2 MATERIALS

A. Light switches and receptacles shall meet NEMA WD1 and WD6 standards, be UL listed and be Heavy Duty, **Industrial** Specification grade. Commercial specification grade wiring devices are not acceptable.

B. Amperage rating of each wiring device shall match the circuit's overcurrent device amperage rating to which it is connected.

C. Wiring devices shall have an ivory finish unless otherwise specified.

D. Power receptacles shall be the grounded type. Furnish ground fault circuit interrupter (GFCI) type where indicated on the Drawings or as required by the NEC.

E. All GFCI receptacles shall be listed weather-resistance (WR) type receptacles.

F. Light switches shall be the quiet type.

G. Wiring Device Coverplates:
   1. Unless otherwise indicated, coverplates installed indoors or in control panels shall be brushed anodized aluminum.
   2. Weatherproof locations: Wiring devices installed outdoors or where identified on Drawings with "WP" shall contain a gasketed coverplate UL approved for wet locations.
   3. Where weatherproof-while-in-use coverplates are indicated on the Drawings or required by NEC, power receptacles shall be provided with a metallic cover that

is listed for “extra duty” and maintains UL approval for wet locations when a cord is plugged into the receptacle. Non-metallic covers are not acceptable.

PART 3 - EXECUTION

3.1 INSTALLATION/APPLICATION

A. Devices and coverplates shall be plumb and parallel to adjacent surfaces or trim. Flush-mounted devices must be flush with finished wall surfaces and the coverplates must be tight to surfaces over which they are installed.

B. Receptacles identified as GFCI or when required by the NEC shall have individual GFCI receptacles installed for each outlet. Installing a single GFCI receptacle and standard receptacles connected to the load side of the single GFCI receptacle is unacceptable.

3.2 FIELD QUALITY CONTROL

A. Contractor shall verify that the openings have been properly patched around devices without damage to devices.

B. Damaged or painted devices shall be replaced or cleaned as directed by the Engineer.

END OF SECTION

SECTION 260195 - ELECTRICAL IDENTIFICATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Nameplates and labels

B. Wire and cable markers

C. Conduit markers

1.2 REFERENCES

A. ANSI/NFPA 70 - National Electrical Code.
   1. NEC 110-22 Identification of Disconnecting Means
   2. NEC 200-6 Means of Identifying Grounded Conductors
   3. NEC 200-10 Identification of Terminals
   4. NEC 210-5 Identification for Branch Circuits
   5. NEC 215-8 Means of Identifying Conductor with the Higher Voltage to Ground
   6. NEC 230-70, (B) Service Equipment, Marking
   7. NEC 310-11 Marking
   8. NEC 310-12 Conductor Identification
   9. NEC 400-22 Grounded-Conductor Identification
   10. NEC 400-23 Equipment Grounding Conductor Identification
   11. NEC 408-13 Panelboard circuit identification

B. UL standard 224- Standard for Extruded Thermoplastic Insulating Tubing.

1.3 SUBMITTALS

A. Product Data: Provide catalog data for the following:
   1. Wire and cable marking system
   2. Nameplate materials and fasteners
   3. Conduit markers

1.4 REGULATORY REQUIREMENTS

A. Conform to requirements of ANSI/NFPA 70.

B. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and shown.

PART 2 - PRODUCTS

2.1 NAMEPLATES AND LABELS

A. Engraved laminated plastic nameplates with black letters on white background shall be installed on the following as a minimum:
   1. Electrical distribution equipment enclosures
   2. Disconnect switches and motor controllers
   3. Control panels and cabinets
   4. Each motor controller or control panel door mounted device
   5. Major components, control relays and terminal block strips mounted on the backpanel of control panels

B. Letter Size:
   1. Use 3/8-inch letters for identifying electrical distribution equipment enclosures and other large control panels and cabinets. Use 3/16-inch letters for identifying individual control panel components (inside or out) and small control panels/enclosures.

2.2 WIRE MARKERS

A. Manufacturer: Raychem Corporation Model ShrinkMark or equal.

B. Description: heat shrinkable radiation cross-linked, thermally stabilized, modified polyolefin sleeves with 3:1 shrink ratio. Markers shall be UL Standard 224 recognized.

C. Sleeves shall be smear resistant prior to shrinking and achieve mark permanency when shrunk without the need for permatizing equipment. Sleeves should achieve mark permanency when standard ballpoint pens or high-carbon content fabric ribbons are used. The markers shall be flattened and mounted on a carrier suitable for use with commercially available print equipment. Markers shall be printable on both sides. Markers shall be resistant to common industrial fluids including Freon TF, Isopropyl alcohol, and Ethylene Glycol.

D. Locations: Each conductor at each termination and splice.

E. Legend:
   1. Power and Lighting Circuits: Branch circuit or feeder number indicated on the Drawings.
   2. Control Circuits: Control wire number indicated on approved schematics, interconnection diagrams and shop drawings.
   3. Wire numbers shall be the same at both ends of the wire.

2.3 CONDUIT MARKERS

A. Conduit markers shall be 19 gauge, 1 ½-inch diameter round brass (Brady Part No. 23210 or equal) with engraved, black-filled, 1/4-inch Arial font lettering. Markers shall identify conduit number or designation as indicated on the Drawings. If a conduit is not identified on the Drawings, the Contractor shall consult the Engineer for the proper identification.

PART 3 - EXECUTION

3.1 NAMEPLATES

A. Install nameplates parallel to equipment lines.

B. Secure nameplates to the exterior of electrical equipment using UL-508A approved die and tapped stainless steel screws (APM SEELSKREW or equal).

C. Secure nameplate to inside surface or backpanels of control panels with a permanent adhesive (Liquid Nails or equal).

3.2 WIRE MARKERS

A. Wire markers shall be a minimum of 3/8-inches in length and placed as near as possible to the end of the wire before heat-shrinking. Orient wire marker such that the writing can be read without turning or twisting the wire.

B. Wire numbers shall be the same at both ends of the wire.

3.3 CONDUIT MARKERS

A. Conduit markers shall be installed near the end of each conduit run and in intermediate locations such as manholes and handholes.

B. Attach brass conduit markers near the end of exposed conduits with 48 mil stainless steel wire (Brady Part No. 38091 or equal) and zinc wire clamps.

C. Secure conduit markers to the floor using a permanent epoxy (Liquid Nails or equal) where conduits terminate in bell ends flush with finished floor in freestanding equipment.

END OF SECTION

SECTION 260450 - GROUNDING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Grounding and bonding of electrical equipment, raceways and specialized systems, including testing.

1.2 SUBMITTALS

A. Manufacturer's data for the following:
   1. Connection methods
   2. Ground rods
   3. Ground rod wells
   4. Grounding conductors

1.3 SYSTEM DESCRIPTION

A. Ground electrical equipment, conduits, supports, cabinets, and switchgear in accordance with NFPA 70 (NEC) and as shown on the Drawings, the intent being a system ground and an equipment ground.

1.4 QUALITY ASSURANCE

A. Comply with the following Codes and Standards (refer to Section 26 00 50):
   1. IEEE 81-1962--IEEE Recommended Guide for Measuring Ground Resistance and Potential Gradients in the Earth.
   2. NFPA 70 (NEC)
   3. NEMA
   4. UL listing
   5. MIL Handbook 419

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Ground Rods:
   1. Anderson Electric Corp.
   2. Copperweld Corp.
   3. Harger

2.2 MATERIALS

A. Ground rods shall be copperclad rods ¾-inch in diameter and 10-feet long unless indicated otherwise on the Drawings.

B. Ground rod wells shall be 8½-inch diameter constructed of reinforced concrete with a reinforced concrete removable cover stamped "GROUND" as manufactured by Christy or equal.

C. Connectors, mechanical lugs or wire terminals shall be used only to bond ground wires, junction and panel boxes.

D. Grounding conductors shall be stranded copper, size as indicated on the Drawings or as required by the NEC. Grounding conductors shall be bare or contain green insulation.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Where mechanical lugs are not welded or fastened with a threaded bolt, surfaces shall be thoroughly cleaned and paint scraped to bare metal before connections are made to insure good metal-to-metal contact.

B. Grounding conductors shall be so installed as to permit shortest and most direct path from equipment to ground. Ground connections shall be accessible for inspection and made with approved solderless connectors braced (or bolted) to the equipment or structure to be grounded.

C. An equipment grounding conductor must be installed in each conduit with power conductors or, in the case of multi-conductor cable, run inside the cable sheath.

D. The ground system shall also be extended to metallic water piping. Provide a properly sized bonding shunt strap around the meter and dielectric unions in the water pipe unless other connection method indicated on the Drawings.

E. Connections to ground rods and steel water piping system shall be as noted on Drawings or be exothermically welded. Ground rod connections shall be done in a ground rod well for inspection purposes.

F. Burndy HYGROUND connections using a HYPRESS compression tool is acceptable in lieu of exothermic connections. The Engineer must witness each ground connection installation prior to backfill. Notify the Engineer a week in advance for scheduling purposes.

G. All bonds between the grounding electrode conductors and the grounding electrodes must be accessible for inspection and routine maintenance. Any buried ground connections (except for rebar bonds) will not be accepted.

H. All enclosure doors with 120V mounted devices shall be bonded to the enclosure ground bus.

3.2 TESTING

A. Resistance between ground and absolute earth shall not exceed 25 ohms and shall be measured using the fall of potential method with a three or four terminal ground resistance tester. The device used to perform this test must be accurate to the hundredths of an ohm. A minimum of ten (10) ground resistance tests shall be measured at 30-foot intervals from the service grounding electrode. The test results shall be plotted on a curve and submitted in the report. The ground resistance test shall be conducted by a third party, International Electrical Testing Association (NETA) accredited testing agency and shall be witnessed by the Engineer before equipment is placed in operation. Use of salts, water or compounds to attain the specified ground resistance is not acceptable, unless consulted with the Engineer for approval.

B. Test Report: Submit grounding test report including a drawing showing locations of ground tests, date the test was conducted, the weather conditions, and the measured resistance.

END OF SECTION

SECTION 260500 - LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Luminaires.

1.2 SUBMITTALS

A. Submit manufacturer's data for the following:
   1. Luminaires with designation as indicated on the Drawings, for each one proposed.
   2. Lamps (type, color, wattage, etc.), for each one proposed.

B. Submit manufacturer's data demonstrating compliance with Specifications and the luminaires as indicated on the Drawings.

1.3 QUALITY ASSURANCE

A. Comply with the following Codes and Standards (see Section 26 00 50):
   1. UL listed and labeled.
   2. NEMA
   3. NFPA 70 (NEC)
   4. IES

PART 2 - PRODUCTS

2.1 MATERIALS

A. Luminaires shall be:
   1. Furnished with proper outlet boxes, hangers, hardware, supports, canopy extensions, etc.
   2. Furnished complete with lamps with wattage and voltage as indicated on the Drawings.
   3. Furnished complete with plaster frames and light tight gaskets when recessed in drywall or plaster ceilings or overhangs.
   4. Of the specified finishes and color.

B. LEDs:
   1. LED's and their driver shall be designed for minimum operational life of 50,000 hours in -20°C - 40°C ambient air temperature. The lumen output shall not decrease by more than 20% over the operational life. The driver shall decrease output power when the ambient air temperature is outside the -20°C - 40°C range instead of shutting the LED's off. The driver shall be UL listed and include a quick disconnect plug for maintenance. Kelvin temperature shall be 4000K unless otherwise indicated on the Drawings.

PART 3 - EXECUTION

3.1 INTERFERENCES

A. Contractor shall carefully examine the complete areas as well as each individual room where luminaires are to be installed, for interference with piping and other trades. Where such interferences occur, provide luminaires with proper type suspension to overcome such interferences.

3.2 INSTALLATION

A. Luminaires shall be installed parallel with walls and ground for a neat appearance. Where luminaires are indicated to be mounted on a perimeter wall, luminaires shall be installed on a flush mounted box at an elevation such that the top of fixture is flush with the top of wall.

B. Operate luminaires after installation and connection. Check for proper operation. Relamp luminaires that have failed lamps.

3.3 OPERATION

A. Area lights shall be controlled by a 3-position selector switch (On-Off-PC)as indicated on the drawings.

B. Lighting shall be controlled as indicated on the Drawings.

END OF SECTION

SECTION 400205 – PIPING SCHEDULE – SWTP

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The work of this section, and of the Detail Piping Specifications hereinafter, applies to the water treatment plant at the White Mountain Apache Tribal Utility Authority Surface Water Treatment Plant (SWTP).

B. This section presents and explains a tabulation of the piping to be used for each of the various process piping systems for this project.

PART 2 - PRODUCTS

2.1 GENERAL

A. The piping systems being furnished and installed in this project are tabulated in the Piping Schedule included at the end of this section.

2.2 PIPING SCHEDULE

A. The Piping Schedule lists each service by name and by legend and tabulates the applicable detail piping specification section numbers for each piping material to be used in a given service and location.

B. The detail piping specification section numbers are referenced also as to nominal pipe size and location, exposed or buried, submerged, concrete encased, etc.

C. The test pressure for each piping service is listed in the Piping Schedule.

D. In locations where the referenced specifications for a service are unacceptable due to unique or localized physical limitations, specifications or acceptable alternative materials are listed in the “Notes/Remarks” column of the Piping Schedule. If not listed, the Contractor shall notify the Engineer for verification of an acceptable alternative.

E. Where the use of the material listed in the Piping Schedule is not intended but the quantity of the material does not warrant the inclusion of additional materials of construction in the “Notes/Remarks” column, materials of construction will be shown on the Drawings. The material to be used is shown by the standard abbreviation for the material listed herein. In addition, piping not identified by service is identified by material of construction. The appropriate Specification for that material is also listed.

2.3 ABBREVIATIONS

CPVC - Chlorinated polyvinyl chloride
DIP - Ductile Iron
PE - Polyethylene Tubing
PVC - Polyvinyl Chloride
STL – Steel
THPVC – Thickwall PVC (AWWA C900)
< - Less than
≤ - Equal to or less than
> - Greater than
≥ - Equal to or greater than
X=H - Hydrostatic test
X=P - Pneumatic test
NR - Not required

2.4 COLOR CODES AND LABELS

A. Piping color codes and labels are specified in table.

Pipe Designation	Pipe Description	Pipe Label	Pipe Color	Bands
AL	ALUMINUM SULFATE	ALUM	Federal Safety Orange	None
ALP	AIR, LOW PRESSURE	SCOUR AIR	Federal Safety Green	None
BWW	BACKWASH WASTE	BACKWASH WATER	Light Brown	None
BWS	BACKWASH SUPPLY	BACKWASH WATER	Dark Blue	None
D	DRAIN	DRAIN	Black	None
FW	FINISHED WATER	FINISHED WATER	Dark Blue	None
NAOCL	SODIUM HYPOCHLORITE	CHLORINE	Federal Safety Yellow	None
PW	POTABLE WATER	POTABLE WATER	Dark Blue	3-Safety Red
POLY	POLYMER	POLYMER	Federal Safety Orange	1-Green
RAW	RAW WATER	RAW WATER	Olive Green	None
V	VENT	-	Grey	None
WS	WASTE SLUDGE	SLUDGE	Dark Brown	None

B. Piping shall be identified by stenciling or decals.
   1. Stenciling shall use paint or ink resistive to alkalis, acids, chemical reagents and solvents. Stenciled pipe shall have the words indicated in the pipe label from the table above and flow arrows printed in black or white lettering on the corresponding pipe color background. Lettering shall be a minimum of 1½ inches high. Spacing between the individual words of the message shall not exceed three inches.
   2. Stenciled pipe shall be installed so that the wording runs along both sides of the pipe.
   3. Decals shall be made of inert material resistant to cracking, peeling, and fading due to sunlight and heat. Decals shall have an aggressive adhesive to ensure permanent bonding to the surface that is being identified. The decals shall have the words indicated in the pipe label from the table above and flow arrows printed in black or white lettering on the corresponding pipe color background. Spacing between the individual words of the message shall not exceed three inches.
   4. Identification decals shall be placed on both sides of the pipe at intervals no greater than 10 feet. Surfaces shall be prepared to ensure proper adhesion of the decals.

2.5 PIPING SCHEDULE NOTES

A. Test procedures for gravity pipes and overflow pipes are specified in Section 400510, PIPING – GENERAL.

B. Test procedures for pressure pipes are specified in Section 400510, PIPING - GENERAL.

C. Test pressure for process vents, drains, and sample lines to be the same as process piping connected to the line.

D. Convert piping materials where shown on Drawings.

E. Concrete encase piping below building slabs and under structures.

F. PVC or CPVC piping in this service shall be Schedule 80.

G. Some piping may be provided by equipment manufacturers. Connect to equipment with required fittings.

H. All piping and tubing shall be coated per Table 2.4.A.

I. See the Drawings for more detailed pipe material clarification.

PART 3 - EXECUTION

3.1 GENERAL

A. All piping listed in the Piping Schedule shall be installed in accordance with the referenced detail piping specifications.

END OF SECTION
(See Piping Schedule Attached)

PIPING SCHEDULE

PIPING SERVICE	LEGEND	PIPE SIZE (inches)	INSTALLATION	SPECIFICATION SECTION (a)	TEST PRESSURE AND TYPE (PSIG - X)(b)	NOTES/REMARKS (c)
Alum	AL	1/2”	EXPOSED	400510.13	20-P	B, I
Air, Low Pressure	ALP	ALL	EXPOSED	400510.12	30-P	B, D, H
Drain	D	ALL 6”-8”	EXPOSED EXPOSED	400510.12 400510.03	10-P 10-P	A, C, H
Sodium Hypochlorite	NAOCL	1/2”	EXPOSED	400510.13	20-P	B, I
Potable Water	PW	ALL	EXPOSED	400510.03	150-H	B, F, H
Plant Effluent	PE	ALL	EXPOSED	400510.03	30-H	A, B, C, H
Polymer	POLY	1/2”	EXPOSED	400510.12	20-H	B, D, F, G, I, H
Vent (Chemical) Vent (Other)	V	ALL	EXPOSED	400510.12	n/a	
Waste Sludge	WAS	ALL	EXPOSED	400510.03	30-H	B, H

(a) 400510.03 – DPS: Ductile Iron Pipe and Fittings
400510.12 – DPS: Polyvinyl Chloride (PVC) Pipe and Fittings
400510.13 – DPS: Chlorinated Polyvinyl Chloride (CPVC) Pipe and Fittings
(b) Designation: H = Hydrostatic, P = Pneumatic.
(c) See Section 400205, Article 2.5 for applicable notes.

SECTION 400510 – PIPING GENERAL – SWTP

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The work of this section, and of the Detail Piping Specifications hereinafter, applies to the White Mountain Apache Tribal Utility Authority Surface Water Treatment Plant (SWTP).

B. This section covers the material specification for most pipe, pipe fittings, and pipe accessories to be utilized, including methods of pipe jointing and general installation guidelines.

1.2 GENERAL

A. Like items of material provided hereunder shall be the end products of one manufacturer. All piping and accessories shall meet NSF 61 requirements and shall be new products.

1.3 SUBMITTALS

A. The Contractor shall provide the following information to the Engineer:
   1. Certification by the manufacturer that all pipe and pipe fittings comply with ANSI or other applicable national standards and the applicable portions of this specification.
   2. Certified copies of all pipe hydrostatic and pneumatic tests.
   3. Welding procedures and qualifications of welders for steel pipe.
   4. Metal Framing Support Systems: Detailed installation drawings, catalog information, and complete component specifications.
   5. Ductile Iron or Steel Wall Pipes: Manufacturer’s data, including thrust collar type and the test report substantiating the pressure rating and safety factor for fabricated thrust collars.
   6. Expansion Joints and Expansion Compensators: Manufacturer’s data on materials, construction and ratings.
   7. Support Systems:
      a. Drawings of each piping system locating each support, hangar, guide and anchor, including seismic bracing.
      b. Identify support, hanger, guide, and anchor type by catalog number and shop drawing detail number.
      c. Submit a piping support plan for temporary supports where piping will be encased in concrete. Submit piping support plant at least 21 days prior to pipe installation.
   8. Shop Fabricated Piping: Pipe design calculations and detailed shop drawings including:
      a. Detailed pipe sections, special fittings and bends, showing dimensions, coatings and other pertinent information.
      b. Laying drawing showing location of each pipe section and each special length; number or otherwise designate laying sequence on each piece.
   9. Manufacturer catalog data and information for each specified product.
   10. Hydraulic Thrust Restraint: Details including materials, sizes, and assembly ratings, and pipe attachment methods for each pipe material.

11. Thrust blocks including concrete quantity, area of bearing on pipe, and fitting joint locations.
12. Joint types, materials, details and drawings for dissimilar buried pipes, restrained joints, couplings, and other similar piping accessories.
13. Manufacturer's instructions for special procedures and setting dimensions.

