
IFB NO. Y14-785-PH

ISSUED: March 28, 2014

INVITATION FOR BIDS

FOR

MEADOW WOODS WATER SUPPLY FACILITY MODIFICATIONS

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**Part H
Technical Specifications**

PART H

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Orange County Utilities
Meadow Woods WSF Modifications

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PROJECT REQUIREMENTS

1. GENERAL DESCRIPTION OF WORK. The Work to be performed under these Contract Documents is generally described as follows:

Retrofit the two existing wells with new pumps and discharge piping, construction of a well house at each well, connection of those wells to a newly constructed raw water main, and the conversion of the ground storage tanks (GST's) and High Service Pump Building (HSPB) into a reclaimed water storage and booster pumping station. The existing engine generator will be removed from the HSPB and the generator room will be converted to an electrical room to house new VFD's for the high service pumps. Yard piping will be modified as necessary to connect the existing reclaimed water main to fill the GST's and connect the high service pump discharge to the reclaimed water main.

2. UNITS OF MEASUREMENT. Both inch-pound (English) and SI (metric) units of measurement are specified herein; the values expressed in inch-pound units shall govern.

3. OFFSITE STORAGE. Offsite storage arrangements shall be approved by Owner for all materials and equipment not incorporated into the Work but included in Applications for Payment. Such offsite storage arrangements shall be presented in writing and shall afford adequate and satisfactory security and protection. Offsite storage facilities shall be accessible to Owner and Engineer.

4. SUBSTITUTES AND "OR-EQUAL" ITEMS. Provisions for evaluation of substitutes and "or-equal" items of materials and equipment are covered in Article 9 of the General Conditions. Requests for review of equivalency will not be accepted by Engineer from anyone except Contractor, and such requests will not be considered until after the Effective Date of the Agreement.

5. PREPARATION FOR SHIPMENT. All materials shall be suitably packaged to facilitate handling and protect against damage during transit and storage. Painted surfaces shall be protected against impact, abrasion, discoloration, and other damage. All painted surfaces which are damaged prior to acceptance of equipment shall be repainted to the satisfaction of Engineer.

Each item, package, or bundle of material shall be tagged or marked as identified in the delivery schedule or on the Shop Drawings. Complete packing lists and bills of material shall be included with each shipment.

6. SALVAGE OF MATERIALS AND EQUIPMENT. Unless otherwise specified, existing materials and equipment to be removed shall not be reused as a part of the Work and shall become Contractor's property.

7. LAND FOR CONSTRUCTION PURPOSES. Contractor will be permitted to use available land belonging to Owner, on or near the Site, for construction purposes and for storage of materials and equipment.

The locations and extent of the areas so used shall be as indicated on the Drawings.

Contractor shall immediately move stored materials or equipment if any occasion arises, as determined by Owner, requiring access to the storage area. Materials or equipment shall not be placed on the property of Owner until Owner has agreed to the location to be used for storage.

8. EASEMENTS AND RIGHTS-OF-WAY. The easements and rights-of-way for the pipelines will be provided by Owner. Contractor shall confine its construction operations within the limits indicated on the Drawings. Contractor shall use due care in placing construction tools, equipment, excavated materials, and pipeline materials and supplies in order to avoid damage to property and interference with traffic.

8.01. On Private Property. Easements across private property are indicated on the Drawings. Contractor shall set stakes to mark the boundaries of construction easements across private property. Contractor shall furnish, without charge, competent persons and such tools, stakes, and other materials as Engineer may require in staking out the boundaries of construction easements. Contractor will not be required to provide an instrument person. The stakes shall be protected and maintained until completion of construction and cleanup.

8.02. Work Within Rights-of-Way. Permits shall be obtained by Owner. All Work performed and all operations of Contractor, its employees, or Subcontractors within the limits of road rights-of-way shall be in conformity with the requirements and be under the control (through Owner) of the authority owning, or having jurisdiction over and control of, the right-of-way in each case.

8.03. Work Within OUC Easement. A portion of the work occurs in the Orlando Utilities Commission (OUC) power line easement crossing the site. Prior to commencement of Work in OUC's easement, the Contractor will schedule and conduct a safety meeting with OUC to discuss the precautions and procedures concerning working in the proximity of the power lines and the support tower. The Contractor will be obligated to comply with OUC's safety requirements.

9. OPERATION OF EXISTING FACILITIES. The existing reclaimed water main must be kept in continuous operation throughout the construction period, unless permission is obtained from Owner. Provided permission is obtained from Owner in advance, portions of the existing facilities may be taken out of service for short periods corresponding with periods of minimum service demands.

Contractor shall provide temporary facilities and make temporary modifications as necessary to keep the existing facilities in operation during the construction period.

10. NOTICES TO OWNERS AND AUTHORITIES. Contractor shall, as provided in the General Conditions, notify owners of adjacent property and utilities when prosecution of the Work may affect them.

When it is necessary to temporarily deny access to property, or when any utility service connection must be interrupted, Contractor shall give notices sufficiently in advance to enable the affected persons to provide for their needs. Notices shall conform to any applicable local

ordinance and, whether delivered orally or in writing, shall include appropriate information concerning the interruption and instructions on how to limit inconvenience caused thereby.

Utilities and other concerned agencies shall be notified at least 72 hours prior to cutting or closing streets or other traffic areas or excavating near underground utilities or pole lines.

11. LINES AND GRADES. All Work shall be done to the lines, grades, and elevations indicated on the Drawings.

Basic horizontal and vertical control points will be established or designated by Engineer to be used as datums for the Work. All additional survey, layout, and measurement work shall be performed by Contractor as a part of the Work.

Contractor shall provide an experienced instrument person, competent assistants, and such instruments, tools, stakes, and other materials required to complete the survey, layout, and measurement work. In addition, Contractor shall furnish, without charge, competent persons and such tools, stakes, and other materials as Engineer may require in establishing or designating control points, in establishing construction easement boundaries, or in checking survey, layout, and measurement work performed by Contractor.

Contractor shall keep Engineer informed, a reasonable time in advance, of the times and places at which it wishes to do Work, so that horizontal and vertical control points may be established and any checking deemed necessary by Engineer may be done with minimum inconvenience to Engineer and minimum delay to Contractor.

Contractor shall remove and reconstruct work which is improperly located.

12. CONNECTIONS TO EXISTING FACILITIES. Unless otherwise specified or indicated, Contractor shall make all necessary connections to existing facilities, including structures, drain lines, and utilities such as water, sewer, gas, telephone, and electric. In each case, Contractor shall receive permission from Owner or the owning utility prior to undertaking connections. Contractor shall protect facilities against deleterious substances and damage.

Connections to existing facilities which are in service shall be thoroughly planned in advance, and all required equipment, materials, and labor shall be on hand at the time of undertaking the connections. Work shall proceed continuously (around the clock) if necessary to complete connections in the minimum time. Operation of valves or other appurtenances on existing utilities, when required, shall be by or under the direct supervision of the owning utility.

13. UNFAVORABLE CONSTRUCTION CONDITIONS. During unfavorable weather, wet ground, or other unsuitable construction conditions, Contractor shall confine its operations to work which will not be affected adversely by such conditions. No portion of the Work shall be constructed under conditions which would affect adversely the quality or efficiency thereof, unless special means or precautions are taken by Contractor to perform the Work in a proper and satisfactory manner.

14. CUTTING AND PATCHING. As provided in General Conditions, Contractor shall perform all cutting and patching required for the Work and as may be necessary in connection with uncovering Work for inspection or for the correction of defective Work.

Contractor shall perform all cutting and patching required for and in connection with the Work, including but not limited to the following:

Removal of improperly timed Work.

Removal of samples of installed materials for testing.

Alteration of existing facilities.

Installation of new Work in existing facilities.

Contractor shall provide all shoring, bracing, supports, and protective devices necessary to safeguard all Work and existing facilities during cutting and patching operations. Contractor shall not undertake any cutting or demolition which may affect the structural stability of the Work or existing facilities without Engineer's concurrence.

Materials shall be cut and removed to the extent indicated on the Drawings or as required to complete the Work. Materials shall be removed in a careful manner, with no damage to adjacent facilities or materials. Materials which are not salvable shall be removed from the site by Contractor.

All Work and existing facilities affected by cutting operations shall be restored with new materials, or with salvaged materials acceptable to Engineer, to obtain a finished installation with the strength, appearance, and functional capacity required. If necessary, entire surfaces shall be patched and refinished.

15. HAZARDOUS ENVIRONMENTAL CONDITIONS AT SITE. No Hazardous Environmental Conditions at the Site in areas that will be affected by the Work are known to the Owner.

16. CLEANING UP. Contractor shall keep the premises free at all times from accumulations of waste materials and rubbish. Contractor shall provide adequate trash receptacles about the Site and shall promptly empty the containers when filled.

Construction materials, such as concrete forms and scaffolding, shall be neatly stacked by Contractor when not in use. Contractor shall promptly remove splattered concrete, asphalt, oil, paint, corrosive liquids, and cleaning solutions from surfaces to prevent marring or other damage.

Volatile wastes shall be properly stored in covered metal containers and removed daily.

Wastes shall not be buried or burned on the Site or disposed of into storm drains, sanitary sewers, streams, or waterways. All wastes shall be removed from the Site and disposed of in a manner complying with local ordinances and antipollution laws.

Adequate cleanup will be a condition for recommendation of progress payment applications.

17. APPLICABLE CODES. References in the Contract Documents to local codes mean the following:

2010 Florida Building Code

Other standard codes which apply to the Work are designated in the Specifications.

18. REFERENCE STANDARDS. Reference to standards, specifications, manuals, or codes of any technical society, organization, or association, or to the laws or regulations of any governmental authority, whether such reference be specific or by implication, shall mean the latest standard specification, manual, code, or laws or regulations in effect at the time of opening of Bids (or on the effective date of the Contract or Agreement if there were no Bids), except as may be otherwise specifically stated in the Contract Documents. However, no provision of any referenced standard, specification, manual, or code, or any instruction of a Supplier, shall be effective to change the duties or responsibilities of Owner, Contractor, or Engineer, or any of their subcontractors, consultants, agents, or employees from those set forth in the Contract Documents, nor shall any such provision or instruction be effective to assign to Owner, Engineer, or any of Engineer's CONSULTANTS, agents, or employees, any duty or authority to supervise or direct the performance of the Work or any duty or authority to undertake responsibility inconsistent with the provisions of the Contract Documents.

19. PRECONSTRUCTION CONFERENCE. Prior to the commencement of Work at the Site, a preconstruction conference will be held at a mutually agreed time and place. The conference shall be attended by:

Contractor and its superintendent.

Principal Subcontractors.

Representatives of principal Suppliers and manufacturers as appropriate.

Engineer and its Resident Project Representative.

Representatives of Owner.

Government representatives as appropriate.

Others as requested by Contractor, Owner, or Engineer.

Unless previously submitted to Engineer Contractor shall bring to the conference a preliminary schedule for each of the following:

Progress Schedule.

Procurement Schedule.

Schedule of Values for progress payment purposes.

Schedule of Shop Drawings and other submittals.

The purpose of the conference is to designate responsible personnel and establish a working relationship. Matters requiring coordination will be discussed and procedures for handling such matters established. The agenda will include:

Contractor's preliminary schedules.

Transmittal, review, and distribution of Contractor's submittals.

Processing Applications for Payment.

Maintaining record documents.

Critical Work sequencing.

Field decisions and Change Orders.

Use of premises, office and storage areas, security, housekeeping, and Owner's needs.

Major equipment deliveries and priorities.

Contractor's assignments for safety and first aid.

Engineer will preside at the conference and will arrange for keeping the minutes and distributing the minutes to all persons in attendance.

20. PROGRESS MEETINGS. Contractor shall schedule and hold regular progress meetings at least monthly and at other times as requested by Engineer or required by progress of the Work. Contractor, Engineer, and all Subcontractors active on the Site shall be represented at each meeting. Contractor may at its discretion request attendance by representatives of its Suppliers, manufacturers, and other Subcontractors.

Contractor shall preside at the meetings. Meeting minutes shall be prepared and distributed by Contractor. The purpose of the meetings will be to review the progress of the Work, maintain coordination of efforts, discuss changes in scheduling, and resolve other problems which may develop.

21. SITE ADMINISTRATION. Contractor shall be responsible for all areas of the Site used by it and by all Subcontractors in the performance of the Work. Contractor shall exert full control over the actions of all employees and other persons with respect to the use and preservation of property and existing facilities, except such controls as may be specifically reserved to Owner or others. Contractor shall have the right to exclude from the Site all persons who have no purpose related to the Work or its inspection, and may require all persons on the Site (except Owner's employees) to observe the same regulations as Contractor requires of its employees.

22. USE OF PREMISES. Contractor shall limit site disturbance on the entire site, including earthwork and clearing of vegetation, to 40 feet (12.2 m) beyond building or other major structure perimeters; 10 feet (3 m) beyond surface walkways, patios, surface parking, and trenches for utilities less than 12 inches (300 mm) in diameter; 15 feet (4.5 m) beyond primary

roadway curbs, main utility trenches, outdoor equipment pads, and electrical equipment yards; and 25 feet (7.6 m) beyond constructed areas with permeable surfaces (such as pervious paving areas, stormwater detention facilities) that require additional staging areas in order to limit compaction in the constructed area.

The wells shall be protected at all times, for the duration of the Work. No laydown of materials shall occur within 50 feet of the wells.

23. NON-SMOKING SITE. Contractor's personnel shall not smoke on site.

24. COUNTY'S WORK SCHEDULE. The County reserves the right to have their Resident Project Representative (RPR) present to witness and inspect all Work performed by the Contractor. Working hours for the RPR are an 8-hour period between the hours of 7:00 a.m. and 4:00 p.m., Monday through Friday. Any Work beyond the 8-hour period shall be considered overtime and shall be requested in writing 24 hours prior. Contractor, with verbal permission of the RPR, may work 24 hours a day to provide clean-up, maintenance of vehicles and equipment, and other such items without the RPR present.

Any Work required on Saturday or Sunday shall be considered overtime and shall be requested in writing 48 hours in advance. All requests must be approved by County in advance. Under emergency situations a verbal request may be made with a follow-up written request.

County observes the following holidays: New Year's Day, Martin Luther King Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, day after Thanksgiving, Christmas Eve and Christmas Day.

Contractor shall pay for the RPR's overtime. Overtime shall be defined as time beyond the 8-hour working period between 7:00 a.m. and 4:00 p.m. on Monday through Friday, and all time on Saturdays, Sundays, and on holidays observed by the County. Hourly rates for the Resident Project Representatives shall be \$50 per hour.

25. NETWORK COORDINATION. Instrumentation and Control System Supplier shall coordinate with Orange County ISS group regarding schedule for the installation of network equipment. A minimum of 90 days advance notice is required.

End of Section

MEASUREMENT AND PAYMENT

1.01 GENERAL

- A. The Contractor shall receive and accept the compensation provided in the Proposal and the Contract as full payment for furnishing all materials, labor, tools and equipment, for performing all operations necessary to complete the work under the Contract, and also in full payment for all loss or damages arising from the nature of work, or from any discrepancy between the actual quantities of work and quantities herein estimated by the Engineer, or from the action of the elements or from any unforeseen difficulties which may be encountered during the prosecution of the work until the final acceptance by the Owner.
- B. The prices stated in the proposal include all costs and expenses for taxes, labor, equipment, materials, commissions, transportation charges and expenses, patent fees and royalties, labor for handling materials during inspection, costs for General Requirements, Mobilization and Demobilization together with any and all other costs and expenses for performing and completing the work as shown on the Drawings and specified herein.
- C. The Contractor's attention is again called to the fact that the quotations for the various items of work are intended to establish a total price for completing the work in its entirety. Should the Contractor feel that the cost for any item of work has not been established by the Bid Form or Payment Items, he shall include the cost for that work in some other applicable bid item, so that his proposal for the project does reflect his total price for completing the work in its entirety.

1.02 MEASUREMENT

- A. The quantities for payment under this Contract shall be determined by actual measurement of the completed items, in place, ready for service and accepted by the Owner, in accordance with the applicable method of measurement.

1.03 PAYMENT ITEMS

- A. Items are as enumerated on the bid form.
 - 1. Item 1 – Meadow Woods Water Supply Facility Modifications.
 - a. Payment for all the other work associated with the construction of the Meadow Woods Water Supply Facility Modifications will be made at the Contract lump sum price, based upon the approved schedule of values.
 - b. This item shall include all materials, equipment, labor, testing, permits, appurtenances, and work required for the Meadow Woods Water Supply Facility.
 - c. This item shall include costs for General Requirements, Mobilization, and Demobilization. Measurement for various items covered under General Requirements, Mobilization and

Demobilization will not be made for payment, and all items shall be included in the lump sum price.

- d. Payment for General Requirements shall include all Insurance requirement costs, the cost of bonds, and all Administrative costs. This item will be paid upon each payment request made by the Contractor. The Contractor shall attach with the pay request invoices to substantiate that appropriate insurance and bonds have been obtained by the Contractor.
- e. Payment for Mobilization/Demobilization will be made at the Contract lump sum price for the item, which price and payment shall be full compensation for the Work consisting of the preparatory Work and operations in mobilizing for beginning Work on the Contract, including, but not limited to, furnishing those supplies and incidentals to the project site, preparation of submittals, and for the establishment of temporary offices and buildings, safety equipment and first aid supplies, project signs, field surveys, sanitary and other facilities required by these specifications, and State and local laws and regulations. The costs of bonds and any required insurance and any other preconstruction expense necessary for the start of the work, excluding the cost of construction materials, shall also be included. This Work also consist of the general project management of the Work including, but not limited to, field supervision and office management, as well as other incidental cost for management of the Work during the duration of the Contract. This Work also includes maintenance of the field offices for the duration of the Contract. The Work specified in this item also consists of demobilization or the operations normally involved in ending Work on the project including, but not limited to, termination and removal of temporary utility service and field offices; demolition and removal of temporary structures and facilities; restoration of Contractor storage areas; disposal of trash and rubbish, and any other post-construction work necessary for the proper conclusion of the Work. This pay item may not exceed 5% of the Total Base Bid amount.

Payment for Indemnification: In consideration of the Contractor's Indemnity Agreement as set out in the Contract Documents, Owner specifically agrees to give the Contractor \$100.00 and other good and valuable consideration, receipt of which is acknowledged upon signing of the Agreement.

End of Section

PERMITS AND REGULATORY REQUIREMENTS

PART 1 - GENERAL

1.01 RELATED SECTIONS: N/A

1.02 REGULATORY AGENCIES:

- A. General: The Contractor shall;
 - a. Obtain and pay for all permits and licenses as provided for in the General Conditions, except as otherwise specified herein.
 - b. Schedule all inspections and obtain all written approvals of the agencies required by the permits and licenses.
 - c. Comply with all conditions specified in each of the permits and licenses.
 - d. A copy of the permits obtained by the County will be furnished to the Contractor upon request.

1.03 PERMITS OBTAINED BY THE COUNTY:

- A. The County will apply for and pay for the following permits:
 - a. The initial Orange County Building Permit.
 - b. FDEP Application to Construct a Public Drinking Water System
 - c. FDEP Wastewater Facility or Activity Permit Application.
 - d. FDEP/SFWMD Environmental Resource Permit.

1.04 PERMITS OBTAINED BY CONTRACTOR:

- A. The Contractor shall be responsible for obtaining the following permits:
 - a. The Contractor shall be responsible for obtaining and paying for the Orange County Demolition Permit.
 - b. The Contractor shall be responsible for obtaining the Orange County Building Permit, and shall pay for all permits subsequent to the initial Building Permit as required for various building trades such as mechanical, electrical, plumbing, roofing, etc.

- c. The Contractor shall, within 14 days of the date of the Notice-to-Proceed, prepare the application and pay fees associated with a Notice of Intent (NOI) to Use Generic Permit for Stormwater Discharge from Large and Small Construction Activities and the Stormwater Pollution Prevention Plan (SPPP) for compliance with the USEPA's General Permit for construction activities.
- d. The Contractor shall apply and pay for the permits required for the temporary construction trailers.
- e. The Contractor shall apply and pay for the DEP Fuel Tank Removal Permit.
- f. All other permits required for Contractor's operations or required elsewhere in Contract Documents and not included herein. Furnish three copies of permits to the Owner prior to performance of work authorized by permits.
- g. Contractor will be responsible for obtaining extensions to permits obtained by the Owner if construction authorized by permits has not been completed by expiration date noted on these permits.
- h. Permits may require that a representative of permitting agency be present at site during construction or prior to covering up of activity authorized by permit. Contractor will be responsible for notifying permitting agency in compliance with requirements of such permits.
- i. Contractor shall include time to obtain permits in his construction schedule.

PART 2 – PRODUCTS: N/A

PART 3 - EXECUTION: N/A

End of Section

Section 01070

ABBREVIATIONS OF TERMS AND ORGANIZATIONS

1. LIST OF ABBREVIATIONS. Abbreviations for standards and organizations used in the Contract Documents are defined as follows:

AA	Aluminum Association
AABC	Associated Air Balance Council
AAMA	Architectural Aluminum Manufacturers Association
AASHTO	American Association of State Highway and Transportation Officials
ABMA	American Bearing Manufacturers Association
ACI	American Concrete Institute
ACPA	American Concrete Pipe Association
AEIC	Association of Edison Illuminating Companies
AFBMA	Antifriction Bearing Manufacturers Association now recognized as the ABMA
AFPA	American Forest & Paper Association
AGA	American Gas Association
AGMA	American Gear Manufacturers Association
AHA	American Hardboard Association
AHRI	Air-Conditioning, Heating and Refrigeration Institute
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
AITC	American Institute of Timber Construction
AMCA	Air Movement and Control Association International
ANSI	American National Standards Institute
APA	Engineered Wood Association (formerly American Plywood Association)
API	American Petroleum Institute
AREMA	American Railway Engineers and Maintenance-of-Way Association
ASAHC	American Society of Architectural Hardware Consultants
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigerating, and Air- Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASSE	American Society of Sanitary Engineers
ASTM	ASTM International
AWG	American Wire Gauge
AWI	Architectural Woodwork Institute
AWPA	American Wood-Preservers' Association
AWS	American Welding Society

AWWA	American Water Works Association
BHMA	Builders Hardware Manufacturers Association
BIA	Brick Institute of America (formerly SCPI)
CDA	Copper Development Association
CISPI	Cast Iron Soil Pipe Institute
CMAA	Crane Manufacturers Association of America
CRA	California Redwood Association
CRSI	Concrete Reinforcing Steel Institute
CS	Commercial Standard (U.S. Department of Commerce)
DHI	Door and Hardware Institute
DIPRA	Ductile Iron Pipe Research Association
EEI	Edison Electric Institute
EJCDC	Engineers' Joint Contract Documents Committee
EPA	Environmental Protection Agency
FCC	Federal Communications Commission
FCI	Fluid Controls Institute
Fed Spec	Federal Specification
FGMA	Flat Glass Marketing Association
FHWA	Federal Highway Administration
FIA	Factory Insurance Association
FM	Factory Mutual
FSA	Fluid Sealing Association
HEI	Heat Exchange Institute
HMI	Hoist Manufacturers Institute
HPMA	Hardwood Plywood Manufacturers Association
HTI	Hand Tools Institute
I-B-R	Institute of Boiler and Radiator Manufacturers
IEEE	Institute of Electrical and Electronics Engineers
IBC	International Building Code
IES	Illuminating Engineering Society
IFI	Industrial Fasteners Institute
IPCEA	Insulated Power Cable Engineers Association
IRI	Industrial Risk Insurers
ISA	International Society of Automation
LEED	Leadership in Energy and Environmental Design
MHI	Materials Handling Institute
MIL	Military Specification

MMA	Monorail Manufacturers Association
MSS	Manufacturers Standardization Society of Valve and Fitting Industry
NAAMM	National Association of Architectural Metals Manufacturers
NACE	NACE International
NBBPVI	National Board of Boiler and Pressure Vessel Inspectors
NBS	See NIST
NCSPA	National Corrugated Steel Pipe Association
NEBB	National Environmental Balancing Bureau
NEC	National Electrical Code
NECA	National Electrical Contractors Association
NEII	National Elevator Industry, Inc.
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
NIST	National Institute of Standards and Technology (formerly NBS)
NLA	National Lime Association
NPC	National Plumbing Code
NPT	National Pipe Thread
NRMCA	National Ready Mixed Concrete Association
NSC	National Safety Council
NSF	NSF International (formerly National Sanitation Foundation)
NTMA	National Terrazzo and Mosaic Association
NWMA	National Woodwork Manufacturers Association
OSHA	Occupational Safety and Health Administration
PCA	Portland Cement Association
PCI	Precast/Prestressed Concrete Institute
PS	Product Standard
RIS	Redwood Inspection Service
SAE	SAE International
SDI	Steel Door Institute
SFPA	Southern Forest Products Association
SI	Système International des Unités (International System of Units)
SIGMA	Sealed Insulating Glass Manufacturers Association
SJI	Steel Joist Institute
SMA	Screen Manufacturers Association
SMACNA	Sheet Metal and Air Conditioning Contractors National Association
SPFA	Steel Plate Fabricators Association
SPI	Society of the Plastics Industry
SPTA	Southern Pressure Treaters Association

SSFI	Scaffolding, Shoring & Forming Institute, Inc
SSPC	SSPC: The Society for Protective Coatings
TABB	Testing, Adjusting, and Balancing Bureau
UL	Underwriters' Laboratories
USBR	U.S. Bureau of Reclamation
USGBC	U.S. Green Building Council
WEF	Water Environment Federation

End of Section

SUBMITTALS PROCEDURES

1. SHOP DRAWINGS AND ENGINEERING DATA.

1.01. General. Shop Drawings and engineering data (submittals) covering all equipment and all fabricated components and building materials which will become a permanent part of the Work under this Contract shall be submitted to Engineer for review, as required. Submittals shall verify compliance with the Contract Documents, and shall include drawings and descriptive information in sufficient detail to show the kind, size, arrangement, and the operation of component materials and devices; the external connections, anchorages, and supports required; the performance characteristics; and dimensions needed for installation and correlation with other materials and equipment.

Each submittal shall cover items from only one section of the specification unless the item consists of components from several sources. Contractor shall submit a complete initial submittal including all components. When an item consists of components from several sources, Contractor's initial submittal shall be complete including all components.

All submittals, regardless of origin, shall be approved by Contractor and clearly identified with the name and number of this Contract, Contractor's name, and references to applicable specification paragraphs and Contract Drawings. Each copy of all submittals, regardless of origin, shall be stamped or affixed with an approval statement of Contractor. Each submittal shall indicate the intended use of the item in the Work. When catalog pages are submitted, applicable items shall be clearly identified and inapplicable data crossed out. The current revision, issue number, and date shall be indicated on all drawings and other descriptive data.

Contractor shall be solely responsible for the completeness of each submittal. Contractor's stamp or affixed approval statement of a submittal, per Figure 1-01300, is a representation to Owner and Engineer that Contractor accepts sole responsibility for determining and verifying all quantities, dimensions, field construction criteria, materials, catalog numbers, and similar data, and that Contractor has reviewed and coordinated each submittal with the requirements of the Work and the Contract Documents.

All deviations from the Contract Documents shall be identified as deviations on each submittal and shall be tabulated in Contractor's letter of transmittal using Figure 2-01300. Such submittals shall, as pertinent to the deviation, indicate essential details of all changes proposed by Contractor (including modifications to other facilities that may be a result of the deviation) and all required piping and wiring diagrams.

For hard copy submittals, five copies of each drawing and the necessary data shall be submitted to Engineer. Engineer will return two marked copies (or one marked reproducible copy) to Contractor. Facsimile (fax) or electronic copies will not be acceptable. Engineer will not accept submittals from anyone but Contractor. Submittals shall be consecutively numbered in direct sequence of submittal and without division by subcontracts or trades.

1.02. Engineer's Review of Submittals. Engineer's review of submittals covers only general conformity to the Drawings and Specifications, external connections, and dimensions that affect the layout; it does not indicate thorough review of all dimensions, quantities, and details of the material, equipment, device, or item covered. Engineer's review shall not relieve Contractor of sole responsibility for errors, omissions, or deviations in the drawings and data, nor of Contractor's sole responsibility for compliance with the Contract Documents.

Engineer's submittal review period shall be 21 consecutive calendar days and shall commence on the first calendar day following receipt of the submittal or resubmittal in Engineer's office. The time required to mail the submittal or resubmittal back to Contractor shall not be considered a part of the submittal review period.

Shop drawings will be returned, stamped with following classifications:

No Exceptions Noted (NEN): The Engineer's review found no deviations from the Contract Documents.

Exceptions Noted (EN): The Engineer's review found no major deviations from the Contract Documents; only minor discrepancies or deficiencies are noted. Corrected copies are not required unless specifically requested; however, when the item for which the submittal was prepared is furnished, it must be in compliance with the Engineer's comments. If the Contractor, supplier, or manufacturer takes exception to any comments, they must submit corrected or supplemental data to further explain the reasons for any deviations from the Contract Documents.

Returned for Correction (RFC): The Engineer's review revealed major discrepancies or deficiencies, so that corrected data must be submitted to determine compliance with the Contract Documents.

Record Copy (RC): Typically applies to submittal data which the Engineer determines to be general or supplemental to information being reviewed, such as test reports, manufacturer's or supplier's letters included with submittal data, unmarked catalog data, etc.

Not Acceptable (NA): In the Engineer's opinion, the item submitted for review does not meet the requirements of the Contract Documents. Submittals from a new source should be submitted.

Returned Without Review (RWOR): This status is not stamped on the submittal, but is stated in the return letter for items such as design calculations or items pertaining to the Contractor's means and methods of construction.

Not Applicable (N/App.): This status is not stamped on the submittal, but is stated in the return letter for items that do not apply to the project or the submitted specification section.

1.03. Resubmittal of Drawings and Data. Contractor shall accept full responsibility for the completeness of each resubmittal. Contractor shall verify that all corrected data and additional information previously requested by Engineer are provided on the resubmittal.

When corrected copies are resubmitted, Contractor shall direct specific attention to all revisions in writing and shall list separately any revisions made other than those called for by Engineer on

previous submittals. Requirements specified for initial submittals shall also apply to resubmittals. Resubmittals shall bear the number of the first submittal followed by a letter (A, B, etc.) or a unique identification that indicates the initial submittal and correct sequence of each resubmittal.

If more than one resubmittal is required because of failure of Contractor to provide all previously requested corrected data or additional information, Contractor shall reimburse Owner for the charges of Engineer for review of the additional resubmittals. This does not include initial submittal data such as shop tests and field tests that are submitted after initial submittal.

Resubmittals shall be made within 30 days of the date of the letter returning the material to be modified or corrected, unless within 14 days Contractor submits an acceptable request for an extension of the stipulated time period, listing the reasons the resubmittal cannot be completed within that time.

The need for more than one resubmittal, or any other delay in obtaining Engineer's review of submittals, will not entitle Contractor to extension of the Contract Times unless delay of the Work is the direct result of a change in the Work authorized by a Change Order or failure of Engineer to review and return any submittal to Contractor within the specified review period.