1.4 DELIVERY, STORAGE AND HANDLING

A. General:
   1. Accept all piping materials and accessories on site in manufacturer's original packaging and inspect for cracked, gouged, chipped, dented or other damaged material and immediately remove defective pipe from site. Handle and store materials according to manufacturer's instructions.

B. Pipe:
   1. Protect, support, and handle in a manner to prevent damage to the products, especially linings and coatings.
      a. When necessary, provide shelter to store pipe and apply water to prevent excessive drying.
      b. During cold weather, store pipe on supports to prevent damage to coating.
      c. Do not store pipe on rock or other hard surface.
   2. Use implements, tools, facilities, and equipment suitable for proper and safe protection and handling of piping; do not drop or dump pipe into trenches.
      a. Use heavy canvas or nylon slings, not chains or cables, to lift pipe and fittings.
   3. Cement-Mortar or Polyethylene Lined Pipe: Tightly close ends with polyethylene plastic wrap to protect cement-mortar or polyethylene lining during shipment; leave plastic wrap on pipe until installation.
   4. Remove pipe that is damaged beyond repair, in the opinion of the Engineer.

C. Rubber Gaskets:
   1. Store in a cool, well-ventilated area.
   2. Do not expose to the direct rays of the sun.
   3. Do not allow contact with oils, fuels, or petroleum solvents.

1.5 SEQUENCING AND SCHEDULING

A. Slab, Floor, Wall, and Roof Penetrations:
   1. Order wall pipes and sleeves sufficiently early to ensure they are available for placement in concrete forms.
   2. Verify size and location of building and structure penetrations before forming and placing concrete.

1.6 SYSTEM DESIGN REQUIREMENTS AND QUALITY ASSURANCE

A. General:
   1. Pressure Ratings and Materials Specified: Represent minimum acceptable standards for piping systems.
   2. Piping Systems: Suitable for the services specified and intended.
   3. All pipe and equipment supports and hangers shall be designed to meet the requirements of the State of Arizona for Seismic conditions as summarized in the General Structural Notes on the Drawings.

PART 2 - PRODUCTS

2.1 GENERAL

A. The materials to be used for the process piping systems shown on the Drawings are listed by service in Section 400205, PIPING SCHEDULE. Specific material requirements are specified in the Detail Piping Specifications (DPS) hereinafter.

2.2 PIPE JOINTS FOR EXPOSED PIPING

A. Flanges are to be used for all exposed pipe joints unless shown otherwise on the Drawings or noted below.

B. Dismantling joints or restrained flanged coupling adapters or dismantling joints shall be used where shown on the Drawings, or as necessary to facilitate installations. Before installation, all restrained flanged coupling adaptors or dismantling joints shall be submitted to the Engineer for approval.

2.3 JOINTS FOR DISSIMILAR PIPES

A. Joints between dissimilar exposed pipe (steel and stainless steel, steel and ductile iron, copper and galvanized steel, etc.) shall be made with an insulated flange or dielectric union as specified hereinafter.

2.4 PIPE PAINTING AND LABELING

A. All exposed water, gas, sludge, and other piping shall be painted for color coding and labeled as specified in Section 400205, PIPING SCHEDULE. Coatings shall be as specified by the manufacturer.

2.5 BUILDING AND EQUIPMENT PIPING EXPANSION PROVISIONS

A. Pipe anchors shall be placed where required by Code or shown on the Drawings. Flexible couplings or expansion joints shall be provided for piping systems and at connections to equipment where shown. The Contractor may install additional pipe anchors and flexible couplings to facilitate piping installation, provided that he submits complete details describing location, pipe supports, and hydraulic thrust protection.

2.6 PIPING SUPPORT SYSTEMS

A. Piping shall be supported, in general, as described hereinafter and as shown by the pipe support details on the Drawings, and in accordance with ASME B31.1 and B31.9, and MSS SP-58 and SP-69. Manufacturers' catalog figure numbers are typical of the types and quality of standard pipe supports and hangars to be employed. Special support and hanger details are shown to cover typical locations where standard catalog supports are inapplicable.

B. No attempt has been made to show all required pipe supports in all locations, either on the Drawings or in the details. The absence of pipe supports and details on any Drawings shall not relieve the Contractor of the responsibility for providing them throughout.

C. All submerged piping supports, guides, and fasteners and those installed below channel, basin, and wet well wall tops and cover slabs or other high humidity areas such as in piping galleries shall be Type 316 stainless steel. All submerged metal piping or piping in high humidity areas shall be electrically isolated from the supports with a wrap of 1/4-inch thick neoprene rubber between the pipe and oversize clamps.

D. All support anchoring devices, including anchor bolts, inserts, and other devices used to anchor the support onto a concrete base, roof, wall or structural steel works, shall be of the proper size, strength and spacing to withstand the shear and pullout loads imposed by loading and spacing on each particular support.

E. Detailed shop drawings of all supports, including support anchoring devices, shall be supplied with the submittals specified hereinbefore.

F. Where piping penetrates a wall or connects to equipment it shall be supported by a pipe support and not by the wall or equipment. A pipe support or hanger shall be installed adjacent to each pipe fitting or in-line device such as a valve or meter for all piping larger than 4-inch.

G. Pipe support system components shall withstand the dead loads imposed by the weight of the pipes filled with water. Commercial pipe supports and hangers shall have a minimum safety factor of 5. In seismic zones, pipe supports shall also comply with all seismic design requirements.

H. All exposed hangers, rods, clamps, protective shields, and metal framing support components and accessories shall be galvanized steel unless noted otherwise on the Drawings.

I. Pedestal pipe supports shall be adjustable, with stanchion, saddle, U-bolt, and anchoring flange as shown, Anvil Figure 259; Eaton B-Line Figure B3090; or equal. Provide neoprene waffle isolation pad under anchoring flanges, adjacent to equipment or where otherwise required to provide vibration isolation. Pads shall be Mason Industries, Inc. Type W; Korfund Korpad 40 or 100; or equal.

J. All piping shall be supported in a manner which will prevent undue strain on any valve, fitting, or piece of equipment. In addition, pipe supports shall be provided at changes in direction or elevation, adjacent to flexible couplings, and where otherwise shown.

K. Horizontal piping shall be supported with adjustable swivel-ring, split-ring, or Clevis type hangers as shown, Anvil, Figure 104, 108, or 260; Eaton B-Line, Figure B3198H or B3100; or equal.

L. Pipe hangers for copper and plastic piping shall be coated with a plastic or neoprene protective cover, Anvil Figure 260 ISS; Eaton B-Line Figure B3100C; or equal. No metal portion of a hanger, support, or brace shall contact pipe directly.

M. Stacked horizontal runs of small piping along walls shall be supported by a metal framing system as shown, Unistrut, Eaton B-Line Strut, Anvil-Strut, or equal. No pipe shall be supported from the pipe above it.

N. Horizontal piping hanger support rods shall be supported by attachment to the roof trusses; by attachment to steel beams with concentric loading I-beam clamps; or by attachment to concrete with inserts, brackets, or flanges fastened with concrete anchors; as required or as shown on the Drawings.

O. Vertical piping hangers and supports shall be channel and pipe straps manufactured by Unistrut, Eaton B-Line, Anvil, or equal.

P. Unless noted otherwise on the Drawings, horizontal pipe support or hanger spacing and hanger rod sizing for steel and ductile iron pipe shall be as follows:

Pipe Size	Maximum Support and Hanger Span	Minimum Rod Size Single Rod Hangers
1-inch and Smaller	6 feet	1/4-inch

1-1/4-inch thru 2-1/2-inch	8 feet	1/4-inch
3-inch and 4-inch	10 feet	3/8-inch
6-inch	12 feet	3/8-inch
8-inch	12 feet	1/2-inch
10-inch and 12-inch	14 feet	5/8-inch
14-inch	16 feet	3/4-inch
16-inch and 18-inch	16 feet	7/8-inch
20-inch	18 feet	1-inch
24-inch	18 feet	1 ¼-inch
30-inch and larger	As shown on the Drawings	

Q. The load rating for universal concrete inserts or other attachment devices shall not be less than that of the hanger rods they support.

R. When supporting cast iron and ductile iron pipe or steel pipe, locate hanger rods near all joints and at each change of direction.

S. Hanger rod sizing for plastic pipe shall be same as for steel pipe. Spacing of hangers or supports shall be as recommended by the manufacturer for the flow temperature in the pipe.

T. Vertical sway bracing shall be provided where shown, or on 10-foot maximum centers.

U. See the Detail Pipe Specifications for stainless steel piping supports and hanger requirements.

V. U-bolt type supports that tighten directly onto the pipe at the top or bottom points shall not be used for plastic or thin-walled metal (such as copper, stainless steel, etc.) pipe.

2.7 PIPE COUPLINGS AND EXPANSION JOINTS

A. General: Flexible couplings, flanged coupling adapters, restrained couplings, and transition couplings shall be provided where shown on the Drawings. Size shall be compatible with the outside diameter of pipe(s) on which the coupling is installed. Flexible couplings, transition couplings, and flanged coupling adapters shall be provided with thrust ties where required, including those not shown on the Drawings. Thrust ties shall be attached to steel pipe with fabricated lugs, and to ductile iron pipe with cast-in-place lugs or flange lugs or socket clamps thrust tied across pipe couplings or flanges. Thrust protection shall be adequate to sustain the force developed by the greater of 1.) pipe operating pressure plus transient surge pressure, or 2.) pipe test pressures specified. Buried pipe coupling's coating system shall be fusion bonded epoxy and all bolts and nuts shall be Type 316 stainless steel. Exposed pipe couplings coating system shall match the adjoining pipeline and nuts and bolts shall match the pipeline bolting system specified in the Detailed Pipe specifications.

B. Flexible Couplings: Flexible couplings for use with exposed PVC pipe shall be Smith-Blair Omni 441, or equal. Minimum working pressure shall be 150 psi. Flexible couplings for steel pipe shall be Dresser Style 38 or Smith-Blair Style 411, or equal. Flexible couplings for use with ductile iron pipe shall be Dresser, Style 38 or 138; Smith-Blair, Style 411 or 441; or equal. Flexible couplings for steel and ductile iron pipe shall be rated for 150 psi minimum working pressure, unless noted otherwise or used for high pressure service.

C. Transition Couplings: Transition couplings used to connect pipes with small differences in outside diameter shall be Smith-Blair Omni Style 411 or 441, or Style 413 or 415;

PowerSeal Pipeline Products Style 3501; Dresser Style 62 or 162; or equal. Minimum working pressure shall be 150 psi, unless noted otherwise or used for high pressure service.

D. Flanged Coupling Adapters: Restrained flanged coupling adaptors for ductile iron and steel piping shall be Series 911 as manufactured by Smith-Blair; Series 2100 Megaflange as manufactured by EBAA Iron; Style RFCA as manufactured by Romac Industries; or equal. Restrained flanged coupling adaptors for thickwall PVC piping shall be Series 920 as manufactured by Smith-Blair; Series 2100 Megaflange as manufactured by EBAA Iron; Style RFCA-PVC as manufactured by Romac Industries; or equal. Minimum working pressure shall be 150 psi, unless noted otherwise or used for high pressure service.

E. Dismantling Joints: Restrained dismantling joints for ductile iron and steel piping shall be Romac Industries Style DJ400; Smith-Blair Style 971; or equal. Minimum working pressure shall be 150 psi, unless noted otherwise.

2.8 TAPPING SLEEVES

A. Pipe tapping sleeves for thickwall PVC,ductile iron or steel pipe shall be Smith-Blair Product No. 622, or equal, size as shown on the Drawings. Tapping sleeves shall be able to withstand 175 psig internal pressure without leakage or overstressing. The run diameter shall be compatible with the outside diameter of the pipe on which the tapping sleeve is installed. Taps shall be flanged, AWWA C207 Class D, ANSI 150 pound drilling. Sleeves shall be constructed of carbon steel with a fusion bonded epoxy coating. All bolts and nuts shall be Type 304 stainless steel.

2.9 CONCRETE

A. Thrust Blocks and Encasement: Provide of minimum 2,000 psi at 28 days in accordance with Section 033000, CAST IN PLACE CONCRETE.

2.10 INSULATING FLANGES, COUPLINGS, AND UNIONS

A. Materials and rating shall be in accordance with the applicable Detail Pipe Specifications. Dielectric flanges and unions shall be as provided by Watts Water Technologies; Hart Industrial; or equal. Insulating couplings shall be Smith-Blair 416 or 417; Dresser STAB-39; R.H. Baker Series 216; or equal.

2.11 TAPE WRAP

A. Tape wrap shall be minimum 35-mil total thickness butyl rubber adhesive, polyethylene-backed tape as manufactured by Polyken Tape Technology; Royston/Chase Corporation; or approved equal.

PART 3 - EXECUTION

3.1 GENERAL

A. Install all piping, fixtures, equipment, and accessories in strict accordance with the plumbing laws, rules, and regulations of the state or county, and of the IHS, whichever represents the higher standard. All work shall be approved by the state, county, and/or IHS plumbing inspector. All work shall also be installed according to AWWA C600 and C605.

B. Drawings do not attempt to show exact details of all piping, and no extra payment will be allowed for obstruction by work of other trades or local obstructions to the work under this Contract which require offsets. Where diagrams have been made to show piping connections, the Contractor is cautioned that these diagrams must not be used for obtaining material quantities. Changes in location of equipment or piping, advisable in the opinion of the Contractor, shall be submitted to the Engineer for approval before proceeding with the work. All measurements and dimensions shall be verified at the site.

C. In piping that is not flanged, install unions in piping system wherever they will expedite removal of equipment and valves.

D. All air release valves, water-lubricated bearings, and other appurtenances having water effluent shall be piped to nearest drain with copper tubing pipe, unless otherwise shown on the Drawings.

3.2 PIPE PREPARATION AND HANDLING

A. Each pipe and fitting shall be carefully inspected before the exposed pipe or fitting is installed or the pipe or fitting is lowered into the trench. Interior and exterior protective coatings shall be inspected, and all damaged areas patched in the field with material similar to the original. Plastic pipe shall not have scratches exceeding manufacturer recommended depths. Clean ends of pipe thoroughly. Remove foreign matter and dirt from inside of pipe and keep clean during and after laying. A maximum of 500 feet of pipe shall be distributed along the pipe route, on the ground surface, ahead of the trenching and excavation operation.

B. Use proper implements, tools, and facilities for the safe and proper protection of the pipe. Carefully handle pipe in such a manner as to avoid any physical damage to the pipe. Do not drop or dump pipe into trenches under any circumstances.

C. Pipe Cutting: Cutting for closure or other reasons shall be done in accordance with manufacturer recommendations and be done neatly by methods which will not damage pipe. Plastic pipe shall be cut with fine tooth saw, cutter, or knife designed for use with plastic pipe. Burrs shall be removed by smoothing edges with a knife, file or sandpaper. Spigot end shall be beveled.

3.3 INSTALLATION OF FLEXIBLE COUPLINGS, FLANGED COUPLING ADAPTERS, TRANSITION COUPLINGS, RESTRAINED COUPLINGS, AND SERVICE SADDLES

A. Prior to installation, thoroughly clean oil, and dirt from the pipe to provide a clean seat for the gasket. Care shall be taken that the gaskets are wiped clean before they are installed. Flexible couplings, flanged coupling adapters, and transition coupling gaskets shall be lubricated with manufacturer’s standard lubricant before installation on the pipe ends. Install in accordance with the manufacturer's recommendations. Bolts shall be tightened progressively, drawing up bolts on opposite sides until all bolts have a uniform tightness. Workmen tightening bolts shall use torque-limiting wrenches.

3.4 INSTALLATION OF EXPOSED PIPING

A. All pipe flanges shall be set level, plumb, and aligned. All flanged fittings shall be true and perpendicular to the axis of the pipes. All bolt-holes in flanges shall straddle vertical centerline of pipes.

B. Piping shall be installed without springing or forcing the pipe in a manner which would set up stresses in the pipe, valves, or connected equipment.

C. Unless shown otherwise, piping shall be parallel to building lines. Hangers on adjacent piping shall be aligned where possible on common size ranges.

D. On screwed or welded pipe, unions shall be installed where required for piping or equipment installation, even though they are not shown on the Drawings.

E. Plastic flanges shall be bolted up using a filler gasket at any joint with a raised face. The filler gasket shall bear the bolt load uniformly and remove the flange moment from that part of the flange protruding beyond the outer edge of the raised face.

F. Required straight runs of piping upstream and downstream of flow measuring devices shall be smooth.

G. Where valve hand wheels are shown, valve orientation shall be as shown. Where valve hand wheels are not shown, valves shall be oriented to permit easy access to the hand wheels, and to avoid interferences.

H. Unions, strainers, and all other similar in-line devices shall be installed in piping in a manner which allows adequate clearances for maintenance of the device.

I. Lateral supports for seismic loads shall be provided at all changes in direction.

3.5 PIPING CORROSION PROTECTION

A. General:
   1. All pipe and accessories shall be protected from corrosion and adverse environmental conditions. Protection shall include lining and coatings of pipe, material selection, and/or coatings of supports, tie rods, expansion joints, and all other piping accessories and appurtenances.
   2. Also see Section 099600, HIGH PERFORMANCE COATINGS and the Detail Piping Specifications.

B. Exposed Piping Accessories:
   1. All exposed surfaces of black and hot-dip galvanized steel, brass, copper and bronze piping components including, but not limited to, pipe supports, expansion joints, pipe guides, flexible couplings, vent and drain valves and fasteners shall be painted in accordance with Section 099600, HIGH PERFORMANCE COATINGS.
   2. Pipe support systems shall be painted the same color and paint system as the supported piping. Stainless steel pipe supports shall not be painted unless directed by Engineer.

C. Ductile Iron Pipe:
   1. For Exposed Ductile Iron: Exterior protection shall be in accordance with Section 099600, HIGH PERFORMANCE COATINGS. Fittings, bolts, and nuts shall be coated the same as the pipe.

3.6 PROTECTION FOR NON-METALLIC PIPE

A. For all non-metallic pipe, duct, and other accessories exposed and outside of buildings, ultraviolet protection and/or color coding shall be provided by coating pipe as specified in Section 099600, HIGH PERFORMANCE COATINGS.

B. PVC and CPVC pipe shall be color coded using paint as specified in Section 099600, HIGH PERFORMANCE COATINGS.

3.7 PIPE PAINTING AND COLOR CODING

A. Painting, identification, and color coding of piping systems shall be as specified in Section 400205, PIPING SCHEDULE. Coatings shall be applied to piping prior to insulating. Identification and color coding shall also be applied to the exterior covering of insulated piping.

3.8 TESTING

A. General: The Contractor shall conduct pressure and leakage tests concurrently on all newly installed pipelines in accordance with this specification and AWWA C600 and C605. Furnish all necessary equipment and material and make all taps in the pipe, as required. The Engineer will monitor the tests and all testing and results must meet the satisfaction of the Engineer. Test pressures shall be as specified in Section 400205, PIPING SCHEDULE. New pipelines which are to be connected to existing pipelines shall be tested by isolating the new pipe with grooved end pipe caps, spectacle blinds, or blind flanges, plugs or other fittings as appropriate for the pipe type.

B. Preparation and Execution: Conduct hydrostatic and leakage tests on buried piping after the trench has been adequately backfilled. The Contractor may, if field conditions permit, as determined by the Engineer, partially backfill the trench and leave the joints open for inspection and conduct an initial service leak test. The acceptance test shall not, however, be conducted until all backfilling has been completed. Conduct the tests on exposed piping after the piping has been completely installed, including all supports and anchors. Exposed piping shall have no visible leakage.

C. Hydrostatic Leak Test:
   1. Perform hydrostatic leak test per Maricopa Association of Governments Section Specifications Section 611.

D. Pneumatic Leak Tests:
   1. Equipment: Contractor shall conduct and furnish the following equipment for the pneumatic tests:

Amount	Description
1	Pneumatic compressor separator-dryer system capable of providing oil-free dry air and equipped with one or more full capacity safety relief valves set at a pressure of not more than 105 percent of the required primary test pressure.
1	Calibrated test gauge.