1.04. Color Selection. Contractor shall submit samples of colors and finishes for all accepted products before Engineer will coordinate the selection of colors and finishes with Owner. Engineer will prepare a schedule of finishes that includes the colors and finishes selected for both manufactured products and for surfaces to be field painted or finished and will furnish this schedule to Contractor within 60 days after the date of acceptance of the last color or finish sample.

2. OPERATION AND MAINTENANCE DATA AND MANUALS. Adequate operation and maintenance information shall be supplied for all equipment requiring maintenance or other attention. The equipment Supplier shall prepare a project specific operation and maintenance manual for each type of equipment indicated in the individual equipment sections or the equipment schedule.

Parts lists and operating and maintenance instructions shall be furnished for other equipment not listed in the individual equipment sections or the equipment schedule.

Operation and maintenance (O&M) manuals shall include the following:

- a. Equipment function, normal operating characteristics, and limiting conditions.
- b. Assembly, installation, alignment, adjustment, and checking instructions.
- c. Operating instructions for startup, routine and normal operation, regulation and control, shutdown, and emergency conditions.
- d. Lubrication and maintenance instructions.
- e. Guide to troubleshooting.

- f. Parts lists and predicted life of parts subject to wear.
- g. Outline, cross section, and assembly drawings; engineering data; and wiring diagrams.
- h. Test data and performance curves, where applicable.

The O&M manuals shall be in addition to any instructions or parts lists packed with or attached to the equipment when delivered, or which may be required by Contractor.

Three hard copies of each O&M manual shall be submitted to Engineer prior to the date of shipment of the equipment. When the manuals are assigned the review status "RETURNED FOR CORRECTION", the corrections shall be made as instructed by the Engineer, and two copies of the corrected portion(s) and one complete corrected copy of the manual returned to the Engineer. After review by Engineer is complete, with no exceptions, two additional hard copies for a total of five hard copies and one electronic copy of each operation and maintenance manual shall be prepared and delivered to Engineer, not later than 30 days prior to placing the equipment in operation. When corrections are required, a corrected version of the electronic copy shall be resubmitted. When review of the electronic copy by the Engineer is complete, with no exceptions, five copies of each electronic O&M manual shall be delivered on CD-ROM to the Engineer. Each CD shall contain only one copy of one manual.

2.01. Hard Copy Operation and Maintenance Manuals. Hard copies submitted for review shall be temporarily bound in heavy paper covers bearing suitable identification. All manuals and other data shall be printed on heavy, first quality 8-1/2 x 11 inch [215 x 279 mm] paper, with standard three-hole punching. Drawings and diagrams shall be reduced to 8-1/2 x 11 inches [215 x 279 mm] or 11 x 17 inches [279 x 431 mm]. Where reduction is not practicable, larger drawings shall be folded separately and placed in envelopes, which are bound into the manuals. Each envelope shall be suitably identified on the outside. Each volume containing data for three or more items of equipment shall include a table of contents and index tabs. The final hard copy of each manual shall be prepared and delivered in substantial, permanent, three-ring or three-post binders with a table of contents and suitable index tabs.

2.02. Electronic Operation and Maintenance Manuals. Electronic manuals shall be in Adobe Acrobat's Portable Document Format (PDF), and shall be prepared at a resolution between 300 and 600 dots per inch (dpi), depending on document type. Optical Character Recognition (OCR) capture shall be performed on these documents. OCR settings shall be performed with the "original image with hidden text" option in Adobe Acrobat Exchange.

File size shall be limited to 10 MB. When multiple files are required the least number of files possible shall be created. File names shall be in the format OMXXXXX-YYYYZ-V.pdf, where XXXXX is the five digit number corresponding to the specification section, YYY is a three digit O&M manual number, e.g. 001, Z is the letter signifying a resubmittal, A, B, C, etc, and V is a number used only when more than one 10 MB file is required for an O&M manual.

Documents prepared in PDF format shall be processed as follows:

1. Pages shall be searchable (processed for optical character recognition) and indexed when multiple files are required.
2. Pages shall be rotated for viewing in proper orientation.

3. A bookmark shall be provided in the navigation frame for each entry in the Table of Contents.
4. Embedded thumbnails shall be generated for each completed PDF file.
5. The opening view for PDF files shall be as follows:
 - Initial View: Bookmarks and Page
 - Page Number: Title Page (usually Page 1)
 - Magnification: Set to Fit in Window
 - Page: Single Page
6. Where the bookmark structure is longer than one page the bookmarks shall be collapsed to show the chapter headings only.
7. When multiple files are required the first file of the series (the parent file) shall list every major topic in the Table of Contents. The parent file shall also include minor headings bookmarked based on the Table of Contents. Major headings, whose content is contained in subsequent files (children) shall be linked to be called from the parent to the specific location in the child file. The child file shall contain bookmark entries for both major and minor headings contained in the child file. The first bookmark of any child file shall link back to the parent file and shall read as follows "Return to the *Equipment Name* Table of Contents", e.g. Return to the Polymer Feed System Table of Contents.
8. Drawings shall be bookmarked individually.
9. Files shall be delivered without security settings to permit editing, insertion and deletion of material to update the manual provided by the manufacturer.

2.03. Labeling. As a minimum, the following information shall be included on all final O&M manual materials, including CD-ROM disks, jewel cases, and hard copy manuals:

Equipment name and/or O&M title spelled out in complete words.
Project Name.
City Project/Contract Number.
Specification Section Number. Example: "Section 15500"
Manufacturer's name.
File Name and Date.

For example:

Backwash Pump Operation and Maintenance Manual
Somewhere Plant Expansion
Project/Contract No. _____
Specification Section 11110
Manufacturer
OM11110-001.pdf, 5/05/07

End of Section

SUBMITTAL No. _____

SECTION _____

Do not combine multiple sections together unless required by specifications.

(Contractor's Letterhead)

SUBMITTAL IDENTIFICATION & CONTRACTOR'S APPROVAL STATEMENT

DATE: _____ **COPIES** _____ **DRAWING SHEET NO.** _____

Description submittal contents: _____

Location: _____

Manufacturer _____

Subcontractor or Supplier (Optional) _____

REMARKS: _____

CONTRACTOR'S APPROVAL

(_____ Construction Company) has reviewed and coordinated the submitted documentation and verifies that the equipment and material meet the requirements of the Work and the Contract Documents. We accept sole responsibility for determining and verifying all quantities, dimensions, field construction criteria, materials, catalog numbers, and similar data contained in the submittal as required by the Contract Documents.

Deviations: None Yes (See attached Figure 2-01300 for written description)

Approved By: _____ Date: _____

This approval does not release subcontractor / vendor from the contractual responsibilities.

Black & Veatch
Project No. _____ Phase _____
Contract No. _____
Project Description: _____

SUBMITTAL No. _____

SECTION _____

Do not combine multiple sections together unless required by specifications.

(Contractor's Letterhead)

**SUBMITTAL IDENTIFICATION &
CONTRACTOR'S APPROVAL STATEMENT**

DATE: _____ COPIES _____ DRAWING SHEET NO. _____

Description submittal contents: _____

Location: _____

Manufacturer _____

Subcontractor or Supplier (Optional) _____

DEVIATIONS

Black & Veatch
Project No. _____ Phase _____
Contract No. _____
Project Description: _____

Section 01310

CONSTRUCTION SCHEDULING

1. PROGRESS SCHEDULE. A Progress Schedule shall be submitted to Engineer. The Progress Schedule shall indicate the sequence of the Work; the time of starting and completion of each part; the installation date for each major item of equipment; and the time for making connections to existing piping, structures, or facilities. An initial Progress Schedule shall be submitted after the preconstruction conference and before Work is started. The schedule shall be revised as necessary to reflect changes in the progress of the Work. Revised schedules shall be submitted at the minimum frequency of 30 days.

1.01. Progress Reports. A progress report shall be furnished to Owner with each Application for Payment. If the Work falls behind schedule, Contractor shall submit additional progress reports at such intervals as Owner may request.

Each progress report shall include sufficient narrative to describe current and anticipated delaying factors, their effect on the progress schedule, and proposed corrective actions. Any work reported complete, but which is not readily apparent to Owner, must be substantiated with satisfactory evidence.

1.02. Schedule Recovery. The shall Contractor, at no additional cost to the Owner, add to its facilities, equipment, or construction forces, as well as increase the working hours, if operations fall behind schedule at any time during the construction period.

End of Section

SCHEDULE OF VALUES

PART 1 – GENERAL

1.01 DEFINITION Schedule of Values (SOV) – Schedule that divides the Contract Amount into pay items, such that the sum of all pay items equals the Contract Amount for the Work, or for any portion of the Work having a separate specified Contract Amount.

1.02 REQUIREMENT The Schedule of Values established as provided in the General Conditions will serve as the basis for progress payments and will be incorporated into a form of Application for Payment acceptable to the Project Manager. Progress payments on account of Unit Price Work will be based on the number of units completed.

No payment will be made for work performed on a lump sum contract or a lump sum item until the appropriate Schedule of Values is approved by the Project Manager.

The equitable value of work deleted from a lump sum contract or lump sum item shall be determined from the approved Schedule of Values.

1.03 SUBMITTALS Submit three copies of a Preliminary Schedule of Values within fifteen (15) days after the recommended award of the Contract.

Submit three copies of a proposed final detailed Schedule of Values within twenty (20) days after receipt of Notice to Proceed as per the General Conditions.

Submit the Schedule of Values, typed, on EJCDC 1910-8-E form or Orange County forms or spreadsheets provided by Project Manager. The Contractor's standard form or electronic media printout will be considered for acceptability by the County.

List installed value of each major item of work and each subcontracted item of work as a separate line item to serve as a basis for computing values for Progress Payments. Round off values to nearest dollar.

Coordinate listings with the Progress Schedule.

For items on which payments will be requested for stored materials or equipment, list sub-values for cost of stored products with taxes paid.

The sum of values listed shall equal the total Contract Amount for the Work or the Contract Amount for a part of the Work with a separate Contract Amount provided for by the Contract Documents.

When the Project Manager requires substantiating information, submit data justifying line item amounts in question.

1.04 PRELIMINARY SCHEDULE OF VALUES. The preliminary schedule of values listing shall include, at a minimum, the proposed value for the following major work;

Mobilization, General Requirements and Demobilization as per the specified percentage of Contract Amount.

The total value of access road construction inclusive of clearing and grubbing, stripping, excavation, fill construction, paving, road removal, site restoration, and all incidental work associated with access roads. This total value shall be broken down into separate values for each access road.

The total value of pipeline construction work inclusive of fabrication, excavation, pipe installation, pipe structures (air-release valves, blowoff valves, and vents), backfilling, testing, site restoration, and all incidental work associated with pipeline construction. The total value shall be broken down into separate values for each pipeline section.

The total value of reinforced concrete and building construction work by structure and building inclusive of all excavation, dewatering, subgrade preparation, backfill, and incidental work for all new structures. Additionally, this total value shall be broken down into separate values for each new structure constructed as a part of the work. Miscellaneous and minor concrete work may be listed as one item in this breakdown.

The total value of all mechanical work (HVAC and plumbing), including piping, valves, and equipment.

The total value of process piping, valves, and mechanical equipment (such as pumps).

The total value of electrical work.

The total value of instrumentation and control work including fiber-optic cable system.

The total value of all other work not specifically included in the above items.

The Contractor and County Project Manager shall meet and jointly review the preliminary schedule of values and make any adjustments in value allocations if, in the opinion of the Project Manager, these are necessary to establish fair and reasonable allocation of values for the major work components. Front-end loading will not be permitted. The Project Manager may require reallocation of major work components from items in the above listing if, in the opinion of the Project Manager, such reallocation is necessary. This review and any necessary revisions shall be completed within 15 days from the date of the notification of the required reallocation.

1.05 DETAILED SCHEDULE OF VALUES Base the detailed schedule of values on the accepted preliminary schedule of values for major work components. The detailed schedule of values shall provide sufficient detailed breakdown to allow it to be used to determine appropriate monthly progress payment amounts. The County shall be the sole judge of acceptable numbers, details, and description of values established. If, in the opinion of the County, a greater number of schedule of values items than proposed by the Contractor is necessary, the Contractor shall add the additional items so identified by the County as a condition to processing the payment requests.

The minimum detail of breakdown of the major work components is indicated below.

Mobilization/General Requirements/Demobilization. Mobilization/General Requirement/Demobilization costs on the Schedule of Values shall not exceed 5% of the Contract Amount. All Work included in the Schedule of Value that falls under this heading

as described in this paragraph (including such Work by Subcontractors) will be added and checked for compliance with the 5% limitation. Any actual cost in excess of this amount shall be distributed proportionately to Schedule of Values items for direct Work items not covered by this heading. Work under this heading may be detailed on Schedule of Value line items identifying each as to whether it is mobilization or initial costs, maintenance or overhead cost or finalization or demobilization cost. The subdivision of this Work into Schedule of Values line items shall be done to support the payment process that shall be distributed as follows: 50% for the first progress payment, 10% for the final payment following demobilization and restoration, and 40% spread evenly over payments made in between.

Access road and site construction shall be broken down by clearing and grubbing, stripping, excavation, full construction, erosion control, paving, paving removal, site restoration, and any other items determined to be necessary for the establishment of pay and schedule activity items.

Pipeline construction work shall be broken down separately by pipeline segment, which shall not exceed 500-foot-long sections of the pipeline. Each pipeline segment shall be broken down into excavation, pipe fabrication (by wall thickness), pipe installation, pipe structures (air-release valves, blowoff valves, and vents), backfilling, testing, site restoration, and any other items determined to be necessary for the establishment of pay and schedule activity items.

Concrete structures and buildings shall be broken down by structure into excavation, subgrade preparation, and appurtenant prefoundation work; concrete foundation construction; slabs on grade; walls/columns; roof structures and roofing, doors and windows, lifting and other equipment; interior and exterior finishes; miscellaneous metalwork; and backfill.

Mechanical (HVAC and plumbing) Work shall be broken down by building and to identify individual piping and ductwork and equipment installation and equipment testing.

Process piping, valves, and equipment Work shall be broken down by structure into individual piping systems, equipment installation by equipment (including valves, actuators, etc.), name and number, and equipment testing and checkout.

Electrical Work shall be broken down by structure into conduit and raceway installation, cable and wire installation, electrical equipment installation, terminations, and lighting. Yard facilities shall be broken down by duct bank designation and substations.

Instrumentation and control Work shall be broken down by structure and by pull boxes, duct, fiber-optic cable, and installation and testing.

Equipment testing and start-up broken down by process and building.

Other work not specifically included in the above items shall be broken down as necessary for establishment of pay and schedule activity items.

The Contractor and County shall meet and jointly review the detailed schedule of values within 40 days from the date of Notice to Proceed. The value allocations and extent of detail shall be reviewed to determine any necessary adjustments. The Contractor shall make any adjustments deemed necessary to the value allocation or level of detail, and submit a revised detailed schedule of values within 10 days from the date of the review meeting.

End of Section

Section 01380

CONSTRUCTION PHOTOGRAPHS AND VIDEO

PART 1 - GENERAL

1.01 SUMMARY:

A. Section Includes:

1. Providing construction photographs and video pertinent to the Contract work during the Contract period as specified.
2. Non-applicable subsections with N/A designation.