   2. Procedure:
      a. Pneumatic testing shall be performed using accurately calibrated instruments and oil-free, dry air. Test shall be performed only after the piping has been completely installed, including all supports, hangers and anchors, and inspected for proper installation. All parts of the piping system shall be subjected to test pressure specified in Section 400205, PIPING SCHEDULE. The Contractor shall recognize the hazards associated with air testing and shall take all necessary precautions to protect test personnel and Owner's operating personnel. All piping to be tested shall be secured to prevent damage to adjacent piping and equipment in the event of a joint failure. Any appurtenant instruments or devices that could be damaged by the test shall be removed from the piping or suitably isolated prior to

applying the test. Prior to starting the test, the Contractor shall notify the Engineer.

b. A preliminary pneumatic test not to exceed 25 psig shall be applied to the piping system prior to final leak testing, as a means of locating major leaks. Examination for leakage, detected by soap bubbles, shall be made at all joints and connections. After all visible leaks have been corrected, the pressure in the system shall gradually be increased to not more than ½ of the test pressure, after which the pressure shall be increased in steps of approximately 1/10 of the test pressure until the required test pressure has been reached. The pneumatic test pressure shall be continuously maintained for a minimum time of 10 minutes and for such additional time as may be necessary to conduct a soap bubble examination for leakage. The piping system, exclusive of possible localized instances at pump or valve packing, shall show no evidence of leakage. Any visible leakage or pressure loss shall be corrected at the Contractor's sole expense.

c. Following pneumatic testing, lines which are to carry flammable gases shall be thoroughly purged with nitrogen to assure that no explosive mixtures will be present in the system during the filling process.

E. Initial Service Leak Tests:

1. Equipment: Equipment used for initial service leak testing may be the same as that specified under HYDROSTATIC AND PNEUMATIC LEAK TESTS hereinbefore, or the pump or compressor connected to the piping system.
2. Procedure: The initial service leak test shall be performed by gradually bringing the piping system up to normal operating pressure and holding it there continuously for a minimum time of 10 minutes. Examination for leakage shall be made at all joints and connections. Soap bubbles shall be used to detect leaks in pneumatically-tested systems. The piping system, exclusive of possible localized instances at pump or valve packing, shall show no visual evidence of weeping or leaking. Any visible leakage or pressure loss shall be corrected at the Contractor's sole expense.

F. Test Records: Records shall be made of each piping system installation during the test. These records shall include:

1. Date of test.
2. Description and identification of piping tested.
3. Test fluid.
4. Test pressure.
5. Remarks, to include such items as:
   a. Leaks (type, location).
   b. Repairs made on leaks.
6. Certification by Contractor and signed acknowledgment by Engineer.

3.9 INTERIM CLEANING

A. Care shall be exercised during fabrication to prevent the accumulation of weld rod, weld spatter, pipe cuttings and filings, gravel, cleaning rags, etc. within piping sections. All piping shall be examined to assure removal of these and other foreign objects prior to assembly. Shop cleaning may employ any conventional commercial cleaning method if it does not corrode, deform, swell, or otherwise alter the physical properties of the material being cleaned.

3.10 FINAL CLEANING

A. Following assembly and testing and prior to final acceptance, all pipelines installed under this section, except chemical gas, air lines, fuel lines, and instrument air lines, shall be flushed with water and all accumulated construction debris and other foreign matter removed. Flushing velocities shall be a minimum of 2.5 feet per second. Cone strainers shall be inserted in the connections to attached equipment and left there until cleaning has been accomplished to the satisfaction of the Engineer. Accumulated debris shall be removed through drains 2-inch and larger or by removing spools and valves. Immediately following drainage of flushed lines, the piping shall be air dried with compressed air.

B. It must be understood that flushing removes only light solids and cannot be relied on to remove heavy materials allowed to get into the pipe during installation. If necessary, the Contractor shall also clean pipelines 2 inches and larger by pigging with an acceptable flexible pig made specifically for this purpose.

C. Chemical gas, air, fuel lines, and instrument air piping shall be blown clean of loose debris with compressed air.

3.11 DISINFECTION

A. Following assembly and prior to final acceptance, all pipelines installed under this section except chemical gas, air lines, fuel lines, and instrument air lines, shall be disinfected. The method of chlorination used shall be approved by the Owner and must conform to NSF/ANSI 60 & 61 and the AWWA C651 (Latest Version) Standards. The spray or swab application of a minimum 1 percent chlorine is acceptable. The contractor is responsible for providing equipment to properly disinfect the new pipe.

3.12 WALL PIPES AND PIPE SLEEVES

A. Wall pipes and pipe sleeves embedded in concrete walls, floors, and slabs shall be embedded as specified in Section 033000, CAST IN PLACE CONCRETE and as shown. Support all pipes embedded in concrete walls, floors, and slabs with formwork to prevent contact with the reinforcing steel.

3.13 PERMISSIBLE DEFLECTION AT JOINTS

A. Wherever it is necessary to deflect pipe from a straight line, either in the vertical or horizontal plane, do not exceed 50 percent of the amount of deflection recommended by the pipe or coupling manufacturer, or as shown on the Drawings.

3.14 INSTALLATION OF INSULATING FLANGES, COUPLINGS, AND UNIONS

A. Install insulating flanges, couplings, or unions wherever copper and/ or dissimilar ferrous metal piping are connected, wherever metallic lines enter buildings, wherever submerged metallic piping is connected to unsubmerged piping, and where shown on the Drawings, all in accordance with the manufacturer’s recommendations. Insulated joints connecting submerged piping to exposed piping shall be installed above maximum water surface elevation and before the first pipe support not having coated anchor bolts or adhesive-bonded concrete anchors. All submerged metallic piping shall be isolated from the concrete reinforcement.

3.15 FABRICATION OF FLANGED PIPE

A. Flanged pipe shall be fabricated in the shop, not in the field, and delivered to the

jobsite with flanges in place and properly faced. Threaded flanges shall be individually fitted and machine tightened on matching threaded pipe by the manufacturer. Flanges shall be faced after fabrication in accordance with ANSI A21.15/AWWA C115. A sufficient number of selected flange-to-pipe threaded joints shall be hydrostatically shop tested to ensure joint integrity.

3.16 ADDITIONAL CONSIDERATIONS FOR DUCTILE IRON OR STEEL PIPE

A. Transportation, Storage and Handling for Ductile Iron and Steel Pipe: Shop coated materials shall be handled, transported, stored and shipped in a manner that will prevent damage to the coating and lining. Coating or lining damaged in handling or other operations shall be repaired to the approval of and at no additional cost to the Owner. Damage to the coating or lining shall be repaired. At all times during construction, the Contractor shall use every precaution to prevent damage to protective coating and lining on the pipe. No metal tools or heavy objects shall be permitted to come into contact unnecessarily with the finished coating. Workmen shall not be permitted to walk upon the coating except when absolutely necessary; in such case, they shall wear shoes with rubber or composition soles and heels or other suitable footwear that will not damage the coating. Any damage to the pipe or the protective coating from any cause during the installation of the pipeline and before final acceptance by the Engineer shall be repaired in accordance with these Specifications and at no additional cost to the Owner. Adequate cross bracing shall be installed in the ends of the pipe to maintain the pipe roundness during transportation and handling. The ends of the pipe shall be sealed with clear polyethylene film at the point of manufacture. The seals shall remain until the pipe is being prepared to be installed.

B. Pipe shall be hoisted by means of wide-belt slings. Metal chains, cables, tongs or other equipment likely to cause damage to the coating shall not be permitted. The Contractor shall allow inspection of the coating on the underside of the pipe while the pipe is suspended from the slings. Coated pipe shall be handled with nylon sling choker belts or equivalent. Caliper clamps shall not be used. Sufficient shoring of dunnage, padding and bonding shall be used when stacking and shipping pipe to adequately protect the pipe and its coating.

C. Cut ends of pipe shall be beveled and filed to prevent gasket damage in joint assembly.

D. Bolted sleeve-type couplings shall be installed in accordance with AWWA C219. Install joint harnesses in accordance with AWWA M11.

3.17 SAFETY CONSIDERATIONS

A. No water piping shall be installed immediately over or within a 3-foot plan view clearance of any electrical panel, motor starter, or mechanical mounting panel. Where piping must be located within these zones, install piping inside a PVC conduit or shield the electrical device to prevent direct water access to electrical equipment in the event of a pipe leak, or provide other protection as allowed by the National Electrical Code.

3.18 CONFINED SPACE ENTRY

A. The Contractor shall satisfy confined space entry requirements for the Engineer and Owner to enter covered structures, large pipes, pipe galleries, and other confined spaces. The requirements shall include furnishing and operating air quality testing equipment, furnishing and operating air movement equipment, and furnishing and

operating other equipment and manpower to satisfy confined space entry requirements.

END OF SECTION

SECTION 400510.03 – DPS – DUCTILE IRON PIPE AND FITTINGS – SWTP

PART 1 - GENERAL

1.1 WORK INCLUDED

A. This section covers the work necessary to furnish and install, complete, the cement lined ductile iron pipe and gray cast iron or ductile iron fittings specified herein, and as specified further in Section 400510, PIPING - GENERAL.

1.2 GENERAL

A. See Section 400510, PIPING - GENERAL, for additional requirements.

1.3 REFERENCE STANDARDS

A. American Water Works Association:
   1. AWWA C104 - Cement-Mortar Lining for Ductile Iron Pipe and Fittings.
   2. AWWA C110 - Ductile-Iron and Gray-Iron Fittings.
   3. AWWA C111 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
   4. AWWA C115 - Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges.
   5. AWWA C150 - Thickness Design of Ductile-Iron Pipe.
   6. AWWA C151 - Ductile-Iron Pipe, Centrifugally Cast.
   7. AWWA C153 - Ductile-Iron Compact Fittings.
   8. AWWA C600 – Installation of Ductile Iron Water Mains and Their Appurtenances.
   9. AWWA C606 – Grooved and Shouldered Joints.

B. ASME International:
   1. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.
   2. ASME B18.2.1 – Square, Hex, Heavy Hex and Askew Head Bolts and Hex, Heavy Hex, Hex Flange, Lobed Head and Lax Screws (Inch Series).
   3. ASME B31.3 - Process Piping.

C. ASTM International:
   1. ASTM A48/A48M - Standard Specification for Gray Iron Castings.
   2. ASTM A307 – Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.
   3. ASTM A354 – Specification for Quenched and Tempered Alloy Steel Bolts, Studs and Other Externally Threaded Fasteners.

1.4 QUALITY ASSURANCE

A. Manufacturer shall have a minimum of five years experience producing ductile iron pipe and fittings, and shall be able to show evidence of at least five installations in satisfactory operation of similar diameters, lengths and pipe class required for the Work.

B. All ductile iron pipe shall be furnished by a single manufacturer and fully manufactured in the USA, including casting, testing and all applicable linings and coatings. The supplier shall be responsible for the provisions of all test requirements specified in AWWA C151 as applicable.

1.5 SUBMITTAL/SHOP DRAWINGS

A. Submittals during construction shall be made in accordance with Section 013300, SUBMITTAL PROCEDURES in Division 01, GENERAL REQUIREMENTS. Equipment shall not be fabricated until manufacturer receives written engineer approval of submitted information.

B. Submittals shall include detailed drawings and data on pipe, fittings, gaskets and appurtenances, as required. Shop drawings shall include piping layouts and schedules. Drawings shall include dimensioning, joint details (including standard and restrained joint details) indicating all pertinent dimensions and manufacturing tolerances, methods and location of supports, anchorage, gasket material, grade of material, and all other pertinent technical information for all items to be furnished.

PART 2 - PRODUCTS

2.1 PIPE

A. Centrifugally cast, Grade 60-42-10 ductile iron, in accordance with AWWA C151/ANSI A21.51, cement-mortar-lined in accordance with AWWA C104, 250 psi minimum working pressure, except as follows:
   1. Threaded flanged pipe shall be Class 53 minimum for 4-inch through 48-inch.
   2. Grooved end pipe shall be Class 53 minimum for 4-inch through 12-inch, Class 54 minimum for 14-inch and larger.

2.2 JOINTS

A. Flanged, grooved end, mechanical joint or push-on as specified herein, with application as specified in Section 400510, PIPING - GENERAL, or as shown on the Drawings.

B. Flanged joint pipe shall conform to AWWA C115/ANSI A21.15 and shall use ductile iron flanges.

C. Grooved end joints shall be rigid type, radius cut grooved, conforming to AWWA C606.

2.3 FITTINGS

A. Gray or ductile iron, 250 psi minimum working pressure, cement-mortar-lined. Where taps are shown on fittings, tapping bosses shall be provided. ANSI B16.1 fittings shall be used only for nonstandard fittings not manufactured under AWWA C110/ANSI A21.10 or AWWA C153/ANSI A21.53.
   1. Flanged: AWWA C110/ANSI A21.10 or AWWA C153/ANSI A21.53 faced and drilled 125-pound ANSI standard flanges; as manufactured by American Cast Iron Pipe Company, U.S. Pipe, or approved equal.
   2. Grooved End: Ductile iron fittings in accordance with AWWA C110/ANSI A21.10 or AWWA C153/ANSI A21.53; rigid radius grooved ends in accordance with AWWA C606 for grooved and shouldered type joints; as manufactured by Victaulic Company, Anvil International, or approved equal.
   3. Push-On: AWWA C110/ANSI A21.10 and AWWA C111/ANSI A21.11; Fastite Joint as manufactured by American Cast Iron Pipe Company, Tyton Joint as manufactured by U.S. Pipe, or approved equal.
   4. Mechanical Joint: AWWA C110/ANSI A21.10 and AWWA C111/ANSI A21.11; as manufactured by American Cast Iron Pipe Company, U.S. Pipe, or approved equal.

2.4 PIPE AND FITTINGS LININGS AND COATINGS

A. All pipe and fittings shall be cement-mortar lined unless otherwise shown.

B. Ductile iron pipe coatings shall be in accordance with Section 099600, HIGH PERFORMANCE COATINGS. Fittings, bolts, and nuts shall be coated the same as the pipe.

2.5 FLANGES

A. Ductile iron, AWWA C115/ANSI A21.15, threaded, 250 psi working pressure, ANSI 125-pound drilling.

B. Grooved end pipe adapter flanges shall be malleable iron, ASTM A47, or ductile iron, ASTM A536, Victaulic Company, Anvil International, or equal.

2.6 GROOVED END COUPLINGS

A. Grooved end pipe couplings shall be malleable iron, ASTM A47, or ductile iron, ASTM A536, in accordance with AWWA C606; Victaulic Company Style 31, Anvil International, or equal.

2.7 BOLTS

A. For Class 125 FF Flanges:
   1. Exposed Dry Locations: Carbon steel, ASTM A307, Grade A hex head bolts and ASTM A563, Grade A hex head nuts.
   2. Submerged and Humid/Corrosive Locations: Type 316L stainless steel, ASTM F594, hex head bolts with minimum yield strength of 75,000 psi and Type 316L stainless steel, ASTM F594 hex head nuts.

B. For Class 250 RF Flanges:
   1. Exposed Dry Locations: Carbon steel, ASTM A 307, Grade B hex head bolts and ASTM A 563, Grade A heavy hex head nuts.
   2. Submerged and Humid/Corrosive Locations: Type 316L stainless steel, ASTM F594, hex head bolts with minimum yield strength of 75,000 psi and Type 316L stainless steel, ASTM F594 hex head nuts.

C. For Grooved End or Mechanical Joint: Manufacturer’s standard for exposed dry locations and manufacturer’s recommended stainless steel for humid and corrosive applications. Do not use grooved end or mechanical joint flanges in submerged applications.

2.8 GASKETS

A. Gaskets for push-on and mechanical joints shall be rubber, conforming to AWWA C111/ANSI A21.11.

B. Gaskets for flanged joints shall be 1/8-inch thick conforming to applicable parts of ANSI B16.21, AWWA C207, and NSF 61. Gasket material shall be free from corrosive alkali or acid ingredients and suitable for use in sewage or potable waterlines. Gaskets shall be full-face type, EPDM elastomer with cloth finish, Garlock Style 98206, or approved equal, for 125-pound FF flanges. Gaskets shall be flat ring type, made of synthetic fibers with a rubber binder or PTFE with glass microspheres, Garlock Style 3760-U or Style 3505, or approved equal, for 250-pound RF flanges.

C. Gaskets for grooved end joints shall be manufacturer's flush-seal type specifically designed for cast surfaces. Properties shall be as designated in ASTM D2000 for the required service. Dimensions shall conform to AWWA C606.

2.9 LUBRICANT

A. Lubricant for joints shall be manufacturer's standard.

PART 3 - EXECUTION

3.1 CUTTING PIPE

A. As far as is practicable, all ductile iron pipe shall be furnished in the proper lengths and shall not require cutting. If cutting of the pipe is required in the field, it shall be done without damaging the pipe or interior lining, and shall leave a smooth end at right angles to the axis of the pipe.

B. Cut pipe with milling type cutter, rolling pipe cutter, or abrasive saw cutter. Do not flame cut. The cut end shall be cleaned and coated using repair material provided by the pipe manufacturer.

3.2 DRESSING CUT ENDS

A. Dress cut ends of pipe in accordance with the type of joint to be made.

B. Dress cut ends of buried pipe joints to remove sharp edges or projections which may damage the rubber gasket.

C. Dress cut ends of push-on joint pipe by beveling, as recommended by the pipe manufacturer.

D. Dress cut ends of pipe for flexible couplings, flanged coupling adapters, and grooved end pipe couplings as recommended by the coupling or adapter manufacturer.

3.3 FABRICATION OF FLANGED PIPE

A. Flanged pipe shall be fabricated in the shop, not in the field, and delivered to the jobsite with flanges in place and properly faced. Threaded flanges shall be individually fitted and machine tightened on matching threaded pipe by manufacturer. Flanges shall be faced after fabrication in accordance with AWWA C115/ANSI A21.15. A sufficient number (at least 10 percent) of selected flange-to-pipe threaded joints shall be hydrostatically shop tested to ensure joint integrity.

3.4 JOINING PIPE

A. Flanged: Prior to connecting flanged pipe, the faces of the flanges shall be thoroughly cleaned of all oil, grease, and foreign material. The rubber gaskets shall be checked for proper fit and thoroughly cleaned. Care shall be taken to assure proper seating of the flange gasket. Bolts shall be tightened so that the pressure on the gasket is uniform. Torque-limiting wrenches shall be used to ensure uniform bearing insofar as possible. If joints leak when the hydrostatic test is applied, the gaskets shall be removed and reset and bolts retightened.

B. Grooved End: Installation shall be in accordance with the manufacturer's printed instructions.

C. Push-On and Mechanical Joint: Join pipe with push-on or mechanical type joints in accordance with the manufacturer's recommendations. Provide all special tools and devices, such as special jacks, chokers, and similar items required for proper

installation. Lubricant for the pipe gaskets shall be furnished by the pipe manufacturer, and no substitutes shall be permitted under any circumstances.

3.5 TESTING

A. All pipelines shall be hydrostatically tested at the pressures listed in Section 400205, PIPING SCHEDULE. Test procedures shall be as specified in Section 400510, PIPING - GENERAL. The Contractor shall be responsible for proper coordination of all pipe, fittings, and other accessories so that all lines are designed to handle the test pressures specified.

3.6 CORROSION PROTECTION

A. As specified in Section 400510, PIPING – GENERAL.

3.7 SUPPORTS AND HANGERS

A. As specified in Section 400510, PIPING - GENERAL.

END OF SECTION

SECTION 400510.12 – DPS- POLYVINYL CHLORIDE (PVC) PIPE AND FITTINGS – SWTP

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Work necessary to furnish and install, complete, the polyvinyl chloride (PVC) pipe and fittings specified herein, and as specified further in Section 400510, PIPING - GENERAL.

1.2 GENERAL

A. See Section 400510, PIPING - GENERAL, for additional requirements. All PVC piping components shall be the products of one manufacturer.

1.3 REFERENCES

A. Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.
   1. ASTM D1598 - Test Method for Time-to-Failure of Plastic Pipe Under Constant Internal Pressure
   2. ASTM D1599 – Test Method for Short-Time Hydraulic Failure Pressure of Plastic Pipe, Tubing and Fittings.
   3. ASTM D1784 - Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
   4. ASTM D1785 – Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
   5. ASTM D2122 – Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings.
   6. ASTM D2564 – Specification for Solvent Cements for Poly (Vinyl Chloride) PVC Plastic Piping Systems.
   7. ASTM D2855 – Standard Practice for the Two-Step (Primer and Solvent Cement) Method of Joining Poly (Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) (CPVC) Pipe and Piping Components with Tapered Sockets.
   8. ASTM F402 – Standard Practice for Safe Handling of Solvent Cements, Primers, and Cleaners Used for Joining Thermoplastic Pipe and Fittings.
   9. ASTM F656 – Specification for Primers for Use in Solvent Cement Joints of Poly (Vinyl Chloride) (PVC) and Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe and Fittings.

1.4 QUALITY ASSURANCE

A. Piping manufacturer shall maintain a continuous quality control program. All CPVC plastic molding materials used to manufacture pipe and fittings under this Section shall be tested for conformance to the requirements of ASTM D1784.

PART 2 - PRODUCTS

2.1 PIPE

A. PVC, Schedule 80 or Schedule 40, Type I, Grade 1, or Class 12454-B, conforming to ASTM D1784 and ASTM D1785. Provide Schedule 80 pipe where specified in Section 400205, PIPING SCHEDULE and where PVC pipe is threaded.