1.02 SYSTEM DESCRIPTION

A. Design Requirements: N/A

B. Performance Requirements:

1. Photographer proposed is to be approved by Owner.
2. Photographer's experience and qualifications:
 - a. Not less than 3 accumulated years of experience with similar construction photography obtained over the last 3 years.
3. Photographer to use techniques, material and equipment capable of producing photographs of at least 4 mega pixel resolution.
4. Photographer to be available on call on one day notice when requested by Owner and be prepared to respond on shorter notice in unusual or unexpected conditions.
5. Dates for photography at site to be coordinated with the Owner and the Owner's representative to be present during photographic periods at site unless approved otherwise by Owner.
6. Photographer to make and retain detailed records of all photographs:
 - a. The records to be in sufficient detail to support any attestation that may be required of photographer.
 - b. Photographer to retain such records for a period not less than two years from the final acceptance of entire work under this Contract.

1.03 SUBMITTALS

A. Product Data:

1. Submit to the County two 4-in. x 5-in. prints of each view, and electronic images on CD-ROM. Twenty four photographs of the entire site, or pertinent features thereof, shall be taken before commencement of work and promptly submitted to the Engineer. The same views shall be photographed upon completion of all construction activities and submitted with Contractor's application for final payment. Twenty four additional photographs shall be made each month throughout the progress of the work at such time as requested by the Engineer and submitted with Contractor's application for progress payment.
 - a. Photographs shall be taken from a least a 4 mega pixel camera, image files shall be in a .tiff format, and stored on a CD-ROM and provided to Orange County.
 - (1) Mark each CD-ROM with name and number of Contract, name of Contractor and date photographed.
2. CONTRACTOR shall provide OWNER with a video record of the existing conditions prior to construction. This video shall contain audio and shall be a standard DVD disk in standard mpeg 2 format. Audio portion shall describe the location of the video footage. The following features shall be shown in a clear manner, but not limited to the following:
 - a. All existing features and improvements within the plant site.
 - b. All existing features and improvements within the right-of-way.
 - c. All existing features and improvements within temporary construction easements.
 - d. All existing features and improvements within permanent easements.
 - e. All existing features and improvements adjacent to any construction.
3. Detail of the video shall be such that the following features and improvements shall be clear and visible:
 - a. Condition of buildings and cracks in walls.
 - b. Condition of fencing.
 - c. Condition of planted areas and types of vegetation.
 - d. Condition of sodded areas.
 - e. Conditions of sprinkler systems and associated controls and wiring.
 - f. Condition of paved areas.
 - g. Condition of signs.

- g. Conditions of lighting and associated wiring.
- 4. Sufficient detail of any preexisting damages to physical features and improvements shall be shown. The coverage of the video should include the limits of effects of the use of vibratory rollers. This video record shall be presented to the County within thirty (30) days of the Commencement Date specified in the Notice to Proceed.

B. Quality Control Submittals:

- 1. Prints: Submit as two copies of each print, each identified and mounted as specified.

PART 2 - PRODUCTS

2.01 MATERIALS:

A. Prints:

- 1. Type: Color prints.
- 2. Finish: Smooth glossy surface.
- 3. Size: 4-in. x 5-in. plus suitable margin for identification.
- 4. Paper weight: Not less than 194 gsm.
- 5. Number of prints: Two of each photograph.

B. Print Identification:

- 1. Each print to carry identification and information on it in a manner that results in minimum interference with exposure printed.
- 2. Front of Print:
 - a. Top margin:
 - (1) Project name, station name and location.
 - (2) Brief title of view.
 - b. Bottom margin:
 - (1) Photographer's numbered identification of exposure.
 - (2) Time and date of exposure.

(3) Name of photographer making exposure.

3. Back of Print:

- a. Detailed description of view including point from which exposure made, compass direction of view, vertical declination of view (horizontal, looking up, looking down etc.) identification of main features in view and any other data and information pertinent to the purpose and identification of the exposure photographer feels necessary to include.
- b. Weather conditions under which exposure made.

C. Print Mounting:

1. Each print to be inserted in a clear plastic envelope designed for the purpose.
 - a. Print deterioration not to be caused by envelope material or fabrication.
 - b. Designed to prevent print from accidentally slipping out of envelope.
 - c. Front and back of print to be visible through the plastic envelope.
 - d. Permit convenient removal and insertion of print.
 - e. To have 1 inch hinged binding edge suitable for binder specified under subsection D below.

D. Print Filing Binder:

1. Furnish binders for filing specified under subsection PRINT MOUNTING.
 - a. Furnish separate binders for each pumping station.
 - b. All binders to be alike.
2. Binders:
 - a. For filing of prints.
 - b. Provisions for labeling front cover and binding face.
 - c. Have back and front cover hinges.
 - d. Permit removal and insertion of mounted prints.

PART 3 - EXECUTION

3.01 APPLICATION:

A. Special Techniques:

1. General:

- a. Contractor to notify Owner at least 5 days in advance of any photographic sessions.
- b. All views to contain a relative dimension reference that is recognizable. In views where dimensions are critical use a recognizable measuring devices such as folding ruler, measuring tape in a manner the markings are clear and sharp in the photograph and the device located in close relationship with subject of photograph.

2. Site photography required:

- a. Provide photographs at following stages of construction:
 - (1) Site before commencement of any construction at the facility.
 - (2) At 1-month intervals, progress photography during construction of facilities. Photos of any month need show only new work performed during month.
 - (3) Upon completion of all Contract work, overall site photography.
 - (4) Consult with Engineer for instructions concerning views required at each specified visit to site.
 - (5) Photograph from locations to adequately illustrate state of project, or condition of construction.
 - (6) Take photographs from as close to the same position each time as practical.
 - (7) In addition, provide photographs prior to, at critical stages of, and at the end of construction, when they do not coincide with scheduled times.

End of Section

QUALITY CONTROL

1. TESTING SERVICES. All tests to determine compliance with the Contract Documents shall be performed by an independent commercial testing firm acceptable to Engineer. The testing firm's laboratory shall be staffed with experienced technicians, properly equipped and fully qualified to perform the tests in accordance with the specified standards.

Testing services provided by Owner are for the sole benefit of Owner; however, test results shall be available to Contractor. Testing necessary to satisfy Contractor's internal quality control procedures shall be the sole responsibility of Contractor.

1.01. Testing Services Provided by Contractor. Unless otherwise specified, Contractor shall provide all testing services in connection with the following:

Concrete materials and trial batch mixtures.

Masonry units and masonry grout and mortar materials and design mixtures.

Asphaltic concrete materials and design mixtures.

Embedment, fill, and backfill materials.

All other tests and engineering data required for Engineer's review of materials and equipment proposed to be used in the Work.

Contractor shall obtain Engineer's acceptance of the testing firm before having services performed, and shall pay all costs for these testing services.

1.02. Testing Services and Special Inspections Provided by Owner. Unless otherwise specified, Owner shall provide for tests made on the following materials and equipment:

Concrete.

Tests of masonry prisms.

Field control test of masonry.

Moisture-density (Proctor) tests and relative density tests on embedment, fill, and backfill materials.

In-place field density tests on embedments, fills, and backfill.

Other materials and equipment at the discretion of Owner.

Testing, including sampling, will be performed by Engineer or the testing firm's laboratory personnel, in the general manner indicated in the Specifications. Engineer shall determine the exact time, location, and number of tests, including samples.

Arrangements for delivery of samples and test specimens to the testing firm's laboratory will be made by Owner. The testing firm's laboratory shall perform all laboratory tests within a reasonable time consistent with the specified standards and shall furnish a written report of each test.

Contractor shall furnish all sample materials and cooperate in the testing activities, including sampling. Contractor shall interrupt the Work when necessary to allow testing, including sampling, to be performed. Contractor shall have no Claim for an increase in Contract Price or Contract Times due to such interruption. When testing activities, including sampling, are performed in the field by Engineer or laboratory personnel, Contractor shall furnish personnel and facilities to assist in the activities.

1.03. Transmittal of Test Reports. Written reports of tests and engineering data furnished by Contractor for Engineer's review of materials and equipment proposed to be used in the Work shall be submitted as specified for Shop Drawings.

The laboratory retained by Owner will furnish four copies of a written report of each test. Two copies of each test report will be transmitted to the Resident Project Representative, one copy to Engineer, and one copy to Contractor, within 3 days after each test is completed.

2. OFFSITE INSPECTION. Inspection of materials or equipment during the production, manufacturing, or fabricating process, or before shipment, will be performed by Engineer or an independent testing firm or inspection organization acceptable to Engineer as specified in the materials and equipment sections.

Except as otherwise specified in the materials or equipment sections, Contractor shall give appropriate written notice to Engineer not less than 10 days before offsite inspection services are required, and shall provide for the producer, manufacturer, or fabricator to furnish safe access and proper facilities and to cooperate with inspecting personnel in the performance of their duties.

The inspection organization will submit a written report to Engineer, with a copy to Contractor, at least once each week.

3. MANUFACTURER'S FIELD SERVICES. Manufacturer's field services shall be as specified herein except as specifically specified in the respective equipment sections.

3.01. Services Furnished Under This Contract. An experienced, competent, and authorized representative of the manufacturer of each item of equipment for which field services are indicated in the respective equipment section or in the equipment schedule section shall visit the Site of the Work and inspect, check, adjust if necessary, and approve the equipment installation. In each case, the manufacturer's representative shall be present when the equipment is placed in operation. The manufacturer's representative shall revisit the jobsite as often as necessary until

all trouble is corrected and the equipment installation and operation are satisfactory in the opinion of Engineer.

Each manufacturer's representative shall furnish to Owner, through Engineer, a written report certifying that the equipment has been properly installed and lubricated; is in accurate alignment; is free from any undue stress imposed by connecting piping or anchor bolts; and has been operated under full load conditions and that it operated satisfactorily.

All costs for these services shall be included in the Contract Price.

End of Section

TEMPORARY FACILITIES

1. UNITS OF MEASUREMENT. When both inch-pound (English) and SI (metric) units of measurement are specified herein, the values expressed in inch-pound units shall govern.

2. OFFICES AT SITE OF WORK. During the performance of this Contract, Contractor shall maintain a suitable office at the project site, which shall be the headquarters of its representative authorized to receive drawings, instructions, or other communication or articles. Any communication given to the said representative or delivered at Contractor's office at the Site in the representative's absence shall be deemed to have been delivered to Contractor.

Copies of the Drawings, Specifications, and other Contract Documents shall be kept at Contractor's office at the Site and available for use at all times.

3. WATER. All water required for and in connection with the Work to be performed will be furnished by County in the vicinity of the site without charge to Contractor, provided:

A. Contractor shall procure such water in the location and in the manner designated by County.

B. Contractor at its own expense shall make authorized connections and provide means for delivering the water to the worksite.

C. Contractor shall provide adequately against waste and needless use of water.

4. POWER. Contractor shall provide all power for heating, lighting, operation of Contractor's plant or equipment, or for any other use by Contractor. Temporary heat and lighting shall be maintained until the Work is accepted.

5. TELEPHONE SERVICE. Not used.

6. SANITARY FACILITIES. Contractor shall furnish temporary sanitary facilities at the Site, as provided herein, for the needs of all construction workers and others performing work or furnishing services on the Project.

Sanitary facilities shall be of reasonable capacity, properly maintained throughout the construction period, and obscured from public view to the greatest practical extent. If toilets of the chemically treated type are used, at least one toilet will be furnished for each 20 persons. Contractor shall enforce the use of such sanitary facilities by all personnel at the Site.

7. CONSTRUCTION AIDS. Contractor shall furnish, install, maintain, and operate all construction aids required by it and its Subcontractors in the performance of the Work, except as otherwise provided herein.

The use of any plant equipment, whether furnished and installed under this Contract or not, including elevators, shop cranes, heating, ventilating, air conditioning, and plumbing fixtures, shall be only with County's written permission.

8. MAINTENANCE OF TRAFFIC. Contractor shall conduct its work to interfere as little as possible with public travel, whether vehicular or pedestrian. Whenever it is necessary to cross, obstruct, or close roads, driveways, and walks, whether public or private, Contractor shall provide and maintain suitable and safe bridges, detours, or other temporary expedients for the accommodation of public and private travel, and shall give reasonable notice to owners of private drives before interfering with them. Such maintenance of traffic will not be required when Contractor has obtained permission from the owner and tenant of private property, or from the authority having jurisdiction over public property involved, to obstruct traffic at the designated point.

Maintenance of traffic plans, if required by the regulatory agency having jurisdiction, shall be prepared by the Contractor and submitted as required by the agency for approval. The Contractor shall be responsible for providing the maintenance of traffic provisions in accordance with the approved plans.

9. FENCES. All existing fences affected by the Work shall be maintained by Contractor until completion of the Work. Fences which interfere with construction operations shall not be relocated or dismantled until written permission is obtained from the owner of the fence, and the period the fence may be left relocated or dismantled has been agreed upon. Where fences must be maintained across the construction easement, adequate gates shall be installed. Gates shall be kept closed and locked at all times when not in use.

On completion of the Work across any tract of land, Contractor shall restore all fences to their original or to a better condition and to their original locations.

10. DAMAGE TO EXISTING PROPERTY. Contractor will be held responsible for any damage to existing structures, Work, materials, or equipment because of his operations and shall repair or replace any damaged structures, Work, materials, or equipment to the satisfaction of, and at no additional cost to, County.

Contractor shall protect all existing structures and property from damage and shall provide bracing, shoring, or other work necessary for such protection.

Contractor shall be responsible for all damage to streets, roads, curbs, sidewalks, highways, shoulders, ditches, embankments, culverts, bridges, or other public or private property, which may be caused by transporting equipment, materials, or workers to or from the Work. Contractor shall make satisfactory and acceptable arrangements with the agency having jurisdiction over the damaged property concerning its repair or replacement.

11. TREE AND PLANT PROTECTION. All trees and other vegetation which must be removed to perform the Work shall be removed and disposed of by Contractor; however, no trees or cultured plants shall be unnecessarily removed unless their removal is indicated on the Drawings. All trees and plants not removed shall be protected against injury from construction operations.

12. SECURITY. Contractor shall be responsible for protection of the Site, and all Work, materials, equipment, and existing facilities thereon, against vandals and other unauthorized persons.

No Claim shall be made against County by reason of any act of an employee or trespasser, and Contractor shall make good all damage to County's property resulting from Contractor's failure to provide security measures as specified.

All personnel, employees and or subcontractors and suppliers that pass through the gates shall wear picture identification badges. All personnel passing through the gates shall be subject to background checks to identify any historical crimes dealing with terrorism, sabotage, or other government related illegal activities. Background checks shall be provided by the Contractor. The background checks shall include running fingerprints through FDLE to determine nationwide arrest history.

All deliveries entering the fence shall be escorted by Contractor for the duration of the time on site.

13. LOCATION OF STORAGE AREAS. Areas where the Contractor may store materials used in his operations shall be approved by the County.

Offsite storage arrangements, if allowed, require pre-approval by County for all materials and equipment not incorporated into the Work but included in Applications for Payment. Such offsite storage arrangements shall be presented in writing and shall afford security and protection that is satisfactory to the COUNTY. Offsite storage facilities shall be accessible to COUNTY and ENGINEER.

14. ACCESS ROADS. Contractor shall establish and maintain temporary access roads to various parts of the Site as required to complete the Project. Such roads shall be available for the use of all others performing work or furnishing services in connection with the Project.

15. PARKING. Contractor shall provide and maintain suitable parking areas for the use of all workers and others performing work or furnishing services in connection with the Project, as required to avoid any need for parking personal vehicles where they may interfere with public traffic, County's operations, or construction activities.

16. NOISE CONTROL. Contractor shall take reasonable measures to avoid unnecessary noise. Such measures shall be appropriate for the normal ambient sound levels in the area during working hours. All construction machinery and vehicles shall be equipped with practical sound-muffling devices, and operated in a manner to cause the least noise consistent with efficient performance of the Work.

During construction activities on or adjacent to occupied buildings, and when appropriate, Contractor shall erect screens or barriers effective in reducing noise in the building and shall conduct its operations to avoid unnecessary noise which might interfere with the activities of building occupants.

17. DUST CONTROL. Contractor shall take reasonable measures to prevent unnecessary dust. Earth surfaces subject to dusting shall be kept moist with water or by application of a chemical dust suppressant. Dusty materials in piles or in transit shall be covered to prevent blowing dust.

Buildings or operating facilities which may be affected adversely by dust shall be adequately protected from dust. Existing or new machinery, motors, instrument panels, or similar equipment shall be protected by suitable dust screens. Proper ventilation shall be included with dust screens.

18. TEMPORARY DRAINAGE PROVISIONS. Contractor shall provide for the drainage of storm water and such water as may be applied or discharged on the Site in performance of the Work. Drainage facilities shall be adequate to prevent damage to the Work, the Site, and adjacent property.

Existing drainage channels and conduits shall be cleaned, enlarged, or supplemented as necessary to carry all increased runoff attributable to Contractor's operations. Dikes shall be constructed as necessary to divert increased runoff from entering adjacent property (except in natural channels), to protect County's facilities and the Work, and to direct water to drainage channels or conduits. Ponding shall be provided as necessary to prevent downstream flooding.

19. EROSION CONTROL. Contractor shall prevent erosion of soil on the Site and adjacent property resulting from its construction activities. Effective measures shall be initiated prior to the commencement of clearing, grading, excavation, or other operation that will disturb the natural protection.

Work shall be scheduled to expose areas subject to erosion for the shortest possible time, and natural vegetation shall be preserved to the greatest extent practicable. Temporary storage and construction buildings shall be located, and construction traffic routed, to minimize erosion. Temporary fast-growing vegetation or other suitable ground cover shall be provided as necessary to control runoff.

20. POLLUTION CONTROL. Contractor shall prevent the pollution of drains and watercourses by sanitary wastes, sediment, debris, and other substances resulting from construction activities. No sanitary wastes shall be permitted to enter any drain or watercourse other than sanitary sewers. No sediment, debris, or other substance shall be permitted to enter sanitary sewers, and reasonable measures shall be taken to prevent such materials from entering any drain or watercourse.

21. PROJECT CONSTRUCTION SIGN. Contractor shall provide two (2) project construction signs as described herein and as shown in the figure included at the end of this section. Signs shall be 4' high x 8' wide x 3/4" MDO plywood. Signs shall be painted dark blue on both sides. Front face shall be trimmed with 1" orange border and shall have two horizontal 3/4" white lines dividing the face into three sections. The upper section shall include the Orange County logo in orange, green, and dark blue, and the project name in white. The middle section shall include the names of the County Commissioners, the County Administrator, and the Utility Director. The lower section shown shall include the name and logo of the engineer and name and logo of the Contractor. Signs shall have 2"x4" wood stops on the top and bottom of both sides and shall be painted white. Signs shall be mounted on 4"x4" pressure treated wood posts, painted white, with the bottom of the sign 4' above grade. Posts shall be embedded a minimum of 4 ft. The sign shall be installed within 30 days following the Notice to Proceed and shall be maintained in good condition during the course of the work.

End of Section



Meadow Woods Water Supply Facility Modifications

BOARD OF COUNTY COMMISSIONERS

AJIT LALCHANDANI, P.E.
County Administrator

TERESA JACOBS
Mayor

RAYMOND E. HANSON, P.E.
Director, Utilities Department

S. SCOTT BOYD
District 1

FRED BRUMMER
District 2

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District 6



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GENERAL EQUIPMENT STIPULATIONS

1. SCOPE. When an equipment specification section in this Contract references this section, the equipment shall conform to the general stipulations set forth in this section, except as otherwise specified in other sections.
2. COORDINATION. Contractor shall coordinate all details of the equipment with other related parts of the Work, including verification that all structures, piping, wiring, and equipment components are compatible. Contractor shall be responsible for all structural and other alterations in the Work required to accommodate equipment differing in dimensions or other characteristics from that contemplated in the Drawings or Specifications.
3. MANUFACTURER'S EXPERIENCE. Unless specifically named in the Specifications, a manufacturer shall have furnished equipment of the type and size specified which has been in successful operation for not less than the past 5 years.
4. WORKMANSHIP AND MATERIALS. Contractor shall guarantee all equipment against faulty or inadequate design, improper assembly or erection, defective workmanship or materials, and leakage, breakage, or other failure. Materials shall be suitable for service conditions.

All equipment shall be designed, fabricated, and assembled in accordance with recognized and acceptable engineering and shop practice. Individual parts shall be manufactured to standard sizes and thicknesses so that repair parts, furnished at any time, can be installed in the field. Like parts of duplicate units shall be interchangeable. Equipment shall not have been in service at any time prior to delivery, except as required by tests.

Except where otherwise specified, structural and miscellaneous fabricated steel used in equipment shall conform to AISC standards. All structural members shall be designed for shock or vibratory loads. Unless otherwise specified, all steel which will be submerged, all or in part, during normal operation of the equipment shall be at least 1/4 inch [6.3 mm] thick. When dissimilar metal components are used, consideration shall be given to prevention of galvanic corrosion.

5. STRUCTURAL DESIGN REQUIREMENTS. All equipment, and other non-structural components and non-building structures as defined in ASCE 7, and their anchorage, shall be designed and detailed in accordance with the Meteorological and Seismic Design Criteria section. Submittals for equipment and other non-structural components and non-building structures shall include a seal by a professional engineer registered in the state of the project, to confirm that the anchorage design meets the code requirements. Conformance to the building code of the Contractor designed pipe support systems, shall be certified by a professional engineer registered in the state of the project.

6. LUBRICATION. Equipment shall be adequately lubricated by systems which require attention no more frequently than weekly during continuous operation. Lubrication systems shall not require attention during startup or shutdown and shall not waste lubricants.

Lubricants of the types recommended by the equipment manufacturer shall be provided in sufficient quantities to fill all lubricant reservoirs and to replace all consumption during testing, startup, and operation prior to acceptance of equipment by Owner. Lubricants for equipment where the lubricants may come in contact with water before or during a potable water treatment process or with potable water, shall be food grade lubricants. This includes lubricants for equipment not normally in contact with water, but where accidental leakage of the lubricants may contaminate the water.

Lubrication facilities shall be convenient and accessible. Oil drains and fill openings shall be easily accessible from the normal operating area or platform. Drains shall allow for convenient collection of waste oil in containers from the normal operating area or platform without removing the unit from its normal installed position.

7. ELEVATION. The elevation of the site shall be as indicated in the Meteorological and Seismic Design Criteria section. All equipment furnished shall be designed to meet stipulated conditions and to operate satisfactorily at the specified elevation.

8. ELECTRIC MOTORS. Unless otherwise specified, motors furnished with equipment shall meet the requirements specified in Common Motor Requirements for Process Equipment section or specified in specific equipment sections.

9. DRIVE UNITS. The nominal input horsepower [kW] rating of each gear or speed reducer shall be at least equal to the nameplate horsepower [kW] of the drive motor. Drive units shall be designed for 24 hour continuous service.

9.01. Gearmotors. The use of gearmotors sharing an integral housing or cutgears into the motor output shaft, or that require removal of lubricant from the gear reducer to change out the motor will not be acceptable.

9.02. Gear Reducers. Each gear reducer shall be a totally enclosed unit with oil or grease lubricated, rolling element, antifriction bearings throughout.

Unless superseded by individual specification requirements each helical, spiral bevel, combination bevel-helical, and worm gear reducers shall have a service factor of at least 1.50 based on the nameplate horsepower [kilowatts] of the drive motor. Cycloidal gear reducers shall have a service factor of at least 2.0 based on the nameplate horsepower [kW] of the drive motor. Shaft-mounted and flange-mounted gear reducers shall be rated AGMA Class III. Helical gear reducers shall have a gear strength rating to catalog rating of 1.5. Each gear reducer shall be designed and manufactured in compliance with applicable most current AGMA standards, except the L₁₀ bearing life shall be 200, 000 hours.

The thermal horsepower [kW] rating of each unit shall equal or exceed the nameplate horsepower [kW] of the drive motor. During continuous operation, the maximum sump oil temperature shall not rise more than 100°F [38°C] above the ambient air temperature in the vicinity of the unit and shall not exceed 200°F [93°C].

Each grease lubricated bearing shall be installed in a bearing housing designed to facilitate periodic regreasing of the bearing by means of a manually operated grease gun. Each bearing housing shall be designed to evenly distribute new grease, to properly dispose of old grease, and

to prevent overgreasing of the bearing. The use of permanently sealed, grease lubricated bearings will not be acceptable in large sized reducers. In small reducers, similar to basin equipment, permanently sealed grease lubricated bearings rated L₁₀ 200,000 hour life may be provided at the manufacturer's option. An internal or external oil pump and appurtenances shall be provided if required to properly lubricate oil lubricated bearings. A dipstick or a sight glass arranged to permit visual inspection of lubricant level shall be provided on each unit.

Gear reducers which require the removal of parts or the periodic disassembly of the unit for cleaning and manual regreasing of bearings will not be acceptable.

Certification shall be furnished by the gear reducer manufacturer indicating that the intended application of each unit has been reviewed in detail by the manufacturer and that the unit provided is fully compatible with the conditions of installation and service.

9.03. Adjustable Speed Drives. Each mechanical adjustable speed drive shall have a service factor of at least 1.75 at maximum speed based on the nameplate horsepower [kilowatts] of the drive motor. A spare belt shall be provided with each adjustable speed drive unit employing a belt for speed change. Unless specifically permitted by the detailed equipment specifications, bracket type mounting will not be acceptable for variable speed drives.

9.04. V-Belt Drives. Each V-belt drive shall include a sliding base or other suitable tension adjustment. V-belt drives shall have a service factor of at least 1.75 at maximum speed based on the nameplate horsepower [kilowatts] of the drive motor.

10. SAFETY GUARDS. All belt or chain drives, fan blades, couplings, and other moving or rotating parts shall be covered on all sides by a safety guard. Safety guards shall be fabricated from 16 USS gage [1.52 mm] thick or thicker galvanized, aluminum-clad sheet steel, or stainless sheet steel or from 1/2 inch [12.7 mm] mesh galvanized expanded metal, or pultrusion molded UV resistant materials. Each safety guard shall be reinforced or shaped to provide suitable strength to prevent vibration and deflection and shall comply with OSHA. Each guard shall be designed for easy installation and removal. All necessary supports and accessories shall be provided for each guard. Supports and accessories, including bolts, shall be galvanized. All safety guards in outdoor locations shall be designed to prevent the entrance of rain and dripping water.

11. ANCHOR BOLTS. Equipment suppliers shall furnish suitable anchor bolts for each item of equipment. Anchor bolts, together with templates or setting drawings, shall be delivered sufficiently early to permit setting the anchor bolts when the structural concrete is placed. Anchor bolt materials shall comply with the Anchorage in Concrete and Masonry section, and sleeves shall be provided as indicated on the drawings. Unless otherwise specified, anchor bolts shall be at least 3/4 inch [19 mm] in diameter.

Unless otherwise indicated or specified, anchor bolts for items of equipment mounted on baseplates shall be long enough to permit 1-1/2 inches [38 mm] of grout beneath the baseplate and to provide adequate anchorage into structural concrete.

12. EQUIPMENT BASES. Unless otherwise indicated or specified, all equipment shall be installed on concrete bases at least 6 inches [150 mm] high. Cast iron or welded steel baseplates shall be provided for pumps, compressors, and other equipment. Each unit and its drive

assembly shall be supported on a single baseplate of neat design. Baseplates shall have pads for anchoring all components, and adequate grout holes. Baseplates for pumps shall have a means for collecting leakage and a threaded drain connection. Baseplates shall be anchored to the concrete base with suitable anchor bolts and the space beneath filled with grout as specified in the Grouting section.

13. SPECIAL TOOLS AND ACCESSORIES. Equipment requiring periodic repair and adjustment shall be furnished complete with all special tools, instruments, and accessories required for proper maintenance. Equipment requiring special devices for lifting or handling shall be furnished complete with those devices.

14. SHOP PAINTING. All iron and steel surfaces of the equipment shall be protected with suitable protective coatings applied in the shop. Surfaces of the equipment that will be inaccessible after assembly shall be protected for the life of the equipment. Coatings shall be suitable for the environment where the equipment is installed. Exposed surfaces shall be finished, thoroughly cleaned, and filled as necessary to provide a smooth, uniform base for painting. Electric motors, speed reducers, starters, and other self-contained or enclosed components shall be shop primed or finished with an epoxy or polyurethane enamel or universal type primer suitable for top coating in the field with a universal primer and aliphatic polyurethane system.

Surfaces to be coated after installation shall be prepared for painting as recommended by the paint manufacturer for the intended service, and then shop painted with one or more coats of a universal primer.

Machined, polished, and nonferrous surfaces which are not to be painted shall be coated with rust-preventive compound as recommended by the equipment manufacturer.

15. PREPARATION FOR SHIPMENT. Equipment shall be prepared for shipment as specified in the Product Delivery Requirements section.

16. STORAGE. Handling and storage of equipment shall be as specified in the Product Storage and Handling Requirements section.

17. INSTALLATION AND OPERATION. Installation and operation shall be as specified in respective equipment sections and the Startup Requirements section.

18. OBSERVATION OF PERFORMANCE TESTS. Where the Specifications require the presence of Engineer, initial tests shall be observed or witnessed by Engineer. Owner shall be reimbursed by Contractor for all costs of subsequent visits by Engineer to witness or observe incomplete tests, retesting, or subsequent tests.

19. PROGRAMMING SOFTWARE. Programming software shall be provided for any equipment which includes a programmable logic controller (PLC) or other digital controller that is user-programmable. The software shall be suitable for loading and running on a laptop personal computer operating with a Windows-based operating system. A copy of the manufacturer's original operating logic program shall be provided for use in maintaining and troubleshooting the equipment. Where multiple pieces of equipment, from the same or different vendors, use the same programming software, only one copy of the software need be provided.

End of Section

Section 01612

PRODUCT DELIVERY REQUIREMENTS

1. SCOPE. This section covers packaging and shipping of materials and equipment.
2. PREPARATION FOR SHIPMENT. All equipment shall be suitably packaged to facilitate handling and to protect against damage during transit and storage. All equipment shall be boxed, crated, or otherwise completely enclosed and protected during shipment, handling, and storage. All equipment shall be protected from exposure to the elements and shall be kept dry at all times.

Painted and coated surfaces shall be protected against impact, abrasion, discoloration, and other damage. Painted and coated surfaces which are damaged prior to acceptance of equipment shall be repainted to the satisfaction of Engineer.

Grease and lubricating oil shall be applied to all bearings and similar items.

3. SHIPPING. Before shipping each item of equipment shall be tagged or marked as identified in the delivery schedule or on the Shop Drawings. Complete packing lists and bills of material shall be included with each shipment.

End of Section

PRODUCT STORAGE AND HANDLING REQUIREMENTS

1. SCOPE. This section covers delivery, storage, and handling of materials and equipment.
2. DELIVERY. Contractor shall bear the responsibility for delivery of equipment, spare parts, special tools, and materials to the site and shall comply with the requirements specified herein and shall provide required information concerning the shipment and delivery of the materials specified in this Contract. These requirements also apply to any subsuppliers making direct shipments to the Site.

Contractor shall, either directly or through contractual arrangements with others, accept responsibility for the safe handling and protection of the equipment and materials furnished under this Contract before and after receipt at the port of entry. Acceptance of the equipment shall be made after it is installed, tested, placed in operation and found to comply with all the specified requirements.

All items shall be checked against packing lists immediately on delivery to the site for damage and for shortages. Damage and shortages shall be remedied with the minimum of delay.