2.2 NIPPLES

A. Same as pipe except any threaded nipples shall be Schedule 80.

2.3 JOINTS

A. Socket-weld, except where connecting to unions, valves, and equipment with threaded connections that may require future disassembly.

2.4 FITTINGS

A. Schedule 80, as specified under Article PIPE hereinbefore. Fittings shall conform to the requirements of ASTM D2467 for socket type and ASTM D2464 for threaded type.

B. Where Schedule 40 pipe is allowed, fittings shall be Schedule 40, as specified under Article PIPE hereinbefore. Fittings shall conform to the requirements of ASTM D2466 for socket type and ASTM D2464 for threaded type.

2.5 FLANGES

A. One piece, molded hub type flat faced flanges, 125-pound standard, as specified under Article FITTINGS hereinbefore.

2.6 GASKETS

A. Full-faced, 1/8-inch thick, fabricated from ethylene propylene diene monomer rubber (EPDM) or a blend of fluoroelastomers (FKM) complying with ASME B16.21 and NSF 61.

B. When mating flange has raised face, use flat ring gasket and provide filler gasket between OD of raised face and flange OD to protect PVC flange from bolting moment.

2.7 EXPANSION JOINTS

A. See 400510, PIPING – GENERAL.

2.8 BOLTING FOR EXPOSED APPLICATIONS

A. With Flat Ring Gaskets: Carbon steel, ASTM A307, Grade B square head bolts and ASTM A563, Grade A heavy hex head nuts.

B. With Full Face Gaskets or in Corrosive Areas: Type 316 stainless steel, ASTM A193, Grade B8M hex head bolts and ASTM A194, Grade 8M hex head nuts.

1. Bolts shall be fabricated in accordance with ANSI B18.2 and provided with washers of the same material as bolts.

2.9 SOLVENT CEMENT

A. All socket connections shall be joined with an industrial grade PVC solvent cement conforming to ASTM D2564 and NSF/ANSI 61, suitable for water, wastewater and chemical solution applications. Primer shall comply with ASTM F656. Manufacture and viscosity shall be as recommended by the pipe and fitting manufacturer to assure compatibility. Primer shall be Weld-On P-70 and cement shall be Weld-On 711 PVC, or approved equal.

2.10 THREAD LUBRICANT

A. Teflon tape.

PART 3 - EXECUTION

3.1 GENERAL

A. All rigid PVC pipe shall be cut, made up, and installed in accordance with the pipe manufacturer's recommendations. Plastic PVC pipe shall be laid by snaking the pipe from one side of the trench to the other for direct bury and the offset shall be as recommended by the manufacturer for the maximum temperature variation between time of solvent welding and during operation. PVC pipe shall be properly supported where exposed as shown on the Drawings and as specified in Section 400510, PIPING - GENERAL.

B. Use Schedule 80 threaded nipple where necessary to connect to threaded valve or fitting. Schedule 40 pipe shall not be threaded.

C. Only strap wrenches shall be used for tightening threaded plastic joints, and care shall be taken not to overtighten these fittings. Pipe shall not be laid when the temperature is below 40 degrees F, nor above 90 degrees F when exposed to direct sunlight. Ends to be joined shall be shielded from direct sunlight prior to and during the laying operation.

D. PVC piping shall be installed with unions as necessary for removal of valves and fittings for future maintenance.

E. Provide adequate ventilation when working with pipe joint solvent cement. Cleaning with primer shall be done in accordance with ASTM F402 and joining with solvent cement shall be done in accordance with ASTM D2855.

F. Field cuts of PVC pipe shall be done according to the pipe manufacturer’s recommendations. Ream cut pipe ends to remove burrs and bevel plain-end pipe. Thoroughly clean pipe and fittings before installation to remove all foreign substances. Installation shall comply with ASME B31.3.

G. Provide expansion provisions as specified in Section 400510, PIPING – GENERAL to compensate for pipe expansion due to temperature differences.

3.2 TESTING

A. All lines shall be hydrostatically tested at the pressures listed in Section 400205, PIPING SCHEDULE. Test procedures shall be as specified in Section 400510, PIPING - GENERAL.

3.3 SUPPORTS AND HANGERS

A. In accordance with the manufacturer’s recommendations.

END OF SECTION

SECTION 400510.13 - DPS – CHLORINATED POLYVINYL CHLORIDE (CPVC) PIPE AND FITTINGS – SWTP

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Work necessary to furnish and install, complete, the chlorinated polyvinyl chloride (CPVC) pipe and fittings specified herein, and as specified further in Section 400510, PIPING -GENERAL.

1.2 GENERAL

A. See Section 400510, PIPING - GENERAL, for additional requirements. All CPVC piping components shall be the products of one manufacturer.

1.3 REFERENCES

A. Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.
   1. ASTM D1598 - Test Method for Time-to-Failure of Plastic Pipe Under Constant Internal Pressure
   2. ASTM D1599 – Test Method for Short-Time Hydraulic Failure Pressure of Plastic Pipe, Tubing and Fittings.
   3. ASTM D1784 - Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
   4. ASTM D2122 – Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings.
   5. ASTM D2855 – Standard Practice for the Two-Step (Primer and Solvent Cement) Method of Joining Poly (Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) (CPVC) Pipe and Piping Components with Tapered Sockets.
   6. ASTM F402 – Standard Practice for Safe Handling of Solvent Cements, Primers, and Cleaners Used for Joining Thermoplastic Pipe and Fittings.
   7. ASTM F437 - Specification for Threaded Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80.
   8. ASTM F439 - Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80.
   9. ASTM F441 - Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80.
   10. ASTM F493 - Specification for Solvent Cements for Chlorinated Poly (Vinyl Chloride) Plastic Pipe and Fittings.
   11. ASTM F656 – Specification for Primers for Use in Solvent Cement Joints of Poly (Vinyl Chloride) (PVC) and Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe and Fittings.

1.4 QUALITY ASSURANCE

A. Piping manufacturer shall maintain a continuous quality control program. All CPVC plastic molding materials used to manufacture pipe and fittings under this Section shall be tested for conformance to the requirements of ASTM D1784.

PART 2 - PRODUCTS

2.1 PIPE

A. CPVC, Schedule 80, Type IV, Grade 1, or Class 23447-B, conforming to ASTM D1784 and ASTM F441.

2.2 NIPPLES

A. Same as pipe.

2.3 JOINTS

A. Socket-weld, except where connecting to unions, valves, and equipment with threaded connections that may require future disassembly.

2.4 FITTINGS

A. Schedule 80, as specified under Article PIPE hereinbefore. Fittings shall conform to the requirements of ASTM F439 for socket type and ASTM F437 for threaded type.

2.5 FLANGES

A. One piece, molded hub type flat faced flanges, 125-pound standard, as specified under Article FITTINGS hereinbefore.

2.6 GASKETS

A. Full-faced, 1/8-inch thick, fabricated from ethylene propylene dienne monomer rubber (EPDM) or a blend of fluoroelastomers (FKM) complying with ASTM B16.21 and NSF 61.

B. When mating flange has raised face, use flat ring gasket and provide filler gasket between OD of raised face and flange OD to protect CPVC flange from bolting moment.

2.7 EXPANSION JOINTS

A. See 400510, PIPING – GENERAL.

2.8 BOLTING FOR EXPOSED APPLICATIONS

A. With Flat Ring Gaskets: Carbon steel, ASTM A307, Grade B square head bolts and ASTM A563, Grade A heavy hex head nuts.

B. With Full Face Gaskets or in Corrosive Areas: Type 316 stainless steel, ASTM A193, Grade B8M hex head bolts and ASTM A194, Grade 8M hex head nuts.

1. Bolts shall be fabricated in accordance with ANSI B18.2 and provided with washers of the same material as bolts.

2.9 SOLVENT CEMENT

A. All socket connections shall be joined with an industrial grade CPVC solvent cement conforming to ASTM F493 and NSF/ANSI 61, suitable for water, wastewater and chemical solution applications. Primer shall comply with ASTM F656. Manufacture and viscosity shall be as recommended by the pipe and fitting manufacturer to assure compatibility. Primer shall be Weld-On P-70 and cement shall be Weld-On 724 CPVC, or approved equal.

2.10 THREAD LUBRICANT

A. Teflon tape.

2.11 BALL VALVES

A. Ball valves shall be of CPVC construction, suitable for 150 psi working pressure at 120°F.

B. Valves shall have true union socket ends.

C. Seats and seals shall be Viton.

D. Product and Manufacturer: Provide one of the following:
   1. Nibco Incorporated.
   2. Hayward Manufacturing Company.
   3. ASAHI/America.
   4. Spears.
   5. Or equal.

PART 3 - EXECUTION

3.1 GENERAL

A. All rigid CPVC pipe shall be cut, made up, and installed in accordance with the pipe manufacturer's recommendations. Plastic CPVC pipe shall be laid by snaking the pipe from one side of the trench to the other. Offset shall be as recommended by the manufacturer for the maximum temperature variation between time of solvent welding and during operation. CPVC pipe shall be properly supported where exposed as shown on the Drawings and as specified in Section 400510, PIPING - GENERAL.

B. Use Schedule 80 threaded nipple where necessary to connect to threaded valve or fitting.

C. Only strap wrenches shall be used for tightening threaded plastic joints, and care shall be taken not to overtighten these fittings. Pipe shall not be laid when the temperature is below 40 degrees F, nor above 90 degrees F when exposed to direct sunlight. Ends to be joined shall be shielded from direct sunlight prior to and during the laying operation.

D. CPVC piping shall be installed with unions as necessary for removal of valves and fittings for future maintenance.

E. Provide adequate ventilation when working with pipe joint solvent cement. Cleaning with primer shall be done in accordance with ASTM F402 and joining with solvent cement shall be done in accordance with ASTM D2855.

F. Field cuts of CPVC pipe shall be done according to the pipe manufacturer’s recommendations. Ream cut pipe ends to remove burrs and bevel plain-end pipe. Thoroughly clean pipe and fittings before installation to remove all foreign substances. Installation shall comply with ASME B31.3.

G. Provide expansion provisions as specified in Section 400510, PIPING – GENERAL to compensate for pipe expansion due to temperature differences.

H. If the Engineer should observe the Contractor improperly solvent welding CPVC pipe joints, not strictly adhering to the manufacturer’s recommendations or procedure outlined in Part 3 of this Section, all CPVC already assembled shall be removed from the job site and new CPVC shall be installed at no additional cost to the Owner.

3.2 TESTING

A. All lines shall be hydrostatically tested at the pressures listed in Section 400205, PIPING SCHEDULE. Test procedures shall be as specified in Section 400510, PIPING - GENERAL.

3.3 SUPPORTS AND HANGERS

A. In accordance with the manufacturer's recommendations.

END OF SECTION

SECTION 400553 – MANUAL VALVES – SWTP

PART 1 - GENERAL

1.1 WORK INCLUDED

A. This section covers the work necessary for furnishing and installing the various manual ball valves and other special valves, complete. The work of this section applies to the White Mountain Apache Tribal Utility Authority Surface Water Treatment Plant (SWTP).

B. Motor-operated valves associated with the packaged water treatment system are included in Section 460713, PACKAGED WATER TREATMENT EQUIPMENT - SWTP.

C. Related Sections:
   1. Section 400205, PIPING SCHEDULE - SWTP
   2. Section 400510, PIPING GENERAL - SWTP
   3. Section 460713, PACKAGED WATER TREATMENT EQUIPMENT – SWTP.

1.2 GENERAL

A. Like items of equipment specified herein shall be the end products of one manufacturer in order to achieve standardization for operation, maintenance, spare parts, and manufacturer's service.

B. See the GENERAL CONDITIONS and Division 01, GENERAL REQUIREMENTS, which contain information and requirements that apply to the work specified herein and are mandatory for this project.

1.3 SUBMITTALS DURING CONSTRUCTION

A. Submittals during construction shall be made as required in Section 013300, SUBMITTAL PROCDURES in Division 01, GENERAL REQUIREMENTS. In addition, the following specific information shall be provided:
   1. Valve Type Number.
   2. Specific details regarding valve construction as applicable for each valve type.
   3. Submit each valve type as a complete package.
   4. If requested by the Engineer, the valve manufacturer shall furnish an affidavit stating the materials options furnished have complied with these and other referenced specifications.

1.4 MANUFACTURERS' SERVICES

A. Manufacturer's services shall be provided in accordance with Section 019113, GENERAL COMMISSIONING REQUIREMENTS.

PART 2 - PRODUCTS

2.1 GENERAL

A. All valves shall be complete with all necessary accessories or appurtenances which are required for the proper completion of the work included under this section. Operators and other accessories shall be sized and furnished by the valve supplier and factory mounted.

B. Valves and operators shall be suitable for the exposure they are subject to: buried, submerged, interior, exterior, as applicable. They shall have all safety features required

by OSHA. Unless otherwise shown, valves shall be the same size as the adjoining pipe.

C. All units shall have the name of the manufacturer and the size of the valve cast on the body or bonnet or shown on a permanently attached plate in raised letters.

D. For the purpose of designating the type and grade of valve desired, manufacturers' name is given in the following specifications. Valves of equal quality by other manufacturers will be considered in accordance with the General Conditions.

E. The structure and appurtenant facilities have been designed around the first named manufacturer's equipment. Equipment furnished by all qualified interested manufacturers will be considered, provided that necessary structural and mechanical changes required are submitted in conformance with the requirements of the GENERAL CONDITIONS and Division 01, GENERAL REQUIREMENTS. The Contractor shall bear all costs for necessary changes for a complete and satisfactory installation.

2.2 VALVE TYPES

A. Valve types are specified by number in this Specification. The valves are indicated on the Drawings by valve equipment number call-out and size.

B. Not all valves specified herein may be used on this project. The Contractor shall coordinate all valve types with the Drawings and other specifications in these Contract Documents.

2.3 DESIGN FEATURES

A. Brass and bronze components of valves and appurtenances which have surfaces in contact with the water shall be alloys containing less than 16 percent zinc and 2 percent aluminum.

B. Approved alloys are of the following ASTM designations:
1. A126, Class B, B 61, B 62, B 98 (Alloy UNS No. C65100, C65500, or C66100), B 139 (Alloy UNS No. C51000), B 584 (Alloy UNS No. C90300 or C94700), B 164, B 194, and B 127.
2. Stainless steel Type 304 or 316 may be substituted for bronze at the option of the manufacturer and with the approval of the Engineer.

C. All gland bolts on exposed iron body valves shall be zinc plated steel and shall be fitted with zinc plated nuts. When specified or for valves in buried or submerged applications, gland bolts and nuts shall be Type 316 stainless steel.

D. Valve ends shall be as specified or as shown on the Drawings, and to suit the adjacent piping.

2.4 VALVE OPERATORS

A. General: All valves shall be equipped with operators as applicable. The valve operator types, as specified herein, describe only the general characteristics of the operator. The operator shall be compatible with the valve with which it will be used and shall be of the same manufacturer, or a product that is recommended by the valve manufacturer. The operator shall be sized to operate the valve for the full range of pressures and velocities imposed by the service. All valve operators shall open by turning counterclockwise.

B. Manual Operators:

1. General:
   a. Manual handwheel operators shall be provided unless otherwise shown or specified. Ferrous handwheels shall be epoxy-coated or galvanized steel and then field painted the same color as the valve and associated pipeline. Lever operators may be supplied on quarter-turn type valves 6 inches and smaller, if recommended by the manufacturer; however, operator force shall not exceed 80 pounds under any operating condition, including initial breakaway.
   b. When the maximum force required to operate a valve under full operating head exceeds 80 pounds, gear reduction operators shall be provided. Gear operators shall be totally enclosed and lubricated.
   c. On quarter-turn valves, the valve operators shall be of the self-locking type to prevent the disc or plug from creeping and shall be provided with position indicators to show the position of the valve disc or plug. Operators of the worm and gear type shall have self-locking worm gears, one-piece design, of cast or ductile iron gear material, accurately machine cut. The worm shall be hardened alloy steel, with thread ground and polished.
   d. Operators of the geared traveling nut type shall have threaded steel reach rods with an internally threaded bronze or ductile iron nut.
2. Exposed Operators:
   a. Exposed operators shall be furnished with chain wheel operators (CWO), geared operators (GO), extension stems, floor stands, and other elements as shown on the Drawings or as required to permit operation from the normal operating level.
   b. Lever type operators shall have some means of being fixed in any given position to prevent accidental movement; shall be of rugged, noncorrosive construction; and shall be fully compatible with the valve.
3. Unless specified otherwise hereinafter or shown otherwise on the Drawings, exposed operators shall be of the type listed below:

Type of Valve	Size	Operator
Gate	All Sizes	Handwheel (OS&Y)
Butterfly	6" and Smaller	Locking lever with 10-position plate
	8" and Larger	Geared handwheel
Plug	5" and Smaller	Wrench lever
	6" and Larger	Geared handwheel except as noted hereinafter
Ball	All Sizes	Lever

4. Where valve centerline is more than 6 feet 9 inches above floor line, chain and wheel guide assemblies, or chain lever assemblies, shall be provided.

2.5 ACCESSORIES

A. Tagging: Each valve operator shall be provided with a 1-1/2-inch minimum diameter heavy brass or stainless steel tag. Each tag shall bear the valve number shown on the Drawings. The tags shall be attached to the operator with key rings so that ring and tag cannot be removed. The numbers and letters shall be of block type, with 1/4-inch high numbers and letters stamped thereon.

B. Limit Switches: Certain valves are required to be provided with limit switches. Switches and associated attachment mountings shall be factory installed and, unless otherwise indicated, limit switches shall be SPST, rated at 5 amps, 120 volts ac. Check the various process mechanical drawings and the instrumentation and control drawings to locate valves requiring limit switches. Also refer to Section 460713, PACKAGED WATER TREATMENT EQUIPMENT, for additional switch requirements.

2.6 BALL VALVES

A. Ball valves 3 inches and smaller, for general water and air service, shall be all bronze, end entry type, with threaded or solder ends, full bore ports, PTFE or Teflon seats and packing, and hand lever operators, rated 600 psi minimum at 200 degrees F. Install union adjacent to valves to provide access to seats. Valve shall be Jenkins Figure No. 201J or 202J, Stockham Figure T-255 or S-255, or equal.

B. PVC ball valves 2 inches and smaller shall be rated 150 psi minimum at 73 to 100 degrees F, with ASTM D1784 Cell Classification 12454, Type I, Grade 1 polyvinyl chloride body, ball, and stem. Valves shall be of end entry, double union design with solvent weld socket ends, or single union ball valves with flanged ends drilled to 150-pound ANSI Standard. Valves shall have replaceable PTFE seats and EPDM O-ring stem seals. Valves shall have handle for manual operation. Valves shall be GF Piping Systems Type 546 Linear PVC; Nibco Chemtrol PVC Tru-Bloc True Union Model D; Asahi-America PVC Type 21/21a; Spears Manufacturing Company True Union 2000 PVC; or equal. Where noted, or specifically needed for a unique chemical service, provide vented ball valve. Venting hole shall be provided by the valve manufacturer.

C. PVC ball valves 3 inches and larger shall be rated 150 psi minimum at 73 to 100 degrees F, with ASTM D1784 Cell Classification 12454, Type I, Grade 1 polyvinyl chloride full port body, ball, and stem. Valves shall be of end entry, double union design with solvent weld socket ends, or single union ball valves with flanged ends drilled to 150-pound ANSI Standard. Valves shall have replaceable PTFE seats and EPDMO-ring stem, face and carrier seals. Valves shall have handle for manual operation. Valves shall be GF Piping Systems Type 546 Linear PVC; Nibco Chemtrol PVC Tru-Bloc True Union Model C; Asahi-America PVC Type 21/21a; Spears Manufacturing Company True Union 2000 PVC; or equal.

D. CPVC ball valves 2 inches and smaller shall be rated 200 psi minimum at 73 to 100 degrees F, with ASTM D1784, Type IV, Grade 1 chlorinated polyvinyl chloride (CPVC) body, ball, and stem. Valves shall be of end entry, double union design with solvent weld socket ends, or single union ball valves with flanged ends drilled to 150-pound ANSI Standard. Valves shall have replaceable Teflon or PTFE seats and EPDM O-ring stem seals. Valves shall have handle for manual operation. Valves shall be GF Piping Systems Type 546 Linear CPVC; Nibco Chemtrol CPVC Tru-Bloc True Union Model D; Asahi-America CPVC Type 21/21a; Spears Manufacturing Company True Union 2000 CPVC; or equal. Where noted, or specifically needed for a unique

chemical service, provide vented ball valve. Venting hole shall be provided by the valve manufacturer.