Delivery of portions of the equipment in several individual shipments shall be subject to review of Engineer before shipment. When permitted, all such partial shipments shall be plainly marked to identify, to permit easy accumulation, and to facilitate eventual installation.

3. STORAGE. Upon delivery, all equipment and materials shall immediately be stored and protected until installed in the Work.

Stacked items shall be suitably protected from damage by spacers or load distributing supports that are safely arranged. No metalwork (miscellaneous steel shapes and reinforcing steel) shall be stored directly on the ground. Masonry products shall be handled and stored in a manner to hold breakage, chipping, cracking, and spalling to a minimum. Cement, lime, and similar products shall be stored off the ground on pallets and shall be covered and kept completely dry at all times. Pipe, fittings, and valves may be stored out of doors, but must be placed on wooden blocking. PVC pipe, geomembranes, plastic liner, and other plastic materials shall be stored off the ground on pallets and protected from direct sunlight.

Pumps, motors, electrical equipment, and all equipment with antifriction or sleeve bearings shall be stored in weathertight structures maintained at a temperature above 60°F [16°C]. Electrical equipment, controls, and insulation shall be protected against moisture and water damage. All space heaters furnished in equipment shall be connected and operated continuously.

Equipment having moving parts, such as gears, bearings, and seals, shall be stored fully lubricated with oil, grease, etc., unless otherwise instructed by the manufacturer. Manufacturer's storage instructions shall be carefully followed by Contractor.

When required by the equipment manufacturer, moving parts shall be rotated a minimum of twice a month to ensure proper lubrication and to avoid metal to metal "welding". Upon installation of the equipment, Contractor shall, at the discretion of Engineer, start the equipment

at one-half load for an adequate period of time to ensure that the equipment does not deteriorate from lack of use.

When required by the equipment manufacturer, lubricants shall be changed upon completion of installation and as frequently as required thereafter during the period between installation and acceptance. New lubricants shall be put into the equipment by Contractor at the time of acceptance.

Equipment and materials shall not show any pitting, rust, decay, or other deleterious effects of storage when installed in the Work.

In addition to the protection specified for prolonged storage, the packaging of spare units and spare parts shall be for export packing and shall be suitable for long-term storage in a damp location. Each spare item shall be packed separately and shall be completely identified on the outside of the container.

4. HANDLING. Stored items shall be laid out to facilitate their retrieval for use in the Work. Care shall be taken when removing the equipment for use to ensure the precise piece of equipment is removed and that it is handled in a manner that does not damage the equipment.

End of Section

EQUIPMENT AND VALVE IDENTIFICATION

PART 1 – GENERAL

1-1. SCOPE. This section covers the furnishing and installation of nameplates and tags for identification of equipment, valves, panels, and instruments.

1-2. GENERAL. Except as otherwise specified in equipment, valve, and instrumentation sections, nameplates and tags shall be as specified herein. Nameplates or tags shall be provided for all equipment, valves, operator interfaces, control and electrical panels, cabinets, instruments, and instrument racks that have been named and/or tagged on the Drawings.

1-3. SUBMITTALS. Drawings and data shall be submitted in accordance with the requirements of the Submittals Procedures section for each type of tag provided including materials, colors, sizes, letter sizes, and installation instructions.

PART 2 - PRODUCTS

2-1. EQUIPMENT NUMBER PLATES. All equipment tagged on the drawings, except for submerged equipment shall be provided with number plates bearing the equipment tag number identified on the Drawings. Number plates shall be bevelled, 1/8th inch [3 mm] thick laminated black phenolic plastic engraving stock with white core. Lettering on number plates shall be capitalized block letters 3/4 inch [20 mm] high. Number plate height shall be twice the letter height. Number plate length shall be as needed, with suitable margins all around. Lettering shall be placed in one row where practicable; however, where necessary due to excessive length, lettering shall be placed on more than one row and centered.

Number plates shall be attached with stainless steel panhead screws, rivets, or drive screws.

When a number plate cannot be installed due to the physical size, space, or mounting surface geometry of the equipment, the Contractor shall provide a 12 gauge [2 mm] stainless steel tag with engraved or imprinted equipment tag number. Lettering on tags shall be 1/4 inch [6.5 mm] high. Tags shall be rectangular with smooth edges, and shall be fastened to the equipment with stainless steel mechanical fasteners or with a stainless steel chain.

2-2. EQUIPMENT INFORMATION PLATES. Equipment shall be provided with engraved or stamped equipment information plates securely affixed with mechanical fasteners to the equipment in an accessible and visible location. Equipment information plates shall be in addition to the number plates specified. Equipment information plates shall indicate the manufacturer's name, address, product name, catalog number, serial number, capacity, operating and power characteristics, labels of tested compliances, and any other pertinent design data. Equipment information plates listing the distributing agent only will not be acceptable.

2-3. VALVE AND GATE TAGS.

2-3.01. Temporary Tags. Each valve and gate with an identifying number indicated on the Drawings or listed in the valve or gate schedule, shall be tagged or marked in the factory with the identifying number.

2-3.02. Permanent Tags. All valves and gates, except buried or submerged valves, that have been assigned a number on the Drawings or in the valve or gate schedule, shall be provided with a permanent number plate. Tags shall be permanently attached to valves and gates with stainless steel mechanical fasteners or with stainless steel chains. Numerals shall be ¾ inch [20 mm] high and shall be black baked enamel on an anodized aluminum plate.

All buried valves shall be tagged with a brass plate cast into a 6-inch by 6 inch [150 mm by 150 mm] concrete pad at grade next to the valve box. The valve number shall be engraved in the brass plate with lettering and numerals at least 1 inch [25 mm] high.

2-4. PANEL NAMEPLATES. Nameplates shall be provided on the face of each panel and cabinet. Panel identification nameplates shall be mounted at the top of the panel shall include the panel descriptive name and tag number as indicated on the Drawings, in two or three lines of text. Lettering shall be ¾ inch [20 mm] high.

Nameplates for devices mounted on or in the panel shall be inscribed with the text as indicated on the Drawings. Where nameplate information is not indicated on the Drawings, inscriptions shall be in accordance with information in the supplier's submittal drawings as guided by information in the relevant specification section. Panel device nameplates shall have engraved letters 3/16 inch [5 mm] high.

Nameplate material and size shall be as specified above for equipment number plates. Nameplates shall be secured to the panel with stainless steel panhead screws.

2-5. INSTRUMENT TAGS.

2-5.01. Temporary Tags. Where instruments are not provided with permanent tags furnished from the factory, instruments shall be tagged or marked in the factory with the instrument tag number indicated on the Drawings.

2-5.02. Permanent Tags. Instruments shall be tagged with the instrument tag number indicated on the Drawings. Tags shall be 12 gauge [2 mm] stainless steel with engraved or imprinted symbols. Lettering on tags shall be ¼ inch [6.5 mm] high. Tags shall be rectangular with smooth edges, and shall be fastened to the instrument with stainless steel mechanical fasteners or with a stainless steel chain.

PART 3 – EXECUTION

Not used.

End of Section

STARTUP REQUIREMENTS

1. SCOPE. This section covers startup requirements for all items of equipment and systems including mechanical equipment. Additional requirements may be specified in specific equipment specifications. The requirements of this section shall be satisfactorily completed prior to any field tests specified in the specific equipment sections.

2. GENERAL. Equipment shall not be operated except by, or with the guidance of, qualified personnel having the knowledge and experience necessary to obtain proper results. All items of equipment and systems shall be tested for proper operation, efficiency, and capacity. All required adjustments, tests, operation checks, and other startup activity shall be provided by qualified personnel. Contractor shall be responsible for planning, supervising, and executing the installation of Work.

2.01. Coordination. Contractor shall coordinate all tests related to startup of equipment and systems and shall report the results to Engineer in accordance with the Submittals Procedures section. Contractor shall accept the equipment and the test results related to starting of equipment and systems before Engineer will accept the equipment and the test results.

When equipment is ready for a witness test, Contractor shall give written notice to Engineer at least 14 days before any offsite witness testing is performed or any field witnessed performance testing, unless otherwise specified.

3. EQUIPMENT TESTS.

3.01. Factory Tests. When specified in the specific equipment sections, the equipment will be test run at the point of manufacture and the test results will be delivered to Engineer. Such equipment will not be shipped until Engineer has reviewed the test results and advised the Contractor, in writing, that the equipment is acceptable for shipment. Such acceptance, however, will not be considered as final acceptance, which will only be made on the basis of the test results of the equipment after installation.

3.02. Preliminary Field Tests. All items of mechanical equipment shall be given a preliminary field test by Contractor after installation for proper operation, efficiency, and capacity. The preliminary field test shall consist of the requirements listed herein, unless exceptions or additions are indicated in the specific equipment sections.

Contractor's test operation of each piece of mechanical equipment shall continue for not less than 8 hours without interruption and shall be conducted in the presence of the County Inspector and a representative of OCU Water Production. All moving parts of equipment and machinery shall be carefully tested for operation, and adjusted so all parts move freely and function to secure satisfactory operation. All equipment shall be tested continuously under actual or simulated operating conditions. All parts shall operate satisfactorily in all respects, under continuous full load and in accordance with the specified requirements, for the full duration of the 8 hour test period. If any part of a unit shows evidence of unsatisfactory or improper operation during the

8 hour test period, correction or repairs shall be made and the full 8 hour test operation, as specified, shall be completed after all parts operate satisfactorily.

Tests of all process and pumping equipment, drive motors, including auxiliaries shall be made in accordance with the appropriate and approved test codes such as the American Society of Mechanical Engineers, Hydraulic Institute Standards, and IEEE.

Tests shall be conducted after the Work is substantially complete so each item of equipment is ready for integrated operation with other equipment at the plant. Testing, measuring, and calibrating procedures shall be submitted to Engineer for review and acceptance prior to startup and testing of equipment.

The equipment shall be properly filled, by Contractor, with oil and grease, and Contractor shall furnish all power, personnel, water, chemicals, fuels, oil, grease, and auxiliaries necessary for conducting the testing of the equipment for proper operation, efficiency, and capacity.

The period of inspection, initial startup operation, and field adjustment shall be as needed to achieve satisfactory installation and operation of the items furnished. Any period required for instruction of Owner's personnel shall be as specified in the Contract Documents.

When the specific equipment sections indicate that an installation check is required by the equipment manufacturer, the manufacturer's representative will make all necessary field adjustments and correct defects in materials or workmanship during this test period.

All equipment installed under this Contract, including that furnished by others, shall be placed into successful operation according to the written instructions of the equipment manufacturer and the instructions of the manufacturer's field representative.

3.03. Field System Operation Test. After all equipment is installed and the entire plant or system is ready to operate, Contractor shall conduct a field system operation test. The test shall consist of the requirements listed herein, unless exceptions or additions are indicated in the specific equipment sections.

The test period shall be at least 7 days and shall be conducted in the presence of the County Inspector and a representative of OCU Water Production. Each system shall operate under actual or simulated operating conditions before a certificate of Substantial Completion of the Work is issued. All defects of material, workmanship, or equipment which appear during this test period shall be corrected by Contractor. After such corrections are made, the 7 day test shall be repeated before a certificate of Substantial Completion of Work is issued, unless waived by Engineer.

Contractor shall supply all power, water, oil, grease, auxiliaries, and operating personnel required for this operation test.

When necessary for certain items of equipment, the final adjustments and inspections will be made by factory trained service personnel (other than sales representatives), rather than by Contractor. The service personnel will also supervise the test operation. This requirement will be stated under the detailed specification for the particular piece or pieces of equipment. The manufacturer's service personnel will make adjustments and supervise testing by Contractor until such tests have been accepted by Engineer.

4. ACCEPTANCE. When no other field tests for acceptance are specified in the equipment sections, at the end of the field system operation testing, each system will be accepted if, in the opinion of Engineer, it has operated satisfactorily without excessive power use, wear, or need for lubrication, or requiring undue attention; and if all its rotating parts operate without excessive vibration or noise at any operating condition.

When other field tests for acceptance are specified in the equipment sections, acceptance shall be after all tests are satisfactorily conducted as specified in the appropriate equipment procurement specification.

When a field performance test for baseline is specified in the equipment sections, acceptance shall be after a completion of the baseline performance test that is conducted as specified in the pumping unit field testing - baseline performance section.

Acceptance of Work in connection with the installation of equipment furnished by others will be subject to approval of the manufacturer's field representative.

Acceptance by Owner or approval of the manufacturer's field representative will not relieve Contractor of responsibility for defective Work.

End of Section

PROJECT RECORD DOCUMENTS AND SURVEY

PART 1- GENERAL

1.01 PURPOSE AND DESCRIPTION OF WORK

- A. The purpose of the Project Record Documents is to provide the County with factual information regarding all aspects of the Work, both concealed and visible, to enable future location, identification and modification of the Work without lengthy and expensive site measurement, investigation or examination.
- B. Provide professional surveying and mapping work required for the execution of the contract, including verification of existing survey data, construction layout, and production of the As-Built Drawings. This Work shall be performed by a Surveyor that is licensed by the State of Florida as a professional surveyor and mapper pursuant to Chapter 472, F.S.
- C. The location of the constructed improvements as depicted in the contract drawings is required. To verify the As-Built Drawing accuracies and to insure the Work was constructed in conformance with the contract drawings, the following survey documents are required to be certified by the Surveyor.
 - 1. As-Built Asset Attribute Data Table

1.02 DEFINITIONS

Except where specific definitions are used within a specific section, the following terms, phrases, words and their derivation shall have the meaning given herein when consistent with the context in which they are used. Words used in the present tense include the future tense, words in the plural number include the singular number and words in the singular number include the plural number. The word "shall" is mandatory, and the word "may" is permissive.

- A. **As-Built Drawings:** Drawings prepared by the Contractor's Surveyor shall depict the actual location of installed utilities for the completed WORK in a full size hard copy and an electronic AutoCAD file (dwg) format.
- B. **Record Drawings:** Drawings, prepared by prepared and certified by the County's Consultant Engineer, shall be a compiled representation of the constructed project, a listing of the sources and the basis of information used in the preparation of the "record drawings", the constructed project meets the Engineer's design intent and note the material deviations from the design documents, and the accuracy of the location information is based upon the Contractor's surveyor data supplied in the tables (As-Built Asset Attribute Data, Gravity Main, and Pipe Deflection).
- C. **Boundary Survey:** Boundary survey, map and report certified by a Surveyor shall be provided that meets the requirements of Chapter 61G17-6 'Minimum Technical Standards', FAC.

- D. **Surveyor:** Contractor's Surveyor that is licensed by the State of Florida as a professional surveyor and mapper pursuant to Chapter 472, F.S.
- E. **Survey Map Report:** As a minimum the Survey Map Report shall identify any corners that had to be reset, measurements and computations made, pump station boundary issues, and accuracies obtained.

1.03 QUALIFICATIONS OF THE SURVEYOR

- A. The Surveyor, who is proposed by the Contractor to provide services for the Project, is subject to the approval of the County. Prior to any services being performed, the Contractor shall submit the name and address of any proposed Surveyor and a written acknowledgement from the Surveyor stating that he has the hardware, software and adequate scope of services in his agreement with the Contractor to fully comply with the requirements of this specification. These submittals shall be provided to the County prior to Notice to Proceed. It is recommended that the Surveyor attend the Preconstruction meeting. Any Surveyor, who has not previously performed work for the County in the past, shall attend the Preconstruction meeting.

1.04 RELATED REQUIREMENTS

- A. All General Conditions, Supplements to the General Conditions, and any Addenda issued by the County are a part of this Section in the same manner as if fully written herein, and shall govern the Work of this Section, except where more stringent articles or requirements are stipulated, then they shall govern this Section.
- B. The Contract Documents are complementary and what is required by anyone shall be as binding as if required by all.
- C. Other requirements affecting Record Documents may appear in pertinent other sections of these specifications.

1.05 QUALITY ASSURANCE

- A. Delegate the responsibility for maintenance of the Record Documents to one person on the Contractor's staff as approved by the County.
- B. Thoroughly coordinate changes within the Record Documents, making adequate and proper entries on each page of specifications and each sheet of drawings and other documents where such entry is required to show progress and changes properly.
- C. Make entries within 24-hours after receipt of information has occurred.
- D. Survey documents shall comply with the minimum technical standards of Chapter 61G17-6 of the Florida Administrative Code (FAC) and Table 01720-1 Minimum Survey Accuracies specified in, whichever are more stringent. Asset attribute data shall be signed, sealed and dated by the Surveyor. All coordinates shall be

geographically registered in the Florida State Plan Coordinate System using the contract drawings control points for horizontal and vertical controls.

**Table 01720-1
Minimum Survey Accuracies**

Asset/Location	Horizontal Accuracy (feet)	Elevation Accuracy (feet)	Location: horizontal center and vertical top, unless otherwise specified
Bench Marks	N/A	0.01	Point
Horizontal Control	0.01	N/A	Point
Easements and Tracts	*	N/A	Survey Monuments
Civil Site, Topo and Foundation Drawings	0.1	0.01	All
Hydrants	0.01	N/A	Operating Nut
Blow off Valves	0.01	N/A	Valve Enclosure
Air Release Valves	0.01	N/A	Valve Enclosure
Master Meters	0.01	N/A	Register
Meter Box	0.01	N/A	Top of Meter Box
Clean-out	0.01	N/A	Top of Clean-out
Pump Station	0.01	0.01	Top Center of Wet Well and Pipe Inverts
Manholes	0.01	0.1	Top Center of Cover
Manhole	N/A	0.01	Pipe Inverts
System Valves	0.01	0.1	Operating Nut and Valve Body
Fittings	0.01	0.1	Top of Fitting and Ground
Piping at 100' max intervals	0.01	0.1	Top of Pipe and Ground
Restrained Pipe	0.01	N/A	Limits
Connections	0.01	0.1	Pipe Invert
Bore & Jack Casing	0.01	0.1	Top of Casing at Limits of Casing
Existing Utilities**	0.01	0.1	Conflicts

* Shall conform to the requirements of the "Chapter 61G17-6, 'Minimum Technical Standards', FAC", certified by a Surveyor.

** Existing utilities including but not limited to water, wastewater, reclaimed water, storm, fiber optic cable, electric, gas and structures within the limits of construction.

1.06 SUBMITTALS

- A. Comply with pertinent provisions for the timely submittal requirements under this article and specification section.
- B. Prior to submitting a monthly payment application, the Contractor's progressive As-Built Drawings and tables (As-Built Asset Attribute Data, Gravity Main, and Pipe Deflection) shall be acceptable to the County.
- C. Progressive As-Built Drawings which will indicate the horizontal and vertical locations of all current constructed improvements with sufficient information and notes to easily determine if the improvements were constructed in conformance with the Contract Documents. The progressive As-Built Drawings shall include a Surveyor's certified statement regarding the constructed improvements being within the specified accuracies or if not indicating the variances, as described in Table 01720-1 Minimum Survey Accuracies. The Contractor shall also submit the following updated monthly tables certified by the Surveyor:
- D. Prior to submitting a request for final payment or the County issuing a Certificate of Completion for the Work, the Contractor shall submit the final Record Documents to the County for approval. Retainage funds will be withheld at the County's discretion based on the quality and accuracy of the final Record Documents.

1.07 RECORD DOCUMENTS AT SITE

- A. Maintain at the site and always available for County's use one record copy of:
 - 1. Construction Contract, Drawings, Specifications, General Conditions, Supplemental Conditions, Bid Proposal, Instruction to Bidders, Addenda, and all other Contract Documents.
 - 2. Change Orders, Verbal Orders, and other modifications to Contract.
 - 3. Written instructions by the County as well as correspondence related to Requests for Information (RFIs).
 - 4. Accepted Shop Drawings, Samples, product data, substitution and "or-equal" requests.
 - 5. Field test records, inspection certificates, manufacturer certificates and construction photographs.
 - 6. Progressive As-Built Drawings
 - 7. Current Surveyor's tables for the As-Built Assets Attribute Data, pipe deflection data, and gravity main data.
- B. Maintain the documents in an organized, clean, dry, legible condition and completely protected from deterioration and from loss and damage until completion of the Work, transfer of all record data to the final Record Documents and for submittal to the County.

PART 2- PRODUCTS

2.01 AS-BUILT DRAWINGS

- A. Maintain the electronic As-Built Drawings to accurately record progress of Work and change orders throughout the duration of the Contract.

- B. Date all entries. Enter RFI No., Change Order No., etc. when applicable.
- C. Call attention to the entry by highlighting with a “cloud” drawn around the area affected.
- D. In the event of overlapping changes, use different colors for entries of the overlapping changes.
- E. Design call-outs shall have a thin strike line through the design call-out and all As-Built information must be labeled (or abbreviated “AB”) and be shown in a bolder text that is completely legible.
- F. Make entries in the pertinent other documents while coordinating with the Engineer and the County for validity.
- G. Entries shall consist of graphical representations, plan view and profiles, written comments, dimensions, State Plane Coordinates, details and any other information as required to document field and other changes of the actual Work completed. As a minimum, make entries to also record:
 - 1. Depths of various elements of foundation in relation to finish floor datum and State Plane Coordinates and elevations.
 - 2. Plan view and profile drawings: State Plane coordinates and elevations or depths for all assets shown in the Asset Attribute Data Table on each drawing if the fittings, valves, appurtenances, etc. are shown on that drawing sheet.
 - 3. When electrical boxes, or underground conduits and plumbing are involved as part of the Work, record true elevations and locations, dimensions between boxes.
 - 4. Actually installed pipe or other Work materials, class, pressure rating, diameter, size, specifications, etc. Similar information for other encountered underground utilities, not installed by Contractor, their owner and actual location if different than shown in the Contract Documents.
 - 5. Details, not on original contract Drawings, as needed to show the actual location of the Work completed in a manner that allows the County to find it in the future.
 - 6. The Contractor shall mark all arrangements of conduits, circuits, piping, ducts and similar items shown schematically on the construction documents and show on the As-Built Drawings the actual horizontal and vertical alignments and locations.
 - 7. Major architectural and structural changes including relocation of doors, windows, etc. Architectural schedule changes according to contractor’s records and shop drawings.

2.02 RECORD DOCUMENTS

- A. A full size, two (2) hard copy set of the final Record Documents and shall include all of the documents described below under this subsection 2.02.
- B. The following documents shall be signed and sealed by the Surveyor:
 - 1. As-Built Asset Attribute Data Table (see Table 1720-2 for an example).
- C. Digital Set of the final Record Documents including but not limited to:

1. Scanned digital copies of the final As-Built Drawings.
 2. Electronic Survey documents electronically sealed by the Surveyor.
 3. Final Record Documents information.
 4. Digital As-Built Drawing in the Engineer's current version of AutoCAD file (dwg) format for the Contract Drawings, updated to match the final Record Drawing information.
- D. Pump station site Boundary Survey and Map Report.
- E. New Boundary Survey to re-establish easement corners, right-of-way monuments, or pump station site corners with monuments if destroyed by the Work.
- F. Scanned Documents: Scan the Survey Documents and other Record Documents reflecting changes from the Bid Documents.
- G. The scanned As-Built drawing sets shall be complete and include the title sheet, plan/profile sheets, cross-sections, and details. Each individual sheet contained in the printed set of the As-Built Drawings shall be included in the electronic drawings, with each sheet being converted into an individual tif (tagged image file). The plan sheets shall be scanned in tif format Group 4 at 400 dpi resolution to maintain legibility of each drawing. Then, the tif images shall be embedded into a single pdf (Adobe Acrobat) file representing the complete plan set. Review all Record Documents to ensure a complete record of the project.
- H. Provide an encompassing digital AutoCAD file that includes all the information of the As-Built Drawings and any other graphical information in the As-Built Drawings. It shall include the overall Work, utility system layout and associated parcel boundaries and easements. Feature point, line and polygon information for new or altered Work and all accompanying geodetic control and survey data shall be included. The surveyor's certified as-built asset attribute data shall be added to the As-Built Drawings and Surveyor shall electronically seal the data in a comma-delimited ASCII format (txt).

TABLE 1720-2

Asset Attribute Data Form Example

Asset Type	I.D. Number	Utilities Asset Number	UTILITIES Asset Coordinates		
			Northerly	Easterly	Elevation
Bench Marks	BM-1	N/A	1605466.2	450720.5	86.04
Horizontal control	HC-1	N/A	1605700.1	450879	N/A
Horizontal control	HC-2	N/A	1605332.6	450773.1	N/A
Fire hydrant	FH-1	H67650001	1605629.9	450920.4	N/A
Fire hydrant	FH-2	H67650002	1605161.6	450024.6	N/A
Gate valve	GV-1	G67650001	1605631	450533.2	82.4
Gate valve	GV-2	G67650002	1605400.3	450765.8	86.5
Plug valve	PV-1	F3125P0001	1605024.4	450123.7	82.3
Plug valve	PV-2	F3125P0002	1605625.7	450245.4	89.6
Blow off valve	BO-1	BL67650001	1605804.5	450057.3	N/A
Blow off valve	BO-2	BL67650002	1605029.5	450126.2	N/A
Air release valve	ARV-W1	F3125A0001	1605646.9	450939.9	N/A
Air release valve	ARV-FM2	F3125A0002	1605978.3	450490.1	N/A
Master meter	MM-1	N/A	1605289.6	450130.2	N/A
Master meter	MM-2	N/A	1605900	450883.9	N/A
Detector check meter	DCM-1	N/A	1605244	450848.8	N/A
Detector check meter	DCM-2	N/A	1605829.3	450035.9	N/A
Clean-out	CO-1	N/A	1605289.6	450130.2	N/A
Clean-out	CO-2	N/A	1605900	450883.9	N/A
Force Main Fitting	FMF-1	N/A	1605024.4	450123.7	79.9
Water Main Fitting	WMF-1	N/A	1605625.7	450245.4	81.9
Reclaimed Water Fitting	RWMF-1	N/A	1605680	450302.7	87.9
Water Piping	WM-1	N/A	1605244	450848.8	86.2
Force Main Piping	FM-1	N/A	1605829.3	450035.9	85.9
Reclaimed Water Main Piping	RWM-1	N/A	1605625.7	450245.4	84.7

**TABLE 01720-3
PIPE DEFLECTION TABLE EXAMPLE**

Project Contractor: Progress Mtg Date: Contract # Dwg Sheet # Utility Type Pipe Manufacturer Pipe size & material PVC Manufacturer Deflection County Allowable Deflection 75% Allowable Angle of Offset Allowable Radius of Curvature Laying Length of Pipe	FM National Pipe 16" PVC C905 6 inches 4.5 inches 1.5 degrees 764 feet 20 feet	
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ID	Size and Type	Northing	Easting	Elev.	Calculations Including Elevation (XYZ)							
					Distance between points AB	Distance between points BC	Distance between points AC	Total Deflection ϕ^1	Radius of Curve ^{**}	Average Offset Angle ^{***}	Average Offset ^{****}	
					Length AB	Length BC	Length AC	XYZ (w elevation)	XYZ (w elevation)	per laying length	per laying length	
					ft	ft	ft	degrees	ft	degrees	inches	
14041	16" FM	1505131.50	468948.53	107.68	-	-	-	-	-	-	-	-
7000	16" FM	1505059.60	468932.08	108.15	73.76	38.93	112.66	5.48	1,178.35	0.97	4.07	
2128	16" FM	1505022.11	468921.60	108.55	38.93	39.61	78.54	2.29	1,961.65	0.58	2.45	
2127	16" FM	1504983.85	468911.35	108.29	39.61	38.35	77.96	1.78	2,505.50	0.46	1.92	
2126	16" FM	1504946.67	468901.96	107.81	38.35	39.13	77.42	8.79	505.16	2.27	9.51	
2125	16" FM	1504908.11	468895.31	107.48								

Data that has been inputted
 Values in yellow are over spec

¹ Uses law of cosines to determine angle ABC and ϕ .
 $\text{angle } ABC = \arccos((AB^2 + BC^2 - AC^2) / (2 * AB * BC))$
 $180 - \phi / 2 = \text{angle } ABC$
 Calculate the total deflection ϕ .
 to the outer point (A or C) is equal in angle to the approach from the next point along the

^{**} Uses law of sines, using the chord length AC and radius R.
 Since $\sin((\phi/2) * (\pi/180)) = (\text{Chord}/2) / R$ and length $AC = \text{Chord}$
 $R = AC / (2 * \sin(\phi * \pi / 360))$
 This calculation assumes an average radius over the bend between three points.

^{***} Adds the lengths of AB + BC / 20ft to get an approximate number of bends over the span.
 This value is divided by the total deflection angle to calculate the average bend angle of
 This assumes that the bend angle is consistent across the entire length.

^{****} Uses average offset angle and laying length of pipe.

PART 3- EXECUTION

3.01 SURVEY FIELD WORK

- A. Locate, reference, and preserve existing horizontal and vertical control points and property corners shown on the Drawings prior to starting any construction Work. If the Surveyor performing the Work discovers any discrepancies that will affect the Project, the Contractor must immediately report these findings to the County. All survey work shall meet the requirements as defined in Florida Administrative Code 61G17-6. Reference and preserve all survey points during construction. If survey points are disturbed, it is the responsibility of the Contractor's Surveyor to reset the points at the Contractor's expense. Copies of the Surveyor's field notes and/or electronic files for point replacement shall be provided to the County.
1. The Surveyor shall locate all improvements for the project As-Built Asset Attribute Data using State Plane Coordinates as the horizontal datum and the benchmark referenced on the Drawings as the vertical datum. The County's Engineer will provide electronic files of the Drawings to be used by the Surveyor in complying with these specifications.
 2. The construction layout shall be established from the reference points shown or listed on the Drawings. The accuracy of any method of staking shall be the responsibility of the Contractor. All construction layout staking shall be done such as to provide for easy verification of the Work by the County.
- B. Use survey control points to layout such work tasks as the following:
1. Clearing, grubbing, work limits, right-of-way lines and easements
 2. Locations for pipelines and all associated structures and appurtenances
- C. The Surveyor shall reference and replace any project control points, boundary corners, benchmarks, section corners, and right-of-way monuments that may be lost or destroyed, at no additional cost to the County. Establish replacement points based on the original survey control. Copies of all reference field notes and/or electronic files for point replacement shall be submitted to the County.

3.02 CONSTRUCTION PROGRESS MEETINGS

- A. Contractor shall provide progressive and a final version of the Record Documents both as paper copies and electronic format described below.
1. Construction Contract, As-Built Drawings, Specifications, General Conditions, Supplemental Conditions, Bid Proposal, Instruction to Bidders, Addenda, and all other Contract Documents.
 2. Specifications and Addenda: Record manufacturer, trade name, catalog number and supplier of each product and item of equipment actually installed as well as any changes made by Field Order, Change Order or other.
 3. Change orders, verbal orders, and other modifications to Contract.
 4. Written instructions by the County as well as correspondence related to Requests for Information (RFIs).
 5. Accepted Shop Drawings, samples, product data, substitution and "or-equal" requests.