E. CPVC ball valves 3 inches and larger shall be rated 150 psi minimum at 73 to 100 degrees F with ASTM D 1784, Type IV, Grade 1 chlorinated polyvinyl chloride (CPVC) full port bodies. Valves shall have Teflon or PTFE seats and EPDM O-ring stem, face, and carrier seals. Valves shall be end entry type with dual union solvent weld socket ends, or single union ball valves with flanged ends drilled to 150-pound ANSI Standard. Valves shall be GF Piping Systems Type 546 Linear CPVC; Nibco Chemtrol CPVC Tru-Bloc True Union Model C; Asahi-America CPVC Type 21/21a; Spears Manufacturing Company True Union 2000 CPVC; or equal. Where noted, or specifically needed for a unique chemical service, provide vented ball valve. Venting hole shall be provided by the valve manufacturer.

F. Sampling Valves:
   1. V926: Sampling valves for water service shall be brass body sample hose bibs, globe style, ½-inch male NPT (MIP) inlet by plain end spout, smooth nose, chrome plated, lead free, rated 125 psi, USA Bluebook Model 47393, Matco Norca Model FY-691LF, or equal.

2.7 BOLTS, GASKETS, GLANDS, NUTS, AND SOLVENT CEMENTS

A. Bolts, gaskets, glands, nuts, and miscellaneous accessories required to install all manual valves are to be furnished as specified in Section 400510, PIPING - GENERAL.

B. Bolts and nuts for flanged connections in buried or submerged services shall be Type 316 stainless steel, with American Standard regular hexagonal dimensions. Bolts for flanged connections in exposed services shall be galvanized steel with American Standard regular unfinished square or hex heads. Nuts in exposed applications shall be galvanized steel with American Standard regular hexagonal dimensions.

C. Gaskets for connections in chemical services shall be compatible with the chemicals as recommended by the manufacturer and as approved by the Engineer. Gaskets for flanged connections in all other services shall be 1/8-inch thick cloth inserted rubber suitable for sewage or potable water services. Gaskets shall extend from the inside diameter of the flange to at least the inside edge of the bolt holes (ring gaskets) for raised face flanges, or they shall extend beyond the bolt circle to the outside edge of the flange (full face gaskets for 125 pound flat face flanges). Bolt holes shall be factory punched through full face gaskets. Use of split or segmented gaskets is not acceptable.

D. Solvent cement and primers for solvent weld connections in chemical services shall be compatible with the chemicals as recommended by the manufacturer and as approved by the Engineer.

PART 3 - EXECUTION

3.1 GENERAL

A. Before installation, carefully clean valves of all foreign material, and inspect valves in open and closed positions. Install valves in accordance with the applicable portions of these Specifications. Some valves require special orientation, see the Drawings. Unless otherwise indicated, install valves with the stem vertical. Mount horizontal

valves in such a manner that adequate clearance is provided for operation. Installation practices shall conform to manufacturer's recommendations.

B. Valves shall be tested at the same time that the adjacent pipeline is tested. Joints shall be watertight at test pressures before acceptance. The Contractor will be held liable for any damage caused by the testing.

C. Thoroughly clean threads of screwed joints by wire brushing, swabbing, or other approved methods. Apply joint compound or Teflon tape to threads prior to making joints. Joints shall be watertight at test pressures before acceptance.

D. Bolt holes of flanged valves shall straddle the vertical centerline of the pipe run. Prior to installing flanged valves, the flange faces shall be thoroughly cleaned. After cleaning, insert gasket and bolts, and tighten the nuts progressively and uniformly. If flanges leak under pressure, loosen or remove the nuts and bolts, reseat or replace the gasket, retighten and/or reinstall the nuts and bolts, and retest the joints. Joints shall be watertight at test pressures before acceptance.

E. For electrically actuated valves, the valve and associated actuator shall be mounted per the manufacturer's recommendations. See Section 460713, PACKAGED WATER TREATMENT EQUIPMENT for further details.

3.2 EXPOSED VALVES

A. Teflon tape or joint compound shall be applied to the male end of threaded joints. Tape or compound shall be used only on metal pipe or fittings. Valves shall be installed with the stem plumb and vertical.

3.3 ISOLATION VALVES

A. A line size ball valve and union shall be installed upstream of each solenoid valve, in-line flow switch, or other in-line electrical device, excluding magnetic flowmeters, for isolation during maintenance, unless otherwise specified.

3.4 CERTIFICATION

A. If requested by the Engineer, the valve manufacturer shall furnish an affidavit stating the materials options furnished has complied with these and other referenced specifications.

END OF SECTION

SECTION 407113 – MAGNETIC FLOW METERS – SWTP

PART 1 - GENERAL

1.1 SCOPE

A. This section describes the requirements for a flow sensor.

B. Under this item, the contractor shall furnish and install the flow measurement equipment and accessories as indicated on the plans and as herein specified.

C. The work of this section applies to the White Mountain Apache Tribal Utility Authority Surface Water Treatment Plant (SWTP).

1.2 QUALITY ASSURANCE

A. Referenced Standards and Guidelines – Complies with applicable portions of ANSI/AWWA Standards and NSF/ANSI/CAN Standard 61. There are currently no AWWA standards that specifically address electromagnetic metering.
   1. Flow measurement function complies with Industry Standards:
      a. ANSI B16.5 Class 150 RF
      b. AWWA Class B
      c. NEMA 4X/6P (IP67/IP68)
      d. CSA

1.3 SUBMITTALS

A. The following information shall be included in the submittal for this section:
   1. Outline dimensions, conduit entry locations and weight
   2. Customer connection and power wiring diagrams
   3. Data sheets and catalog literature for microprocessor-based transmitter and sensor
   4. Interconnection drawings
   5. Installation and operations manual
   6. List of spare parts
   7. Complete technical product description including a complete list of options provided
   8. Any portions of this specification not met must be clearly indicated or the supplier and contractor shall be liable to provide all additional components required to meet this specification

1.4 DEFINITIONS

A. Transmitter – Device used for increasing the power of a signal. It does this by taking energy from a power supply and controlling the output to match the input signal shape but with larger amplitude.

B. ANSI – (American National Standards Institute) A private non-profit organization that oversees the development of voluntary consensus standards for products, services, processes, systems, and personnel in the United States. The organization also coordinates U.S standards with international standards so that American products can be used worldwide.

C. AWWA – (American Water Works Association) An international non-profit organization founded to improve water quality and supply.

D. Sensor Coils – Also called an “induction loop”, an electromagnetic communication or detection system which generates a magnetic field to induce an electrical current in a nearby wire.

E. Electrode – An electrical conductor used to make contact with a nonmetallic part of a circuit (e.g. a semiconductor, an electrolyte or a vacuum.)

F. Modbus RTU – a serial communications protocol published by Modicon (now Schneider Electric) in 1979 for use with its programmable logic controllers (PLCs). This is used in serial communication & makes use of a compact, binary representation of the data for protocol communication.

G. NEMA – (National Electrical Manufacturers Association) Is the ‘Association of Electrical Equipment and Medical Imaging Manufacturers’ in the United States. Its approximately 450 member companies manufacture products used in the generation, transmission, distribution, control, and end use of electricity. These products are used in utility, industrial, commercial, institutional, and residential applications.

H. NSF International – An independent, accredited organization that develops standards, and tests and certifies products and systems. They provide auditing, education and risk management solutions for public health and the environment.

I. PLCs – (Programmable Logic Controller) A digital computer used for automation of electrochemical processes, such as control of machinery on factory assembly lines, amusement rides, or light fixtures. PLCs are used in many industries and machines.

J. PTFE – (Polytetrafluoroethylene) A synthetic fluoropolymer of tetrafluoroethylene that finds numerous applications. The best-known brand name of PTFE is Teflon by DuPont Co.

K. Serial Communications – In telecommunication and computer science, serial communication is the process of sending data one bit at a time, sequentially, over a communication channel or computer bus. This is in contrast to parallel communication, where several bits are sent as a whole, on a link with several parallel channels.

L. BACnet Communication – was and is being developed under the auspices of the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE). It is a uniform company-neutral standard for data communication in and with building automation systems. BACnet is standardized under ANSI/ASHRAE standard 135 and ISO standard 16484-5.

PART 2 - PRODUCTS

2.1 APPROVED MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with specifications, provide flow measurement equipment by one of the following:

B. Badger Meter or equal.

2.2 OPERATING CONDITIONS

A. System Components

1. Metering Tube (Sensor)

a. Consists of stainless steel tube lined with a non-conductive material. Energized sensor coils around tube create a magnetic field across the diameter of the pipe. As a conductive fluid flows through the magnetic field, a voltage is induced across two electrodes; this voltage is proportional to the average flow velocity of the fluid.

2. Transmitter
   a. Consists of unit which receives, amplifies, and processes the sensor's analog signal. Signal is converted to both analog and digital signals that are used to display rate of flow and totalization. Processor controls zero-flow stability, analog and frequency outputs, serial communications and a variety of other parameters. Integrated LCD display indicates rate of flow, forward and reverse totalizers and diagnostic messages. Display guides user through programmable routines.

B. Operational Requirements
   1. Electromagnetic Flow Meter
      a. The flow meter shall operate with a pulsed DC excitation frequency and shall produce a signal output that is directly proportional and linear with the volumetric flow rate of the liquid flowing through the metering tube. The metering system shall include a metering tube (sensor), a transmitter, and the necessary connecting wiring. The metering system shall have the ability to incorporate a meter mounted or remote mounted transmitter.

      b. Engineering Units:
         1) The transmitter shall be program selectable to display the following units of measure: U.S. gallons, imperial gallons, million gallons (U.S.), cubic feet, cubic meters, liters, hector-liters, oil barrels, pounds, ounces or acre feet.
      c. Operating Principle: Electromagnetic Induction
      d. Metering Tube (Sensor)
         1) The metering tube (sensor) shall be constructed of stainless steel and rated for a maximum allowable non-shock pressure and temperature for steel pipe flanges, according to ANSI B16.5.
         2) The metering tube (sensor) shall be available in line size from ¼" (6 mm) to 78" (2000 mm).
         3) The metering tube (sensor) end connections shall be carbon steel, 304 or 316 stainless steel flanged, according to ANSI B16, Class 150 and AWWA Class B standards.
         4) The insulating liner material of the metering tube (sensor) shall be made of a hard rubber elastomer and NSF-listed for meter sizes 4" and above, in conformance with manufacturer's recommendation for the intended service or an NSF-listed meter option with PTFE liner.
         5) The metering tube (sensor) shall include two self-cleaning measuring electrodes. The electrode material shall be corrosion resistant and available in Alloy C or 316 stainless steel.

6) The metering tube (sensor) shall include a third “empty pipe detection” electrode located in the upper portion of the inside diameter of the flow tube in order to detect an empty pipe condition when the flow tube is running partially empty. Empty pipe detection that is not activated until the pipe is 50% empty is not acceptable.
7) The metering tube (sensor) housing shall be constructed of carbon steel, welded at all joints, and rated to meet NEMA 4X/6 (IP67) ratings.
8) For remote transmitter applications, the metering tube (sensor) junction box enclosure shall be constructed of cast aluminum (powder-coated paint) and shall meet NEMA 4X/6 (IP67) ratings.
9) For remote transmitter applications, where the sensor can be prolonged submerged, the metering tube (sensor) junction box enclosure shall be constructed of cast aluminum (powder-coated paint) and shall meet NEMA 6P (IP68) ratings.
10) When installed in non-metallic or internally lined piping, the metering tube (sensor) shall be provided with a pair of corrosion resistant grounding rings. The grounding ring material shall be 316 stainless steel.
11) Fluid Temperature Range
    i. For remote transmitter application, the fluid temperature range shall be -40°F to 302°F (-40°C to 150°C) at a maximum ambient temperature of 140°F (60°C) for the PTFE, PFA, ETFE liner material.
    ii. For meter-mounted transmitter applications, the fluid temperature range shall be -4°F to 212°F (-20°C to 100°C) at a maximum ambient temperature of 140°F (60°C) for the PTFE, PFA, ETFE liner material.

e. Transmitter
1) The transmitter shall be microprocessor based, and shall energize the sensor coils with a digitally controlled pulsed DC. The excitation frequency shall be program selectable for the following: 1Hz, 3.75Hz, 7.5Hz, or 15Hz. (factory optimized to pipe size and application)
2) The transmitter electrical power requirement shall be 85-265VAC, 45-65Hz. The power consumption shall not exceed 15W.
3) The transmitter shall have an ambient temperature rating of -4°F to 140°F (-20°C to 60°C).
4) The transmitter shall include non-volatile memory capable of storing all programmable data and accumulated totalizer values in the event of a power interruption.
5) Automatic zero stability, low flow cut-off, empty pipe detection and bi-directional flow measurement shall be inherent capabilities of the transmitter.
6) All transmitter outputs shall be galvanically isolated to 250 volts.
7) The transmitter and remote junction enclosures shall be constructed of cast aluminum (powder-coated paint) and shall meet NEMA 4X/6P (IP66/IP67) ratings.

8) Outputs:
The transmitter shall provide a total of four digital outputs, one analog output and one digital input.
   i. Up to four open collector digital outputs, program selectable from the following: Forward pulse, reverse pulse, AMR pulse, flow set point, empty pipe alarm, flow direction, reset output, error alarm and 24V supply.
   ii. Up to two active digital (24 Volt) outputs, program selectable from the following: Forward pulse, reverse pulse, AMR pulse, flow set point, empty pipe alarm, flow direction, preset output, error alarm and 24V supply.
   iii. Up to two AC solid-state relay outputs, program selectable from the following: Frequency output, flow set point, empty pipe alarm, flow direction, preset amount and error alarm.
   iv. One digital input, program selectable from the following: Remote reset, batch reset and positive return to zero.
   v. Advanced protocol support using Modbus/RTU.
   vi. One analog output programmable and scalable from the following: 0-10mA, 0-20mA, 2-10mA or 4-20mA. Voltage sourced and isolated. Max. loop resistance = 800 ohms.
   vii. Advanced protocol support communication through AquaCUE
   viii. Advanced protocol support communication through BACnet MS/TP

f. Control and Programming
   1) The transmitter shall be programmed via three function buttons. The programming functions shall be available in a user-friendly, menu driven software through the four-line LCD interface. The transmitter shall accommodate the following languages: English, German, Czech, French or Spanish.
   2) Programmable parameters of the transmitter include, but are not limited to: calibration factors, totalizer resets, unit of measure, analog and pulse output scaling, flow-alarm functions, language selection, low-flow cutoff, noise dampening factor and excitation frequency selection.
   3) The transmitter shall have a programming option allowing entry of a selected numeric password value for tamper protection.

g. System Performance
   1) The metering system, shall operate over a flow range of 0.1 to 39.4 ft/s (0.03 to 12 m/s).
   2) The metering system shall perform to an accuracy of ±0.2 percent of rate ±0.0032 ft/s (±1 mm/s). The accuracy for zero straight run with a single elbow up and/or a single elbow down stream shall be 1% or better in the flow range 0.5 ft/s (0.15 m/s) and up.
   3) The metering system shall be capable of measuring the volumetric flow rate of liquids having an electrical conductivity as low as 5 µS/cm (demineralized water 20 µS/cm).
   4) The system measuring repeatability shall be <0.1% of full scale.

h. Indication
1) The transmitter shall include a four-line, 20-character, backlit LCD interface to display the following values:
i. Flow rate in selectable rate units
ii. Forward totalizer in selectable volume units
iii. Reverse totalizer in selectable volume units
iv. Net totalizer in selectable volume units
v. Error or alarm messages
vi. Software revision level

PART 3 - EXECUTION

3.1 INSTALLATION

A. Follow manufacturer's recommendation for installation. Installation will conform to the guidelines provided by the Installation & Operation Manual.
B. Straight pipe requirement shall be an equivalent of three diameters on the inlet (upstream) side, and two diameters on the outlet (downstream) side.
C. For best performance, place meter vertically, with liquid flowing upward and meter electrodes in a closed, full pipe.

3.2 CALIBRATION

A. Each meter shall be hydraulically calibrated in an Iso 17025-certified testing facility, which utilizes a computerized gravimetric testing method with a measuring uncertainty of 0.1%.
B. Each meter shall be provided with a calibration certificate indicating the measured error (percent deviation) at three different flows, respectively equivalent to 25%, 50% and 75% of the nominal flow rate for each size.

3.3 START-UP

A. Refer to start-up specifications provided on Construction Drawings Hospital/Utility Specification Section 019200 Facility Operation, Maintenance and Troubleshooting Mobile Graphical Information Management Platform, for coordination of start-up and training with Digital Mentor.

3.4 MANUFACTURER'S WARRANTY

A. Terms
1. The manufacturer of the above specified equipment warrants the Product to be free from defects in materials and workmanship appearing within the earlier of either: One (1) year after installation; or one (1) year and six (6) months after shipment from manufacturer.

END OF SECTION

SECTION 407553 – TURBIDITY ANALYZERS – SWTP

PART 1 - DESCRIPTION

1.1 GENERAL

A. The work of this section applies to the White Mountain Apache Tribal Utility Authority Surface Water Treatment Plant (SWTP).

B. Section includes instrumentation for continuous, online monitoring of turbidity in water that includes predictive diagnostics capability to monitor instrument status using the following compliance method:
   1. USEPA Approved Hach Method 10258

1.2 RELATED SECTIONS

A. Section 460713 – Packaged Treatment Equipment

B. Section 0192000 – Facility Operation, Maintenance and Troubleshooting Mobile Graphical Information Platform

C. Construction Drawings

1.3 MEASUREMENT PROCEDURES

A. The sensor is used with an SC controller to measure low range turbidity in water. These sensors collect scattered light at an angle of 90° in a 360° radius around the axis of the incident light beam.

1.4 ALTERNATES

A. Methods of turbidity measurement that do not include a laser light source and a 360° x 90° detection system are not acceptable.

B. Instruments that do not have predictive diagnostic capabilities are not acceptable.

1.5 PERFORMANCE REQUIREMENTS

A. Performance requirements
   1. USEPA Approved Hach Method 10258 Sensor
      a. Measuring Range: 0 to 700 NTU

B. Other Specifications
   1. Detection Limit
      a. 0.002 NTU
   2. Accuracy
      a. ±2% of reading ±0.01 NTU from 0 to 40 NTU based on formazin primary standard at 25°C.
      b. ±10% of reading from 0 to 1000 NTU based on formazin primary standard at 25°C.
   3. Repeatability
      a. ±1% of reading or 0.002, whichever is greater based on formazin primary standard at 25°C.
   4. Resolution
      a. 0.0001 NTU
   5. Response Time
      a. T90<45s at 100 mL/min

6. Sample Flow
   a. 100 to 1000 mL/min; optimal flow rate 200 to 500 mL/min
7. Sample Pressure
   a. Max. 6 bar (87 psi) compared to air at sample temperature range of 0 to 40°C (32 to 104°F)
   b. Max. 3 bar (43 psi) compared to air at sample temperature range of 0 to 40°C (32 to 104°F)
8. Sample Temperature
   a. 2 to 60°C (36 to 140°F)

1.6 CERTIFICATIONS

A. CE Compliant.

B. US FDA accession number: 1420493-001 EPA version, 1420492-001 ISO version. Complies with IEC/EN 60825-1 and to 21 CFR 1040.10 in accordance with Laser Notice No. 50.

1.7 ENVIRONMENTAL REQUIREMENTS

A. Operational Criteria
1. Storage Temperature: -40 to 60°C (-40 to 140°F)
2. Operating Temperature: 0 to 50°C (32 to 122°F)
3. Relative Humidity: 5 to 95%, non-condensing

1.8 ENCLOSURE RATING

A. Electronic compartment IP55; all other functional units IP65 with process head/ACM attached.

1.9 MAINTENANCE SERVICE

A. Unscheduled maintenance
1. Clean the measurement vial, depending on the cleanliness of the sample
2. Replacement of desiccant cartridge (depending on ambient temperature, ambient humidity, and sample temperature)
3. Replacement of measurement vial, depending on cleanliness of sample.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. TU5300sc Low Range Laser Turbidimeter

B. Hach

2.2 SENSOR

A. The low range online laser turbidimeter shall consist of a Class 1 650 nm (EPA) laser light source and 360° x 90° detection system with predictive diagnostics designed to continuously monitor turbidity in a sample stream. Automatic cleaning and flow measurement options are available.

2.3 EQUIPMENT

A. Turbidimeters shall be continuous reading, on-line instruments meeting all design and performance criteria specified by USEPA Method 108.1

B. Turbidimeters shall read from 0-100 NTU.

C. Turbidimeters shall provide an analog 4-20 mA output for remote indication as well as two discrete outputs for alarm indication. Signals shall be transmitted to the treatment unit PLC.

D. Online turbidimeter
1. Utilizes a laser-based 360° x 90° optical system that measures turbidity from multiple different angles.
2. Continuous particle removal using a vortex created by the fluid path.
3. Utilizes an identical laser-based optical system that matches the laboratory turbidimeter described in 2.3.C for direct comparison between laboratory and online measurements.
4. If chosen, includes capability to communicate measurements and calibration information via RFID to the laboratory turbidimeter described in 2.3.C.
5. Includes capability to actively monitor all internal components and present diagnostics on the overall health of the turbidimeter and time next to required maintenance.
6. When connected to predictive diagnostics capable controller the overall status of instrument performance is displayed as a percentage value via a measurement indicator.
7. When connected to predictive diagnostics capable controller the overall time remaining until maintenance tasks are due is displayed in days.
8. Built-in help screens included.

E. Controller
1. Provide an SC controller for turbidimeter operation. Include optional capability to communicate measurements and calibration information via LAN to the laboratory turbidimeter described in 2.3C.

F. Laboratory Turbidimeter
1. Furnish laboratory turbidimeter with the same 360° x 90° detection system as online turbidimeter, for validation of readings from the online turbidimeter.

G. Calibration Standards
1. Frequency of use of calibration standards determined by recommendation of local regulator.
2. Manufacturer must make available certified calibration standards that can be used in online and bench top instruments for highest calibration accuracy.
3. Calibration standards must be capable of being used to calibrate laboratory turbidimeters with similar optics systems.
4. Calibration standards must be capable of functioning with the instruments optional RFID module.

2.4 COMPONENTS

A. Analytical Instrument
To deliver:
1. Turbidimeter as selected in section 1.1.A.
2. Mounting bracket
3. Desiccant cartridge
4. User manual

B. Dimensions: Refer to turbidimeter drawings

C. Weight: 5 lbs (2.3 kg)

2.5 INSTRUMENT OPTIONS

A. System Check Module

B. RFID Module

2.6 INSTRUMENT ACCESSORIES

A. Flow sensor

B. Automatic Cleaning Module (adds an additional 3.74 lbs (1.7kg) of weight)

C. Bubble trap

D. Turbidimeter maintenance kit

E. Glass calibration/verification rod

F. StablCal® Sealed Vial Calibration Standards

PART 3 - EXECUTION

3.1 PREPARATION

A. Mounting
   1. As shown on the drawings.

B. Inlet and outlet connection sizes.
   1. As shown on the drawings.

3.2 INSTALLATION

A. Install turbidimeter following transmittal drawings and instrument user manual.

3.3 MANUFACTURER'S SERVICE AND START-UP

A. Refer to start-up specifications provided on Construction Drawings and Hospital/Utility Specification Section 019200 Facility Operation, Maintenance and Troubleshooting Mobile Graphical Information Management Platform, for coordination of start-up and training with Digital Mentor.

B. Contractor will include the manufacturer's services to perform start-up on instrument to include basic operational training and certification of performance of the instrument.

C. Contractor will include a manufacturer's Service Agreement that covers all the manufacturer's recommended preventative maintenance, regularly scheduled calibration and any necessary repairs beginning from the time of equipment startup through to end user acceptance / plant turnover and the first 12 months of end-user operation post turnover.

D. Items A and B are to be performed by the manufacturer's factory-trained service personnel. Field service and factory repair by personnel not employed by the manufacturer is not allowed.

E. Use of the manufacturer's service parts and reagents is required. Third-party parts and reagents are not approved for use.

END OF SECTION

SECTION 460713 – PACKAGED WATER TREATMENT EQUIPMENT – SWTP

PART 1 - DESCRIPTION

1.1 GENERAL

A. The work of this section applies to the White Mountain Apache Tribal Utility Authority Surface Water Treatment Plant (SWTP).

B. See the GENERAL CONDITIONS and Division 01, GENERAL REQUIREMENTS, which contain information and requirements that apply to the work specified herein and are mandatory for this project.

C. The equipment provided by this specification shall be compliant with the Buy American Act (BAA).

1.2 WORK INCLUDED

A. This specification describes a complete operational system to be furnished by a single responsible equipment manufacturer. The equipment described herein is based on products and services as manufactured by Tonka Water, a Kurita brand, of St. Michael, MN.

B. It is the intent of this specification that the filter manufacturer assume system and process responsibility for the filtration equipment and appurtenances. Therefore the filtration equipment manufacturer shall provide the filtration equipment and all appurtenances described in this section of the specification including but not limited to: facepiping, valves, blowers, compressors, PLC controls, PLC programming, SCADA computer programming, instruments, stairways, handrails, etc.

C. PLC programming and HMI configuration, including modifications to the existing SCADA computer graphics, shall be provided by the filter manufacturer to perform monitoring and control as indicated in these specifications and as intended for a fully operational system. The Contractor shall coordinate the fabrication, installation, programming and testing of the entire control system, including SCADA, with the filter manufacturer.

D. PLC programming will include integrating the controls for the motor-operated valves, turbidimeter, flowmeter, MechVac sludge collection system, and new chemical dosing skids for the new treatment unit operation.

E. This specification has been prepared on the basis of the specific requirements for this application. These specifications may require modification of manufacturer's standard equipment design. All equipment manufacturers shall meet the requirements of this specification. Equipment manufacturers shall modify their standard designs and recommended operational parameters to meet all requirements of this specification.

F. The equipment manufacturer must have a quality management system that is ISO 9001:2015 certified. Certification must remain in effect throughout the project start-up.

1.3 RELATED SECTIONS

A. Section 400510.03 – DPS- Ductile Iron Pipe and Fittings

B. Section 400510.12 – DPS- Polyvinyl Chloride (PVC) Pipe and Fittings

C. Section 400553 – Manual Valves

D. Section 407113 – Magnetic Flow Meters

E. Section 407553 – Turbidity Analyzers
F. Section 463344 – Peristaltic Metering Pumps
G. Construction Drawings

1.4 REFERENCES

A. Where applicable, the latest editions of the following standards shall form a part of this specification to the extent referenced. The publications are referenced to in the text of this specification by the basic designation only.
1. AWWA
2. ANSI
3. ASME
4. FDA
5. NSF

1.5 QUALITY ASSURANCE

A. Qualifications of Manufacturers.
1. All contractors shall base their bids on systems and equipment manufactured by the named base bid manufacturer: Tonka Water, a Kurita Brand, of St. Michael, MN or equal.
2. Contractors wishing to pre-qualify manufacturers as alternate suppliers shall submit the following information, to the Engineer at least 14 days prior to the published bid date and time. Submission of pre-qualification materials directly from equipment manufacturers, rather than Bidding Contractors, will not be considered.
   a. A list of ten reference systems of identical type and similar size which have been installed and in successful operation for at least 1 year, using the processes and methods specified herein, <u>including simultaneous air/water backwashing for sustained durations.</u>
   b. Detailed equipment drawings, to scale, and complete detailed information covering equipment, processes and methods specified. Drawings shall include all facepiping, valves, and appurtenances necessary to connect the new unit to the existing processes.
   c. A minimum of six months' operation data from three of the above reference installations.
   d. Proof that the manufacturer has been active in the manufacturing of sustained simultaneous backwash troughs for at least ten (10) years.
   e. An unpriced proposal indicating the total scope of work being proposed and containing an itemized list of all equipment, materials and appurtenances, including structural configuration drawings and details.
   f. <u>A detailed description of the manufacturer's backwash procedure including flow rates and durations, including</u> a calculation of backwash waste volumes based on the backwash production template found in the Equipment Schedule. Manufacturers shall guarantee in writing that their system will not produce a backwash waste volume in excess of the amount indicated in their submitted calculations.

g. Proof that the manufacturer has expert knowledge in the science of combined air/water backwash systems using collapse-pulsing action as described in "Optimum Backwash of Dual Media Filters and GAC Filter-Adsorbers with Air Scour" ISBN 0-89867-576-6, © American Water Works Association. Such proof shall include a video showing a cut-through of the manufacturer's backwash collection trough in operation. The video shall verify steps of a combined air/water backwash cycle, including collapse-pulsing action, active return of media through a return chute, and overflow collection of the dirty water. Submerged orifice designs, or designs incorporating surface penetrating baffles which trap scum and/or floatables are not acceptable. Proof of manufacturer's capability is necessary in the overall evaluation of the manufacturer's qualifications.

h. Installation, operation and maintenance manuals from the ten references in paragraph (2.a.) above.

i. Evidence of manufacturer's engineering staff experience necessary to complete this project. All reports, drawings, and calculations shall be sealed and signed by a professional engineer registered in the state of Arizona. Such engineer shall be a direct employee of the manufacturer.

j. Warranties and Bonds. Proof of ability to furnish warranties and bonds as described elsewhere in this specification.

k. Evidence of the manufacturer's ISO 9001:2015 quality system certification, including certificate. Manufacturer must submit their quality manual upon request.

l. It is the responsibility of the Contractor and manufacturer to design all necessary changes to accommodate the proposed alternative.

m. A statement from the manufacturer stating that their unit will function within the existing treatment plant and process without modification to the existing plant or process. Statement to verify the appropriateness of the proposed alternative.

3. Engineer Review. The above submittal information will be reviewed by the Engineer. Contractors submitting requests for alternate manufacturer approval will be notified by contract addendum 5 days before bids are due. All such decisions shall be final.

4. Failure to submit the pre-qualification documents as described above shall cause rejection of the contractor's bid if such bid indicates a manufacturer other than those pre-approved by the Engineer.

5. Qualified suppliers: Tonka Water, a Kurita brand, of St. Michael, MN has been accepted by the Engineer using its Vertical Pressure Filter system and Simul-Wash filter system and Simul-Wash™ filter backwash method. The equipment is approved as modified specifically to meet the treated water quality warranty, media retention warranty, backwash waste rate and total volume in a 15 minute backwash cycle and to effect sustained air/water backwash in the collapsed pulse operation of the selected media at the water temperature of this project.

1.6 SUBMITTAL/SHOP DRAWINGS

A. Submittals during construction shall be made in accordance with Section 013300, SUBMITTAL PROCEDURES in Division 01, GENERAL REQUIREMENTS. Equipment shall not be fabricated until manufacturer receives written engineer approval of submitted information.

B. The Contractor or filter manufacturer shall set up a teleconference style video and audio meeting using GoToMeeting, Microsoft Teams, Zoom, or similar software with the Engineer and Owner to review the graphics, control, and monitoring schemes for the HMI and SCADA computer graphical screen. The filter manufacturer shall present a simulated run mode of the actual HMI and SCADA screens to be installed in the field. Each feature being monitored or controlled and how the information will be displayed (change color, pop-up text, flashing, etc.) will be reviewed together.
   1. Teleconference style meeting quantity shall be as required but not more than two until all parties are satisfied with the graphics. Once completed, a formal electronic submittal in “pdf” format shall be provided, which will include separate colored screen shots of each proposed graphic screen in normal state and in various alarm states.
   2. Graphic displays may be reviewed again by the Engineer and Owner during the factory testing. If minor modifications are deemed necessary by the Engineer and Owner at that time, modifications shall be made by the filter manufacturer prior to shipment.

1.7 OPERATION AND MAINTENANCE MANUALS

A. Operation and Maintenance Manuals and Maintenance Summary Sheets for the equipment specified herein shall be furnished as specified in Section 017823, OPERATION AND MAINTENANCE DATA in Division 01, GENERAL REQUIREMENTS.

B. Contractor shall provide a digital Operation and Maintenance Manual with videos as created by Digital Mentor Inc., or approved equal.

1.8 DELIVERABLES

A. Two USB solid state memory drive copies of the final PLC program(s) after final acceptance of the project with detailed descriptions for each programming logic sub-section.

B. Two USB solid state memory drive copies of the final HMI graphics configuration files after final acceptance of the project.

C. Two USB solid state memory drive copies of the final SCADA computer HMI graphics configuration files after final acceptance of the project.

PART 2 - PRODUCTS

2.1 MATERIALS/EQUIPMENT

A. All components of the system herein described shall be fabricated and manufactured from new, unused materials, free from defects, of the highest quality possible.

B. The materials and equipment shall be of the configuration, quantity and design features as described on the Equipment Schedule found in this specification.

2.2 DETAILS OF CONSTRUCTION

A. Vessel

1. The treatment unit shall have internal nominal dimensions as indicated on the equipment schedule. The tank bottom shall be of 3/8" thick minimum plate steel. The tank sides shall be of ¼" thick minimum carbon steel, structurally reinforced to withstand the hydrostatic pressures encountered and loads imposed by the stairs. Refer to the Equipment Schedule for further details.
2. All flanges, plates, angles, channels, beams, etc., shall be joined by full penetration welds, each side, continuous welding. All finish welds shall be smooth so that they are acceptable to receive paint.

B. Flocculation Compartment
1. The flocculation chamber shall be a two-stage design capable of providing tapered flocculation. The flocculation chamber shall be provided with inlet distribution and effluent collection launders. Launders shall be provided with adjustable weirs to assure uniform distribution and collection. A transfer plenum shall be provided between the flocculation and sedimentation compartments.
2. The flocculation compartment shall be designed to prevent short-circuiting and to provide the retention time as outlined in the Equipment Schedule included as part of this specification.

C. Sedimentation Compartment
1. Water leaving the flocculation compartment will be distributed in the settling compartment where it will flow upward through tube settler packs. A structural framework shall be provided to support the tube settling pack.
2. The sedimentation compartment shall incorporate access manways, structural reinforcement for the inlet distribution system and sludge collection systems and an effluent collection system. The effluent collection system shall be provided with adjustable straight edge weir and stainless steel fasteners.
3. Mechanized sludge collection shall be provided.

D. Filter Chamber
1. Water from the sedimentation compartment will flow to the filter where it will be uniformly distributed over the cross sectional area of the filter.
2. A double wall partition shall be provided between the sedimentation compartment and the filter chamber to assure that filtered water is isolated from unfiltered water.

2.3 FLOCCULATION INTERIOR COMPONENTS

A. Paddle Wheel Flocculator
1. Four (4) vertical paddle wheel flocculators shall be provided for installation into the tank. The flocculators shall be of a vertical configuration incorporating a single shaft and drive assembly.
2. Maximum paddle tip speed shall not be more than 2 feet per second. Each paddle wheel assembly shall consist of stainless steel angle arms, gusseted plates having a two-arm pattern with three paddles per arm. The vertical paddles will be fabricated from 6" 304SS channels.
3. The drive unit shall be sized by the equipment manufacturer to perform steadily under full load, but in no case shall the motor horsepower be greater than 1.5 HP. The motor shall be rated for the following electrical characteristics: 1750 rpm, 3 phase, 60 cycle, 230/460 volt, induction type, TEFC.

4. A 4:1 ratio of reduction, variable speed drive assembly shall be provided. The variable speed drive shall be of a motor driven conical disc type with friction ring traction drive disc.

2.4 SEDIMENTATION INTERIOR COMPONENTS

A. Tube Settlers
1. Tube settlers shall be provided in the sedimentation compartment and shall be supported on a structural framework. The tube settler packs shall have a 2 ft. depth of 60° tube settlers. Settling tubes at less than 60° shall not be acceptable due to the potential for clogging. The maximum hydraulic loading on the settling tubes shall not exceed 2.0 gpm per square foot of settling chamber surface area.
2. The settling tubes shall be constructed of thermal formed 20 mil thick ABS plastic inclined from horizontal.
3. The tubes and their support system shall be structurally designed to allow a maximum of ½ inch deflection when loaded with their dead weight plus live loads of 10 lbs. per square foot applied uniformly and a dynamic 250 lb. concentrated load applied on a one square foot area.

B. Influent Distribution System
1. The influent to the settling compartment shall be designed to distribute flocculated water uniformly beneath the cross sectional area of the settling tubes. The influent distribution system shall consist of a schedule 80 PVC header-lateral system. The distribution system shall be designed to gently handle the preformed floc so as to prevent shearing.
2. The distribution system shall be structurally supported as necessary to prevent movement. All mounting hardware and fasteners shall be stainless steel.

C. Sludge Collection System (MechVac)
1. Mechanized Sludge Collector: Provide one system for collection of sludge across the entire sedimentation tank area, including below the plates. System will consist of:
   a. Header-lateral sludge removal cart with orifices in laterals for sludge removal.
   b. Chain drive system with variable speed gear motor.
   c. Structural support system for sprocket bearings.
   d. Controls to initiate blowdown, actuate valve and reverse cart direction based on location sensors. Controls shall indicate cart location between end of travel sensors.
2. Collector Drive System. Gear motor sized to drive cart at a variable speed of 2 to 8 feet per minute. Provide mount for gear motor designed to allow tensioning of chain. Enclose chain gearing at gear motor with stainless steel safety shielding.
3. The gear motor shall be sized by the equipment manufacturer to perform steadily under full load, but in no case shall the motor horsepower be greater than 0.5 HP. The motor shall use 120VAC single phase power.
4. Chain and sprockets: 304 stainless steel, ANSI size 50. Cable driven collectors are not allowed.
5. Sludge cart material: 304SS, excluding casters bearings, which shall be non-metallic plastic material designed for submerged service.

6. Design cart to concentrate sludge at orifices for efficient sludge removal. Provide cart with proper number of orifices with spacing and angles oriented for efficient removal of sludge solids.
7. Provide sludge cart complete with floor and side casters and all necessary mounting hardware.
8. Sensors: Two end of travel proximity sensors; one gear tooth counter.

2.5 GRAVITY FILTER INTERIOR COMPONENTS

A. The number of filter cells to be provided shall be as indicated on the Equipment Schedule and as shown on the drawings.
   1. Simultaneous Air/Water Collection System
      a. The required number of simultaneous air/water backwash troughs shall be installed in each filter cell and be specifically designed to accept a sustained simultaneous air/water backwash flow without loss of media and without inhibiting the removal of suspended solids. Sustained is defined as a single duration greater than 10 minutes at specified air and water rates achieving a collapse-pulse action while backwash water overflows through the trough.
      b. Simultaneous air/water backwash collection troughs shall be constructed of minimum 12-gauge Type 304 steel. All mounting hardware shall be stainless steel.
      c. The simultaneous air/water collector troughs shall be designed to simultaneously accept 3 cfm/sq. ft of air and 5 gpm/sq. ft. of water during the simultaneous air/water mode and 15 gpm of water without air (all ratings per square foot of filter area).
      d. The simultaneous air/water collector troughs shall be designed with weir edges along the entire length of trough to allow for equal distribution and collection of water. Pipe collectors with submerged or semi-submerged orifice collection points shall not be acceptable due to the inherent pipe plugging.
      e. The simultaneous air/water backwash collection troughs shall be of the overflow type without deep, overlapping baffles and shall include a quiescent zone for media/solids separation and a return chute for continuous return of settled media to the filter bed. The return chute shall be a separate area and not impede the flow of water being sent to the trough. Systems utilizing the same area for media return and water collection shall not be allowed due to inherent fouling issues. In order to allow surface solids removal, combination air and water backwash collection systems that have surface penetrating baffles that impede the natural horizontal flow of water to the trough edge are not permitted. Systems using hung settling tubes or Lamella-type plates shall be unacceptable due to their increased maintenance requirements. Filter backwashing with water only, air followed by water, or combined air and water for short periods, limited by filter geometry, (freeboard combined air/water backwash using upturned elbows) shall not be acceptable or considered equal.
      f. Backwash collection system shall guarantee media loss of one inch per year or less.

2. Underdrain System
   a. The underdrain system shall be a header-lateral design constructed of schedule 80 PVC. The underdrain shall be located above the filter bottom at an elevation necessary to meet the hydraulic requirements of the system. The underdrain system shall be structurally reinforced as necessary to withstand a differential pressure of 12 psig. The underdrain system shall be fitted with 1” openings to accept underdrain nozzles located on 12” centers.
   b. The underdrain diffuser nozzles shall be non-metallic self-cleaning nozzles. They shall be mounted in the underdrain on 12” centers with orifice control area of the underdrain diffuser nozzle equal to 0.3% of the total filter bed measured at the surface of the filter media. Nozzles shall be provided with peripheral slot opening as required to collect and distribute flow laterally. Slot openings shall be tapering inward to prevent lodging of support gravel in the slot opening. Diffuser nozzles using pressed or crimped sheet metal which are tack welded to the underdrain plate are not acceptable due to galvanic corrosion potential with the weld. Toggle-bolted designs are not permitted due to their inherent loosening potential. Diffuser nozzles using parallel metal or plastic plates, spacers, and coupling bolts shall not be acceptable due to their “dead spot” characteristics and inability to uniformly collect and distribute flow laterally.
   c. The underdrain area is especially critical to the success of the filtration system and particular attention will be paid to diffuser nozzle and layout to insure uniformity of backwash flow. Underdrain designs employing gravelless (non-support bed) applications, will not be accepted.
   d. The underdrain system shall be structurally reinforced to prevent movement. Mounting hardware shall be stainless steel.
   e. Concrete encasement of the underdrain system shall be the responsibility of the installing contractor.

2.6 VESSEL MISCELLANEOUS COMPONENTS

A. Pipe nozzles shall be of the size as shown on the Equipment Schedule and shall consist of Sch. 40 steel pipe, projecting and terminating in a flange 6” from the outside face of the sideshell. Flanges shall be standard ANSI pattern, welded on split centers and shall be true and plumb.

B. A 2” drain with plug shall be provided in each filter cell effluent nozzle. The drain connection shall consist of a half coupling. Guage taps shall be furnished in the influent and effluent nozzle connections (1/2” NPT tap with plug).

C. 1/2" diameter, full couplings shall be provided as described in the Equipment Schedule for sample taps.

2.7 SUPPORT GRAVELS AND FILTRATION MEDIA

A. The support gravel shall consist of hard rounded stones with an average specific gravity of not less than 2.5. It shall not contain more than 2% weight of pieces in which the length is three times the width. The gravel shall be free of shale, mica, clay, sand, dirt and organic impurities.

B. The support gravel shall be placed in the tank as follows:

Layer	Depth	Size
Bottom	4"	3/4" x 1/2"
Second	4"	1/2" x 1/4"
Third	4"	1/4" x 1/8"
Top	3”	0.8 - 1.2 mm torpedo sand

C. The bottom layer of the screened support gravel shall be placed by hand to avoid damage to the diffuser assemblies. Each layer shall be placed and leveled before the addition of the next layer is started. A gravel-less underdrain shall not be acceptable.

D. The filter media shall be placed on top of the support gravel and shall consist of the material, size and uniformity coefficient as shown on the attached Equipment Schedule.

E. The support gravels and filter media shall be procured from a manufacturer that complies with AWWA B-100 standards. Installation of support gravels and filter media shall be under the direct supervision of an employee of the filter manufacturer experienced in this procedure.

2.8 AIRWASH SYSTEM

A. Grid

1. The airwash system shall be a header-lateral system located at the media/gravel interface for complete scouring of filtration media. Vertical penetrations through the media shall be avoided. Air header pipes shall generally enter the filter cells at the media/gravel interface elevation.
2. Materials. The system construction shall be Sch. 80 PVC pipe and fittings with headers being supported at not greater than 4 ft. intervals using stainless steel U-bolts, angles and anchorage. Laterals shall be shop fabricated from Sch. 80 PVC, minimum 3/4" diameter, and screwed or solvent welded in place by the installing contractor. Laterals shall be evenly spaced at not more than 12” lateral to lateral spacing along the entire length of the header, each side. Laterals shall be supported at not greater than 2’ intervals using angles, vertical supports, base plates, and anchorage. Supports shall be adjustable in two directions.
3. Lateral design. Each lateral shall be secured using a double wrap at each support with polypropylene ties, two required per lateral. Each lateral shall be fitted with an end cap and a specially machined Sch. 80 male adapter for screwing or solvent welding into the airwash header. Specially sized air metering control orifices shall be placed at 6” intervals along each lateral. Each orifice shall be recessed to achieve full orifice effect, and shall be protected by two screens for prevention of media entrance into the lateral. The inner screen shall be virgin polypropylene construction with a mesh size chosen to prevent media entrance and to allow free air movement. The second structural or outer screen shall be one piece (1/8” thick) construction and slid over the lateral and inner screen during the fabrication process. Systems are not allowed which use clamping or other friction type fits. The double screened orifice assembly shall be heat welded along its perimeter and bonded to the parent Sch. 80 PVC lateral prior to shipment. Each orifice shall be installed at a 45° angle, alternating from the vertical axis of the installed airwash lateral.

4. Configuration. The system used shall be the airwash grid, or engineer approved equal. Substitute systems shall be of rigid pipe construction. Systems utilizing multiple penetrations into the filter cells shall be prohibited due to the high potential for hydraulic short-circuiting. Systems utilizing flexible piping or hoses (rubber, polyethylene, polypropylene, etc.) shall be prohibited due to their inherent movement in the filtration bed and their inability to remain rigid during normal filter operation. Calculations verifying adequate air distribution design including orifice headloss calculations, shall be submitted to the Engineer for approval upon request.

B. Airwash Blower and Accessories
1. The Contractor shall install an airwash blower with accessories as included in the packaged surface water treatment plant equipment package by Tonka Water, and as described below.
2. The airwash blower shall be the rotary lobe positive displacement type, as manufactured by Sutorbilt, Roots, or equal, and sized in accordance with the Equipment Schedule. The blower and motor shall be coupled together and mounted on a common baseplate, and shall include necessary belt, sheaves, and guards.
3. The blower motor shall be TEFC, with a service factor of not less than 1.10, and shall be rated for continuous duty at 1800 rpm nominal speed.
4. The blower shall be able to provide 704 scfm at 5 psig.
5. Miscellaneous components shall be furnished to include:
   a. Inlet filter
   b. Inlet and outlet silencers
   c. Discharge check valve
   Single sphere expansion joints
   d. Weighted pressure relief valve
   e. Lever-type isolation valve
   f. Discharge pressure gauge (0-10 psi)
   g. Drip leg solenoid valve
6. Components shall be installed by the Contractor where shown or directed by the Engineer. Standard piping, filters and other components not listed above shall be furnished and installed by the Contractor where required. Refer to the Electrical Plans for additional information.
7. The initial filling of the blower gear box with lubricating oil shall be procured and accomplished by the Contractor with material and quantity as recommended by blower manufacturer literature.

2.9 FACEPIPING

A. All piping and fittings shall be cement mortar lined and asphaltic coated ductile iron (pressure class as indicated on the plans). Flanges on all welded pipe shall be slip-on welded type of ANSI construction and bolt pattern.

B. Filter facepiping shall be provided by installing contractor.

2.10 VALVES

A. Filter function valves shall be electrically actuated and shall be provided by the filter equipment manufacturer. Valve size shall be as specified on the attached Equipment Schedule.

B. All filter function valves shall be wafer style butterfly valves, and shall have one piece, internal, through-stem drive requiring no disc screws or pins to connect stem to disc. The body shall be ASTM A126 Class B polyester coated or ASTM A536 Gr. 65-45-12 polyester coated, for mounting between two bolted flanges without the need for flange gaskets. Resilient seats shall be molded directly to the valve body for optimized torque and sealing performance with primary hub seal and secondary seal, to prevent line media from contacting stem or body, and a wide flange sealing surface suitable for weldneck and slip-on flanges. Valves shall be bi-directional pressure ratings of 175 psi through 12" and 150 psi from 14" through 24" sizes and tested to 110% of full rating. Disc construction shall be ductile iron ASTM A536 Gr. 65-45-12 with Nylon 11 coating, or 316 stainless steel ASTM A351 CF8M. Valve shaft shall be one-piece stainless steel, supported on non-corrosive, heavy duty acetal bushing, and be mechanically retained in body neck, with no part of stem or body exposed to line media. Seat shall be peroxide cured EPDM that is NSF-61/372 certified. Valves shall be supplied by Bray Series 3W or engineer approved equal.

C. Where specified on plans, an electric motor operator shall be supplied on butterfly valves. Motor operators shall be quarter turn type and have a cast aluminum NEMA 4 watertight housing, auxiliary open and closed limit switches 24vdc for PLC feedback, open and closed torque switches, end of travel mechanical stops, declutching handwheel manual override, self-locking worm gears, position indicator, and anti-condensation heater. Operators shall use 120VAC single phase power. Valves used for modulating service shall include a 4-20 mA input modulating card. Electric motor operators shall be Bray Series 70 or engineer pre-approved equal. Refer to Section 2.12 below for additional information.

D. Where manual actuators are specified in the Equipment Schedule they shall be handwheel type gear with cast iron housing and handwheel or lever, and position indicator.

2.11 INSTRUMENTATION

A. Loss of Head Gauge and Switch
   1. A combination pressure/vacuum gauge with a -10-0-10 psi 4-1/2" dial shall be provided to sense the pressure below the underdrain of each cell. Loss of head indicator gauges shall be equipped with a brass shut off, tank isolation and sample cock.
   2. One backwash initiate switch with two set points shall be provided to sense the pressure below the underdrain. The switch shall be field adjustable and set at the time of start-up.
   3. The pressure gauge and pressure switch shall be WIKA, Ashcroft or equal.

B. Continuous Level Transmitter
   1. A continuous level monitor shall be provided by the equipment manufacturer to send accurate filter cell water level indication to the PLC for precise level control. The system shall include probe and probe cover. The probe shall be custom cut-to-length 316 stainless steel, capacitance type, and capable of accurate level indication. The probe shall be Teflon™ coated to prevent material buildup and false signals. Repeatability shall be 0.1%FS. The NEMA 4 probe enclosure shall produce a 4-20 mA, 2 wire isolated output. System shall mount to the cells through a ¾" NPT coupling.
   2. Continuous level transmitter shall be Ametek Drexelbrook or equal.

C. Turbidimeters
   1. Refer to Specification Section 40 75 53
   2. Refer to Plans for additional information.

D. Flowmeters
   1. Refer to Specification Section 40 71 13.
   2. Refer to Plans for additional information.

E. Float Switches
   1. The float switches shall be suspension type incorporating mercury-free reed switches in a polypropylene housing. The switches shall provide a series of N.O. contacts.
   2. Float switches shall be Dwyer FSW2 or equal.

2.12 AUTOMATIC FILTER CONTROLS

A. Automatic control system consisting of:
   1. PLC-based control panel, hardware, components, timers, Operator Interface Terminal (OIT), enclosures, relays, switches, alarms, I/O, and other items necessary for a complete operational system.
   2. The automatic filter control system for the Unit A PLC cabinet shall be essentially as described below.

B. Hardware
   1. PLC. The automatic control panel shall be PLC-based using an Allen-Bradley 5380 Series Compact Logix Controller with Allen-Bradley I/O modules. Provide 10% spare I/O capacity including digital and analog I/O. Provide minimum of 10% spare PLC memory.
   2. Network. An unmanaged ethernet switch will be provided with a minimum of four 100BaseTX ports, managed switches to be provided as necessary. The filter manufacturer shall be responsible for communications hardware, protocol converters, and drivers to interface with the existing filter PLC controlled system using the Ethernet/IP protocol.
   3. Components. HOA switches, lights, push buttons, and indicators shall be TYPE 4 rated, Allen-Bradley or equal.
   4. Operator Interface Terminal (OIT) shall be PanelView Plus 7 1000 color touch screen by Allen-Bradley. The OIT shall be panel-mounted and shall indicate the following, via a series of a minimum of twelve custom designed screens:
      a. System Overview Screen (flow, levels, turbidities, etc.)
      b. Individual Filter Screen (to include manual valve control).
      c. Common Equipment Screen (to include blower, MechVac, and pumps HOA controls).
      d. Backwash Timer Setpoint Screen (to include sequence timer setpoints and current time indicators).
      e. Headloss Setpoints Screen.
      f. Headloss BW Window Screen.
      g. Backwash Schedule Screen.
      h. Totalizers Screen.
      i. Alarms Active Screen.
      j. Alarm History Screen.
      k. Alarm Setpoint Screen.
      l. Analog Setup/Trending Screens for each device.

m. Event log screen indicating start, end backwash time, date, how backwash was initiated and successful sequence completion event indicator.
n. Status of exterior signals (backwash holding tank level/lift station level (permissive), finished water tank level, etc.).
o. Individual filter status (service, backwash, alarm, etc.)
p. Graphics to indicate valve status during each backwash step.
q. Other functions, indication and information as required for a complete operating system.

5. Include one 15-minute 24vdc UPS (uninterruptible power supply), UL rated. Furnished to automatically trickle charge. Include adequately sized sealed, maintenance-free lead acid battery to ensure PLC and OIT function and indication for an uninterrupted power outage of 15 minutes duration.
6. Include the 120V, single phase breakers necessary to power the electrically actuated filter function valves as specified herein. Wiring between the panel and the individual valve actuators is by installing contractor. Breakers shall be installed “upstream” of the UPS; the UPS will not include power to filter function valves.
7. Include the 120V, single phase breakers necessary to power the MechVac drive motor, flowmeter, level transmitter, and turbidimeter. Wiring between the panel and the equipment is by the installing contractor. The breakers shall be installed ”upstream” of the UPS. The UPS will not include power to this equipment.
8. Enclosure. UL Listed/TYPE 12 rated enclosure, free-standing with 12” raised mounting feet, size as required, containing space for separate back panel mounting of PLC, power supply, I/O racks, wiring terminal blocks properly labeled and numbered, circuit breakers, switches, etc., all as required for a complete operating system. UL listed and bearing the UL-508A stamp prior to shipment.
9. Timers. Countdown timers shall be part of the OIT to indicate the following:
   a. Draindown
   b. Simultaneous Air/Water (SimulWash™)
   c. Refill / Air Purge
   d. Backwash
   e. Filter to waste

C. Functional Control Description
1. General. During automatic operation, the PLC controls the filter functions, and communicates filter status to the OIT and remote SCADA system. Any modifications required to the existing PLC programming and SCADA computer graphics for the proper operation of the new filter basin shall be included as a part of this project for a fully functional system as intended.
2. Filtration consists of opening filter influent and effluent valves, which are their normal positions. As filter develops headloss throughout the filter run, differential pressure will be sensed.
3. At pre-selected differential pressure, as sensed by the differential sensing device, the filter backwash panel automatically indicates backwash required on the appropriate OIT screen. Backwash will either be manually initiated by the operator at the OIT or automatically as programmed. Automatic backwash initiation is based on head-loss with a 7-day timer override. The backwash procedure automatically sequences through the pre-set backwash procedure without operator action.

4. The system utilizes air and water simultaneously (SimulWash™) to create a sustained collapse-pulse action in the filter bed for a minimum of 10 minutes, followed by a short high-rate water-only backwash for media reclassification. Filter backwashing with air followed by water wash or simultaneous air and water for short periods limited by filter geometry are not acceptable.
5. The simultaneous air and water backwash (SimulWash™) step incorporates air at 3 cfm/ft^2 and water at approximately 3-5 gpm/ft^2. Backwash rates will vary based on water temperature and media type. Rates are set at commissioning to ensure proper collapse-pulse action and optimal media cleansing. Proper collapse-pulse in accordance with the parameters described herein shall be verified by performance testing at the time of commissioning.
6. Following the air/water backwash step, incorporate a water-only step at the low flow rate for a duration necessary to purge air from the media bed.
7. Following the air purge step, incorporate a water-only backwash step at rate sufficient for media fluidization for a duration as necessary to ensure proper reclassification of media.
8. Use separate rate set valves to attain proper low and high backwash rates necessary for simultaneous air/water backwashing and media reclassification. Set rate valves in the field at the time of commissioning by the manufacturer's field technician.
9. After the backwash procedure is complete, the filter is placed into a filter to waste mode. The filter is placed back into service automatically. A watch dog timer programmed into the PLC is provided to place the filter back into service after a pre-selected time for filter to waste.

D. Power Failure. If power to the PLC is lost, the uninterruptable power supply (UPS) engages and continues automatic operation of the filter control panel (all monitoring and indication, excluding the circuits installed "upstream" of the UPS) for a minimum of 15 minutes. Manual control of the equipment and components installed "upstream" of the UPS may be required during a power outage to the Filter A PLC cabinet.

E. Alarms. Indicate the following alarms on the alarm OIT screen: backwash required, backwash abort, high clearwell water level, high NTU, high wash water holding, backwash hold, MechVac failure alarm, sludge blowdown MOV open alarm during backwash, and other alarm conditions affecting filter and motor operations.

F. Remote Access Capability. The system control panel shall contain capability for remote screen mirroring, through Ethernet, of the system control panel PLC and OIT to monitor and operate the system, using the customer's existing VT SCADA software on the SCADA computer. Additionally, transfer of information as necessary for the proper operation of the Water Treatment Plant between the new Unit A PLC and the existing Unit B, C, and D CompactLogix 5370 series PLC's shall be included as a part of this project.

G. Shop Testing. Fully test the filter control panel with all alarms, indication, and I/O fully simulated at the factory. Test all screens with all alarm functions and other control parameters, verified by factory certification as to inspector and date inspected. Testing may be subject to verified witnessing by the Engineer and Owner.

H. Airwash blower. If the PLC sends the start command to the on-duty blower motor controller and the on-duty blower motor controller does not return the running signal to the PLC, then the blower fail alarm will activate on the OIT. The on-duty blower will stop being called to run and will send a start command to the standby blower.

I. MechVac. The MechVac will be controlled for start/stop operation based on a timer. The MechVac will travel the length of the settling tube basing in (2) directions for one cycle of operation, using two end of travel proximity sensors and one gear tooth counter. The sludge blowdown MOV will be called to open during MechVac operation for waste sludge disposal.

2.13 BACKWASH CONTROLS SUPPORT

A. The filter manufacturer shall determine timing and proper operation of airwash blower and valve sequence to take filter out of service, through backwash process, and back into service.

B. The system shall use the dual rate, collapse-pulse method of filter backwash. The backwash sequence shall be:

Step	Description	Duration
1	Sustained air and water wash simultaneously at 2-3 scfm/sq. ft. and 5 gpm/sq. ft. respectively, without media loss (collapse/pulse action to be verified).	Adjustable timer, 0-20 minutes.
2	Re-stratification at 10-15 gpm/sq. ft., or at the media fluidization rate.	Adjustable timer, 0-20 minutes.
3	Filter to waste.	Adjustable timer, 0-20 minutes.

NOTE: Above parameters to be verified by performance testing at time of start-up.

2.14 FILTER EFFLUENT RATE OF FLOW CONTROL

A. The filter shall be operated under constant head conditions requiring a filter effluent rate of control system. The filter effluent rate of flow control shall be designed to sense and maintain a constant head of water above the filter media through the use of the continuous level transmitter, filter automatic backwash PLC and an effluent modulating control valve. The continuous level transmitter shall sense level in the filter chamber and send an analog signal to the filter control panel. The filter control panel shall be configured and programmed to operate as a set point control, i.e., a filter level set point can be entered into the OIT by the operator. The PLC will receive the level sensing signal compare it to the setpoint level and produce an analog signal, which will be used to either open or close the effluent valve as necessary to maintain the filter setpoint level. The analog signal from the PLC shall be a 4-20 mA signal, which will be received by a positioner of the electric actuated filter effluent modulating control valve.

B. The level control system shall be configured to maintain a constant level during service operations. Upon backwash initiation the control will toggle to a pre-backwash set point. The filter will draindown at a controlled rate to the pre-backwash setpoint. Once the level reaches the pre-backwash set point the filter will proceed to the backwash sequence.

C. The effluent modulating butterfly valve shall be identical to those as specified elsewhere in these specifications. The effluent modulating butterfly valve actuator shall be an electric actuator as specified elsewhere in these specifications. The actuator shall include provisions for modulation control.

D. Emergency high level and low level float switches shall be provided to backup the level control system.

2.15 PAINTING

A. The interior of vessels above the underdrain plate shall be sandblasted and protected from corrosion by proper application of approved coatings for potable water. The exterior of the vessels shall be sandblasted and prime painted and finish painted at the factory. The bottom of the vessel shall be coated with two (2) coats 8-10 mil each of Bitumastic Tnemec-Tar Series 46H-412 Hi-Build Tnemec Tar (or equivalent) to prevent galvanic corrosion.

B. Surface Preparation
   1. Interior – Sandblast to near white blast cleaning (SSPC-SP10)
   2. Exterior – Sandblast to commercial blast cleaning (SSPC-SP6)

C. Coating
   1. The total paint system shall be the product of and applied in accordance with the recommendations of one manufacturer. Alternate paint systems must be pre-approved by the Engineer. Contractor shall purchase an adequate amount of touch-up paint, if required.
   2. Interior
      a. Stripe coating: Tnemec Series 21-WH16 Off White, or Sherwin-Williams SherPlate 600 Mill White, to a dry film thickness of 3-5 mils on all welded and hard-to-reach areas.
      b. Prime coating: Tnemec Series 21-1255 Biege, or Sherwin-Williams SherPlate 600 Buff, to a dry film thickness of 4-6 mils before any rust can form.
      c. Finish Coating: Tnemec Series 21-WH16 Off White, or Sherwin-Williams SherPlate 600 Mill White, to a dry film thickness of 4-6 mils.
      d. Total dry film thickness of 8-12 mils.
   3. Exterior
      a. Stripe coating: one coat Tnemec Series 21-WH16 Off White, or Sherwin-Williams SherPlate 600 Mill White, to a dry film thickness of 3-5 mils on all welded and hard-to-reach areas.
      b. Prime coating: Tnemec Series 21-1255 Biege, or Sherwin-Williams SherPlate 600 Buff, to a dry film thickness of 4-6 mils before any rust can form.
      c. Finish Coating: Factory Finish. Tnemec Series 1095-B9333 Endura-Shield Aliphatic Acrylic Polyurethane in Kurita Blue, or Sherwin-Williams Macropoxy 646 in Tonka Blue, applied to a dry film thickness of 3-5 mils.

D. Facepiping
   1. Gaps between flanges and all locations where a gap exists at flange hub/pipe intersection shall be caulked prior to finish painting with Sonneborn NP-1 by Sonneborn-Chem Rex, Inc. Sika FLEX 1-A, or equal.

2. Ductile Iron piping shall be prime painted at factory and finish painted by installing contractor with compatible system. Color to be as indicated in SECTION 400205 PIPING SCHEDULE and approved by the Owner.

E. After the tank has been completely assembled, filled with media and filled with water, a continuous bead of vinyl-based caulk shall be placed between the treatment unit and the pad.

2.16 ACCESS STAIRWAY, WALKWAY, AND HANDRAILS

A. The treatment unit equipment manufacturer shall provide an access stairway, walkway and handrails as shown on the plans. Stairways, walkways and handrails shall be designed and constructed in accordance with OSHA requirements.

B. The access stairway shall be constructed of carbon steel channel stringers and shall be complete including treads and railings. Stringers shall be sandblasted and epoxy coated in accordance with the painting requirements of these specifications. Treads shall be constructed of 1 1/4" aluminum bar grating with non-slip nosing. Treads shall be bolted to the stringers. Access stairway handrails shall be as outlined below.

C. Walkways shall be framed and reinforced with structural steel members as required to meet the live load requirements of OSHA. Walkway framework shall be sandblasted and epoxy coated in accordance with the painting requirements for the exterior of the tank. Walkway grating shall be a minimum of 1 1/4" aluminum bar grating with non-slip surfaces to provide positive traction. Walkway grating shall be anchored to the walkway frame by means of stainless steel “J” bolts. The walkway shall be provided with a 4” kick plate. The kick plate shall be of aluminum construction and shall be attached to the aluminum handrails as described below. Kick plates shall be set ¼” above the walking surface of the walkway. All anchors used for assembly of the walkway shall be stainless steel. Where the aluminum handrails or grating come in contact with dissimilar metals a protective isolator shall be provided.

D. Walkways and stairways shall be provided with a two-rail handrail system. The handrails and posts shall be constructed of 1 ½” schedule 40 aluminum pipe joined together with component fittings. All components shall be mechanically fastened with stainless steel hardware. Handrails shall be clear anodized and protected with a protective wrap that can be removed after installation. The handrails shall be designed to withstand a 200 lb. concentrated load applied in any direction to the top rail. Post spacing shall not be greater than 6’-0”. Posts shall not interrupt the continuation of the top rail at any point along the railing including corners and end terminations. The top surface of the top railing shall be smooth and shall not be interrupted by a projecting fitting.

E. Stairways, walkways and handrails shall be field assembled in accordance with the manufacturer’s drawings by the contractor.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Delivery and Storage

1. Upon delivery of the equipment to the jobsite, the contractor should take inventory of the shipment and immediately report to the equipment manufacturer

any discrepancies between the equipment manufacturer's packing lists and shipping documents.

2. The contractor shall be responsible for off-loading and protection of all equipment against damage and during on-site storage and installation. All media must be stored on pallets in a manner that protects it from UV, radiation, and weather. Damaged equipment and materials will be replaced by the contractor at the contractor's expense.

B. Manufacturer's Instructions. Installation shall be as shown on the plans and in accordance with the manufacturer's recommendations, installation instructions and assembly drawings. Manufacturer's installation instructions and assembly drawings, including of all control panels to be furnished, shall be submitted and approved by the Engineer prior to shipment of equipment. Installation of the filtration system shall be in strict accordance with the details shown on the drawings and in complete conformance to manufacturer's instructions and procedures.

3.2 FACTORY SERVICES AND START-UP

A. Refer to MOPO and start-up specifications provided on Construction Drawings.

B. Installation Supervision. The contractor shall coordinate with the treatment equipment manufacturer to provide factory supervision (as outlined in the Equipment Schedule) or direction during critical phases of installation. Critical phases will include setting of equipment, installation of internals, installation of controls, wiring instrumentation, and other components critical to the successful operation of the system.

C. Media Installation. Installation of support gravels and filter media shall be under the direct supervision of an employee of the filter manufacturer experienced in this procedure, in accordance with the Equipment Schedule.

D. System Start-Up and Training

1. Refer to Hospital/Utility Specification Section 019200 Facility Operation, Maintenance and Troubleshooting Mobile Graphical Information Management Platform, for coordination of start-up and training with Digital Mentor.
2. The contractor will verify in writing that the project is ready for manufacturer's field services. Copies of written verification shall be given to the manufacturer, engineer and owner prior to scheduling field services.
3. The contractor shall provide the services of a factory representative during start-up of the treatment equipment. The contractor shall provide the number of days on site for start-up supervision as outlined in the Equipment Schedule. At a minimum, the equipment manufacturer's technician shall perform the following start-up functions:
    a. Perform input/output signal field checks to ensure correct field connection of each control panel, motor, and instrument supplied.
    b. Inspect the final installation to assure proper installation, connection, and wiring of all equipment of the manufacturer's supply.
    c. Start-up of the equipment in the presence of the Contractor and the Owner's operating personnel.
    d. Training of the Owner's operating personnel in proper operation and maintenance procedures, start-up/shutdown procedures, response to emergency conditions, and troubleshooting. The responsibility of the Contractor and the factory service representative with regard to start-up shall be fulfilled when the start-up is complete, the equipment is functioning

properly, operating personnel have been trained, and the equipment has been accepted by the Owner.

3.3 WARRANTY AND BONDS

A. Simultaneous Air/Water Backwash Process Verification
   1. For filter optimization, the backwash process shall incorporate collapse pulse action during the backwash process as described in the AWWA Research Report by Professor Amirtharajah. These specifications incorporate these researched flow rates. The process of sustained simultaneous air and water backwash systems minimizes the wastewater production while maximizing cleaning of the filter bed.
   2. Manufacturers shall provide certification following start-up, that the unit will be run within accepted collapse-pulse ranges during backwash. These ranges are identified in Section 2.5 of this specification. A representative of the Owner will witness and verify in writing that the system is operating according to specified collapse-pulse rates at the time start-up is completed and are trained in this operation. A copy of the start-up report shall be required before final payment to the contractor can be made.

B. Backwash Waste Production Warranty
   1. All Contractors shall provide with their bid a wastewater generation calculation using the form listed on the Equipment Schedule.
   2. This plant is designed on Tonka Water’s maximum backwash volume guarantee. If a Bidder supplies a system which produces more wastewater than Tonka Water, they shall be held responsible for all costs associated with this increased wastewater production, including but not limited to: expanding the wash water holding tank/lagoon system; revising decant pumps; revising all plans including engineers review time, or other wastewater disposal costs.

C. Effluent Performance Warranty
   1. During start-up, the equipment manufacturer’s representative shall perform raw water and filtered effluent field tests to confirm performance of the equipment. Analytical methods employed for field-testing shall be performed by a digital colorimeter. Color comparators are unacceptable.
   2. The equipment shall be warrantied for a period of one year from the date of placing it on-line. The treatment water effluent during this period of time shall be as detailed in the Equipment Schedule.
   3. Sampling for conformance shall be taken during the middle of a filter run. All adjustments necessary to comply with this guarantee shall be made at the Contractor’s expense.

EQUIPMENT SCHEDULE
UNITIZED TREATMENT SYSTEM™ (UTS™)
PROJECT: Whiteriver, AZ

3.4 Materials and/Equipment

Design Flow Rate:	700 gpm
Flocculator Tip Speed:	2.0 ft. per second max.
Flocculation Comp. Detention Time:	20 minutes
Sedimentation Compartment Upflow Rate:	2.0 gpm/sq. ft. max.
Sedimentation Detention Time:	43 minutes
Filter Surface Loading Rate:	3.0 gpm/sq. ft.

Vessel Construction

Number of Vessels:	1
Min. Sedimentation Compartment:	350 sq. ft.
Surface Area per Filter:	234 sq. ft.
Minimum Sideshell Height:	12 ft.
Vessel Width:	14 ft.
Vessel Length:	53 ft.
Number of Filter Cells:	1

3.5 Filter Media

A. The filter media shall be placed on top of the support gravel and shall consist of:

1. A 3” layer of garnet sand. The garnet sand shall have an effective size of 0.2 to 0.3 mm with a U.C. of less than 1.65. A 30” depth of Tonka Water IMAR media. The media shall have a uniformity coefficient less than 1.65.

3.6 Airwash Blower

Capacity:	704 CFM
Operating Pressure:	5 psig

3.7 Valves

	Diameter (inches)	Quantity per UTS	Actuator
Raw Inlet (RWI):	**8**	**1**	**Modulating**
Filtered Water Effluent (LCV):	**8**	**1**	**Modulating**
Airwash Inlet (AWI):	**6**	**1**	**Electric**
BW Influent (BWI):	**12**	**1**	**Electric**
BW Effluent (BWE):	**18**	**1**	**Electric**
Filter to Waste (FTW):	**8**	**2**	**Modulating**
Sludge Blowdown (SBD):	**4**	**1**	**Electric**
Drain:	**3**	**1**	**Man-LVR**
Drain:	**2**	**3**	**Man-BALL**

3.8 Factory Services & Start-Up

Equipment Installation Supervision: 3 days
Media Installation Supervision: 2 days
Start-up & Operator Instruction: 4 days
Minimum number of trips required: 3 trips

3.9 Media Loss Guarantee

A. 1” per year or less.

3.10 Backwash Waste Production Warranty

Filter draindown	= 626 gallons
Simultaneous air/water backwash @ 3 gpm/sq. ft. x 234 sq. ft./cell x 10 min continuous	= 7,020 gallons
Water only wash (air purge) @ 3 gpm/sq. ft. x 234 sq. ft./cell x 2 min continuous	= 1,404 gallons
Water only wash (restratification) @ 10 gpm/sq. ft. x 234 sq. ft./cell x 3 min continuous	= 7,020 gallons
Total / unit	= 16,070 gallons
Proposed total backwash water per unit 16,070 gallons x 2 units = 32,140 gallons total backwash cycle waste water.	
Note: Calculations shall be based on Ten State Standards durations.	
The above backwash waste calculation shall be completed by the filter manufacturer and included with the contractor’s bid.	

3.11 Effluent Performance Warranty

Turbidity: 0.3 NTU

END OF SECTION

SECTION 463344 – PERISTALTIC METERING PUMPS – SWTP

PART 1 - DESCRIPTION

1.1 WORK INLCUDED

A. This section covers the work necessary to furnish and install, complete, the peristaltic metering pumps specified herein for the chemical dosing at the White Mountain Apache Tribal Utility Authority Surface Water Treatment Plant (SWTP). The pump manufacturer shall provide all pumps and other accessories, complete.

1.2 RELATED SECTIONS

A. Section 400205 – Piping Schedule

B. Section 460713 – Packaged Water Treatment Equipment

C. Construction Drawings

1.3 QUALITY ASSURANCE

A. Like items of equipment provided hereunder shall be the end product of the same manufacturer in order to achieve standardization of operation, maintenance, spare parts and manufacturer's services; and shall include all necessary appurtenances for a complete and working system. The equipment shall be the product of a manufacturer regularly engaged in the production of equipment for the specified use. The manufacturer shall have the sole responsibility for the proper functioning and coordination of the equipment as furnished.

1.4 SUBMITTALS/SHOP DRAWINGS

A. Submittals during construction shall be made in accordance with Section 013300, SUBMITTAL PROCEDURES in Division 01, GENERAL REQUIREMENTS.

1.5 OPERATION AND MAINTENANCE MANUALS

A. Operation and Maintenance (O&M) Manuals for the equipment specified herein shall be furnished as specified in Section 017823, OPERATION AND MAINTENANCE DATA. Submit information from the pump manufacturer and the motor manufacturer.

B. Contractor shall provide a digital Operation and Maintenance Manual with videos as created by Digital Mentor Inc., or approved equal.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. The H21 Series peristaltic chemical feed pump shall be a heavy-duty modular design suitable for 24-hr/day operation. Flomotion Systems, Buffalo, NY or approved equal.

2.2 PUMP

A. Equipment Numbers

Chemical	Equipment Numbers
Alum Pump 3	CHM-AL-3
Alum Pump 4	CHM-AL-4
Polymer Pump 3	CHM-PLY-3
Polymer Pump 4	CHM-PLY-4
Sodium Hypochlorite Pump 3	CHM-CL-3
Sodium Hypochlorite Pump 4	CHM-CL-4

B. Process Conditions

Chemical	Viscosity (cps @ 20 °C)	Specific Gravity (@ 20°C)
Alum	25	1.05
Polymer	1000-1500	1.30
Sodium Hypochlorite	N/A	1.27

C. Pump Characteristics

Pump Characteristics	
Pump Model	H21KA9
Quantity	6
Fluid Being Metered	Alum, Polymer, Chlorine
Tubing Material	Floprene
Min – Max Capacity	0.004-48.5gph
Pump RPM Range	0.8-225
Min Flow Rate (GPH)	0.1
Max Flow Rate (GPH)	38.5
Fittings	1/2" MNPT, NSF61 CPVC
Discharge Pressure (Max PSI)	30
Power Input	115/230Vac, 1ø, 60hz

D. Pumphead
   1. The ABS plastic pumphead shall have a spring-loaded roller assembly utilizing high performance 3/32” (2.4mm) thick wall extruded tubing specifically formulated for use in peristaltic pumps.
   2. The pumphead shall be capable of accepting a minimum of 6 different tubing diameters ranging from 1/16” (1.6mm) to 3/8” (9.6mm) ID.
   3. The stainless steel roller assembly shall have adjustable occlusion to optimize pump performance. The rollers shall be Nylatron MD. Rigid/fixed roller assembly designs are not acceptable.
   4. Pumphead design shall be capable of pressures up to 100-psi depending on tubing sizes with a suction lift of 30 ft. vertical water column and run dry without damage.
   5. One of the two spring loaded rollers shall be fully engaged at all times to prevent backflow or siphoning.
   6. The tubing shall be in contact with the inside diameter of the pumphead through an angle of 180 degrees and be held securely on suction and discharge with an EPDM tube seal grommet.
   7. The pumphead shall be a completely sealed design. Any fluid leakage due to tubing rupture shall be completely contained within the pumphead.

E. Gearmotor
   1. The pumphead/adapter flange shall have a lip seal to prevent fluid leakage between the pumphead and speed reducer.
   2. The output shaft and all mounting hardware shall be stainless steel.
   3. Gearmotor shall have corrosion resistant Dupont black powder coat finish.
   4. Gearmotor shall have horizontal configuration with integral junction box wiring.
   5. Gearmotor shall be 3/8HP, TEFC, Inverter duty, 230/460Vac, 3ø, 50/60 Hz.

F. Speed Controller
   1. Controller shall be pump mounted and housed in a NEMA 4X enclosure.
   2. Controller shall have an integral 8-button keypad and display.
   3. Controller can be operated in manual or automatic mode via 4-20mA input. In automatic mode the speed range shall have the capability of being optimized to the input signal.
   4. Controller shall have the capability to accept a contact closure from an optional tubing rupture detector. The capability of starting a back-up pump shall also be provided.
   5. The controller shall have the following additional input and output functions:
      a. Start/Stop input
      b. Local/Remote input
      c. 4-20mA speed reference output
      d. Fault output
      e. Remote status output
      f. Run output
   6. Controller power input 115/230Vac, 1ø, 60Hz with 10’ grounded power cord.

G. Tubing and Connectors
   1. Pump tubing shall be extruded from NSF61 Floprene or other suitable material based on chemical compatibility with a wall thickness of 2.4mm.

2. Pump tubing shall be provided in a bulk 50ft length and shall be separate from pumphead such that changing pump tubing does not require changing the entire pumphead.
3. Connectors shall be reusable leak proof 4pc precision machined specifically designed for peristaltic pump tubing shall be provided. Hose barbs and collars to be color coded for specific tubing sizes. The use of metal hose clamps will not be permitted.
4. Pre-cut tubing segments with integral connectors are not acceptable. Bulk pump tubing and reusable connectors shall be provided.

H. Spare Parts
1. Three-year supply of pump tubing shall be provided.

I. Rupture Detector
1. Tubing Rupture Detector shall be provided to automatically shut down the pump and signal an alarm in the event of a rupture. A pumphead mounted sensor and wall mount controller shall be provided with the following features:
   a. Sensor shall have no moving parts
   b. LED signals alarm condition
   c. 8 amps @ 250Vac DPDT latching relay
   d. Single reset pushbutton
   e. Ability to start back up pump
   f. 115Vac power input

J. Additional Accessories
1. CPN2KS Sigmamotor 2000ml Graduated Calibration Cylinder.
2. P2N499P Sigmamotor 1/2" PVC Pressure Relief Vales with PTFE/EPDM diaphragm. Two port design. Adjustable 5-150 psi range.
3. FLN12PV Sigmamotor 12 Cu. In. PVC Pulsation Dampener w/ Viton bladder.
4. GIN060PTB Sigmamotor Diaphragm Protected Pressure Gauges, 0-60 psi with PVC isolator body and PTFE diaphragm.
5. BN499P Sigmamotor 1/2" PVC Back Pressure/Anti-siphon valves with PTFE/EPDM diaphragm.
6. JB12P4X Junction Box for I/O and power wiring for two pumps and rupture detectors. Includes separate power receptable with weather proof cover.
7. PES211-H Prepackaged Extrusion Welded Polyethylene Duplex Peristaltic Pump Skid with common suction, common discharge, leak containment and fork lift cut-outs. Tapered floor with rear corner drain. 1/2" schedule 80 PVC piping with transparent true union reversable right side/left side “Y” strainer/flush, PVC ball valves and above accessories included. All pre-mounted, wired and wet tested.

PART 3 - EXECUTION

3.1 SHIPMENT AND PROTECTION

A. Equipment shall be prepared and protected for shipment and shipped in accordance with the requirements of Section 016000, PRODUCT REQUIREMENTS of Division 01, GENERAL REQUIREMENTS. In addition, the following shall be done:
1. After testing and before dismantling for shipment, all wiring and mechanical connections shall be matchmarked or tagged to ensure proper field assembly.

3.2 INSTALLATION

A. Procedures for installation, lubrication and startup of the pumps and motors shall be in strict conformance with the manufacturer's instructions. In addition, the instructions for installation, operation and maintenance from the Hydraulic Institute Standards shall be adhered to where applicable.

B. The pump installation shall be supervised by a manufacturer's representative and shall be approved by this representative prior to operating pumps.

C. All strain from attached piping shall be eliminated from the pumps. Any evidence of pump misalignment, noisy operation, or other signs of improper setting shall be corrected by the Contractor.

D. The equipment shall be provided with all necessary factory lubrication. Before initial startup at final installation, lubrication for all bearings, gears, etc. shall be checked in accordance with the pump and/or motor manufacturer’s recommendations.

3.3 FIELD TESTS

A. Refer to MOPO and start-up specifications provided on Construction Drawings, and Hospital/Utility Specification Section 019200 Facility Operation, Maintenance and Troubleshooting Mobile Graphical Information Management Platform, for coordination of start-up and training with Digital Mentor.

A. Functional Test: Prior to plant startup, all equipment described herein shall be inspected for proper alignment, quiet operation, proper connection, proper rotation, and satisfactory performance by means of a functional test.

B. Vibration Test: The complete assembly, consisting of the driving unit and pump and flexible shafting where shown, connected and in normal operation, shall not develop amplitudes of vibration exceeding limits recommended by the current edition of Hydraulic Institute Standards at any operating speed within the range specified.

C. Performance Test:

1. The Contractor, with the assistance of the pump manufacturer’s representative, shall perform field performance tests on all pump assemblies to demonstrate their conformance to the Specifications to the satisfaction of the Engineer. A test log shall be presented to the Engineer upon the completion of each test that records the following:
    a. Flow, as measured by plant instrumentation and/or storage volumes.
    b. Pump suction and discharge pressures measured by calibrated gauges and converted to feet of the liquid pumped and corrected to pump centerline, calculated velocity heads at the suction and discharge flanges, and total head, all tabulated in feet.
    c. Driving motor voltage and amperage measured for each phase.
    d. Motor manufacturer’s guaranteed power factor and efficiency at 1/4, 1/2, 3/4, and full load.
2. Units failing to meet the Specifications to the satisfaction of the Engineer must be replaced or more accurately tested in accordance with Hydraulic Institute Standards. If the pump fails the second test, the unit will be rejected, and the Contractor shall furnish a unit that will perform as specified.

3.4 MANUFACTURER’S CERTIFICATES

A. Provide manufacturer’s certificate(s) in accordance 019113, GENERAL

COMMISSIONING REQUIREMENTS of Division 01 GENERAL REQUIREMENTS. The certificate shall show:

1. That the handling of pump equipment was satisfactory to the manufacturer.
2. The installation is as specified and is acceptable to the manufacturer.
3. Include all results and testing data recorded during field testing.

END OF SECTION