6. Field test records, inspection certificates, manufacturer certificates and construction photographs.
- B. Progressive record documents shall include the following updated monthly tables certified by the Surveyor:
1. As-Built Asset Attribute Data Table: Surveyor shall obtain field measurements of vertical and horizontal dimensions of constructed improvements. The monthly submittal shall include the Surveyor's statement regarding the constructed improvements being within the specified accuracies as described in Table 01720-1 Minimum Survey Accuracies or if not, indicating the variances.
 2. Gravity Main Table: Surveyor shall prepare and update a Gravity Main Table to include as a minimum the pipe segment identification, pipe lengths, manhole inverts and tops, and slopes for gravity mains. Surveyor shall certify the data entered are correct and indicate if the minimum slopes have not been met.
 3. Pipe Deflection Table: Surveyor shall input the type of pipe, pipe manufacturer, PVC manufacturer deflection allowance, allowable angle of offset and radius of curvature, laying length of pipe, and coordinates. Surveyor shall certify the data entered are correct and indicate if the deflection allowance, offset or radius of curvature exceeds the manufacturer's recommendations. *County will provide an electronic version of a blank table that shall be used to input the data.*

3.03 FINAL RECORD DOCUMENTS SUBMITTAL

- A. Submit the Final Record Documents within 20 days after Substantial Completion.
1. Participate in review meetings as required and make required changes and promptly deliver the Final Record Documents to the Engineer and County.

3.04 STORAGE AND PRESERVATION

- A. Store Record Documents and samples at a protected location in the project field office apart from documents used for construction.
1. Provide files and racks for storage of documents
 2. Provide locked cabinet or secure space for storage of samples.
- B. File documents and samples in accordance with CSI format with section numbers matching those in the Contract Documents.
- C. In the event of loss of recorded data, use means necessary to again secure the data to the County's approval.
1. Such means shall include, if necessary in the opinion of the County, removal and replacement of concealing materials.
 2. In such cases, provide replacements of the concealing materials to the standards originally required by the Contract Documents.

End of Section

FDOT STANDARD SPECIFICATIONS FOR ROAD AND BRIDGE CONSTRUCTION

PART 1 – DESCRIPTION

1-1. FDOT Standard Specifications for Road and Bridge Construction:

- A. When compliance with FDOT Specifications is specified on the Drawings or in the Contract Documents, the Contractor shall comply with all the requirements defined in the Florida Department of Transportation (FDOT) Standard Specifications for Road and Bridge Construction, latest edition (FDOT Specifications), except as specifically modified in this Section or other Sections of the Contract Documents.
- B. When compliance with FDOT Design Standards is specified on the Drawings or in the Contract Documents, the Contractor shall comply with all the requirements of the Florida Department of Transportation (FDOT) Design Standards, latest edition (FDOT Standards), except as specifically modified in this Section or other Sections of the Contract Documents.
- C. When compliance with FDOT Specifications is specified on the Drawings and a Pay Item is identified by a FDOT Pay Item Number, measurement and payment shall be made in accordance with the Florida Department of Transportation (FDOT) Standard Specifications for Road and Bridge Construction, latest edition (FDOT Specifications) and FDOT Basis of Estimates, latest edition, except as specifically modified by this Section or other Sections of the Contract Documents.

1-2. Related Documents:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and other Specifications Sections, apply to this Section.

PART 2 - GENERAL

2-1. Modification of Terms Used in the FDOT Specifications:

The terms defined in Division 0 and 1 of the Contract Documents may be different from the terms used in the FDOT Division 1 Specifications. The following paragraphs redefine the FDOT terms to be consistent with the Contract Documents.

- A. The term “Department” as used in the FDOT Specifications shall mean the same as the term “Owner” as defined in the Contract Documents.
- B. The term “Engineer” as used in the FDOT Specifications shall mean the same as the term “Owner’s Authorized Representative” or “OAR” as defined in the Contract Documents.
- C. The term “Engineer of Record” as used in the FDOT Specifications shall mean the same as the term “Designer” as defined in the Contract Documents.

- D. The term “Inspector” as used in the FDOT specifications shall mean the same as the term “Owner’s Authorized Representative” or “OAR” as defined in the Contract Documents.
- E. The term “Proposal Form” as used in the FDOT Specifications shall mean the same as the term “Bid Form” as used in the Contract Documents.
- F. The term “Proposal Guaranty” as used in the FDOT Specifications shall mean the same as the term “Bid Bond” in the Contract Documents
- G. The term “Right of Way” as used in the FDOT Specifications shall include all areas of the project site, and shall not be limited to roadway areas only.
- H. The term “Secretary” as used in the FDOT Specifications shall mean the same as the term “Designer” as defined in the Contract Documents.
- I. The term “Special Provisions” as used in the FDOT Specifications shall mean the same as the term “Contract Documents” as defined in the Contract Documents.
- J. The term “Specialty Engineer” as used in the FDOT specifications shall mean the same as the term “Designer” as defined in the Contract Documents.
- K. The term “Specifications” as used in the FDOT Specifications shall mean the same as the term “Contract Documents” as defined in the Contract Documents.
- L. The term “Superintendent” as used in the FDOT Specifications shall mean the same as the term “Owner’s Authorized Representative (OAR)” as defined in the Contract Documents.
- M. The “Supplemental Agreement,” “Supplemental Specifications,” and “Technical Specifications” as used in the FDOT Specifications shall mean the same as the term “Contract Documents” as defined in the Contract Documents.

PART 3 - SPECIFIC MODIFICATIONS TO FDOT SPECIFICATIONS

3-1. Section 100, Construction Equipment - General Requirements:

- A. Section 100-3. Delete this entire Section.

3-2. Section 110, Clearing and Grubbing:

- B. The requirements of Section 110 shall not be limited to roadway areas and embankments, but shall also apply to all other areas shown on the Drawings.

3-3. Section 120, Excavation and Embankment:

- A. The requirements of Section 120 shall not be limited to roadway areas, but shall also apply to all areas shown on the Contract Drawings.

End of Section

DEMOLITION AND SALVAGE

PART 1 - GENERAL

1-1. SCOPE. This section covers the demolition of existing structures, piping, equipment, and sitework and the salvage of existing materials and equipment as indicated on the Drawings.

Removal of the above ground fuel storage tank is covered under section 13990

1-2. GENERAL. Contractor shall be responsible for all work under this section. Contractor shall provide 14 days written notice prior to beginning demolition activities.

Blasting will not be permitted.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

3-1. DEMOLITION. Removal of equipment or facilities shall include removal of all accessories, piping, wiring, supports, associated electrical starters and devices, baseplates and frames, and all other appurtenances, unless otherwise directed. Existing materials and equipment removed, and not indicated to be reused as a part of the Work, shall become Contractor's property unless otherwise specified, and shall be removed from the Site.

Contractor shall conduct demolition activities in a manner that prevents damage to existing facilities which are indicated to remain and shall provide all necessary protection for existing facilities. Any remaining facilities damaged during demolition shall be repaired by Contractor to a condition equal to or better than the original condition.

When demolition is complete, all debris shall be removed from the Site and the Site graded to the lines and grades indicated on the Drawings.

All chemical tanks and piping have been cleaned by the Owner in preparation for removal, however there may be some chemical residual present. Therefore, all applicable codes shall be followed regarding handling and disposal of hazardous chemicals.

3-1.01. Structure Demolition. The following structures shall be demolished, and the debris shall be removed from the jobsite.

3-1.01.01. Meadow Woods Water Supply Facility.

Hypochlorite (Bleach) Building

Fluoride Building

Caustic Building

The buildings to be demolished have been inspected by a Florida licensed asbestos consultant and the findings have been summarized in a report that will be made available to the Contractor for use in obtaining the demolition permit. As indicated in the report, the sampled materials were not determined to contain regulated amounts of asbestos. Also as indicated in the report, analysis of paint samples found no detectable levels of lead.

3-1.01.02. Meadow Woods Wastewater Treatment Facility.

Digester Tanks

Decant Tank

The structures to be demolished have been inspected by a Florida licensed asbestos consultant and the findings have been summarized in a report that will be made available to the Contractor for use in obtaining the demolition permit. As indicated in the report, the sampled materials were not determined to contain regulated amounts of asbestos. Also as indicated in the report, analysis of paint samples found no detectable levels of lead.

3-1.02. Piping and Equipment Demolition.

3-1.02.01. Meadow Woods Water Supply Facility.

The following piping and equipment shall be removed, including all buried portions, and shall become the property of Contractor. All such items shall be promptly removed from the jobsite.

Well discharge piping within the limits indicated on the Drawings.

High service discharge piping within the limits indicated on the Drawings.

Chlorine piping and vaults

Fluoride piping and vaults

3-1.02.02. Meadow Woods Wastewater Treatment Facility. The following piping and equipment shall be removed and shall become the property of Contractor. Buried piping may remain in place. Above grade piping shall be removed to a minimum of 2 feet below grade and capped. All such items shall be promptly removed from the jobsite.

Above grade piping, pumps, and appurtenances at the digesters and decant tank.

All loose piping and equipment lying on the ground within the limits indicated on the Drawings.

Electrical power transformer and service meter as indicated on the Drawings

3-1.03. Sitework Demolition. Sitework demolition shall include the following:

Removal of existing fencing within the limits indicated on the Drawings.

Miscellaneous concrete pads and foundations as indicated on the Drawings.

3-2. SALVAGE. Not used.

End of Section

Section 02110

CLEARING AND GRUBBING

PART 1 - GENERAL

1-1. SCOPE. This section covers the necessary clearing and grubbing at the Meadow Woods Wastewater Treatment Facility site, including removal and disposal of plant debris, protection of adjacent property, and surfacing and grading.

The intent of the clearing and grubbing is to produce a site that the County can easily maintain through regular mowing.

1-2. BASIS FOR PAYMENT. Basis for payment shall be as described in the Measurement and Payment section.

PART 2 – PRODUCTS Not used.

PART 3 - EXECUTION

3-1. SITE PREPARATION. The area identified on the drawings shall be cleared of all logs, trees, roots, brush, tree trimmings, and other objectionable materials and debris. All stumps shall be grubbed. All waste materials shall be removed from the site and disposed of by and at the expense of CONTRACTOR. Wastes shall not be buried or burned on the Site or disposed of into storm drains, sanitary sewers, streams, or waterways. All wastes shall be removed from the Site and disposed of in a manner complying with local ordinances and antipollution laws.

3-1.01. Clearing. Clearing shall consist of the removal and disposal of trees, brush, shrubs, stumps, and all vegetative debris within the limits indicated on the Drawings. All stumps shall be grubbed. Mowing will be considered adequate for the clearing of light vegetation.

3-1.02. Grubbing. Grubbing shall mean the removal and disposal of all tree, brush, and shrub stumps and roots larger than 2 inches in diameter, including matted roots whether 2 inches or larger or not, to a minimum depth of 6 inches below the natural surrounding ground surface in each case.

3-1.03. Preservation of Trees. No trees shall be removed outside designated clearing areas, unless their removal is authorized by OWNER. Trees left standing shall be adequately protected from permanent damage by construction operations.

3-1.04. Blasting. Blasting or other use of explosives for clearing and excavation will not be permitted.

3-1.05. Burning. Burning of trees, brush, shrubs, stumps, grasses, vegetative debris, or waste of any type will not be permitted on the site.

3-2. LEVELING TERRAIN. Within the limits of clearing and grubbing, all holes and other depressions shall be filled and all mounds and ridges cut down, and the area shall be brought to sufficiently uniform contour such that the Owner's subsequent mowing operations will not be hindered by irregularity of terrain. This work shall be done regardless of whether the irregularities were the result of the CONTRACTOR's operations or existed originally.

3-4. SEEDING. In areas disturbed by grubbing, filling, grading or other activities, grass shall be re-established by seeding as specified in Seeding and Sodding section.

End of Section

EARTHWORK

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Scope of Work: The work of this Section consists of excavating, backfilling, compaction and grading as required for construction of the structures, piping and appurtenances as shown and specified in the Contract Documents.
- B. Related Work:
 - 1. Section 02100: Site Preparation
 - 2. Section 02140: Dewatering (During Construction)
 - 3. Section 02276: Temporary Erosion and Sedimentation Control
- C. Definitions:
 - 1. Maximum Density: Maximum weight in pounds per cubic foot of a specific material.
 - 2. Optimum Moisture: Percentage of water in a specific material at maximum density.
 - 3. Rock Excavation: Excavation of any hard natural substance which requires the use of explosives and/or special impact tools such as jack hammers, sledges, chisels or similar devices specifically designed for use in cutting or breaking rock, but exclusive of trench excavating machinery.
 - 4. Suitable: Suitable materials for fills shall be a non-cohesive, non-plastic granular local sand free from vegetation, organic material, marl, silt or muck. The Contractor shall furnish all additional fill material required.
 - 5. Unsuitable: Unsuitable materials are highly organic soil (peat or muck) classified as A-8 in accordance with AASHTO Designation M 145. Rock or other non-cushioning material encountered within the pipe trench is also considered unsuitable for bedding or backfilling.
- D. Plan For Earthwork: The Contractor shall be responsible for having determined to his satisfaction, prior to the submission of his bid, the conformation of the ground, the character and quality of the substrata, the types and quantities of materials to be encountered, the nature of the groundwater conditions, the prosecution of the work, the general and local conditions and all other matters which can in any way affect the Work. Prior to commencing the excavation, the Contractor shall submit a plan of his proposed operations to the Engineer for review. The Contractor shall consider, and his plan for excavation shall reflect, the equipment and methods to be employed in the excavation. The prices established in the proposal for the Work shall reflect all costs pertaining to the Work. No claims for extras based on sub-strata or groundwater conditions will be allowed.

1.02 QUALITY ASSURANCE

- A. Comply with the permits, rules, regulations and laws concerning construction activity in rights-of-way and easements of the applicable agencies.
- B. A soils testing laboratory employed by the Owner will make such tests as deemed advisable. The Contractor shall schedule his work so as to permit a reasonable time for testing before placing succeeding lifts and shall keep the laboratory informed of the work progress. Tests which have to be repeated because of the failure of the tested material to meet specifications shall be paid for by the Contractor and the cost shall be deducted from payments due the Contractor.
- C. Determination of laboratory moisture-density relationship and maximum density will be made by Modified Proctor method of ASTM D-1557. At least one (1) test per soil type shall be made.
- D. In place soil density shall be determined either by use of a Nuclear Density Meter per ASTM D 2922 or by use of the Drive Sleeve Method per ASTM D 2937.

1.03 JOB CONDITIONS

- A. Data on the indicated subsurface conditions are not intended as representations or warranties of accuracy or continuity between soil borings. Contractor may rely on the accuracy of the technical data contained in the geotechnical reports, but not upon non-technical data, interpretations or opinions contained therein or for the completeness thereof for the Contractor's purposes. Contractor shall have full responsibility with respect to subsurface conditions at the site.
- B. Existing utilities have been shown on the Drawings insofar as information is reasonably available from the utilities owners' drawings and information. However, it is the Contractor's responsibility to field verify the location, using test pits, all existing utilities whether shown on the Drawings or not.

1.04 TRENCH SAFETY:

- A. The Contractor shall comply with Subpart P, Section 1926.652 of the OSHA Safety and Health Standards for Construction and the Florida Trench Safety Act (90-96, Florida Law).
- B. The Contractor shall submit written assurance, with associated costs, that the trench excavation shall comply with all applicable trench safety standards.
- C. Submit to Engineer for review the proposed methods of construction, including excavation, sheeting, shoring, bedding, filling, compaction and backfilling for the various portions of the Work. Review will be for general method only. The Contractor shall remain responsible for the adequacy and safety of the methods.

PART 2 - PRODUCTS

2.01 MATERIALS

A. General:

- 1. All fill and backfill material shall be subject to the approval of the Owner's Representative and Engineer.

2. All fill and backfill material shall be substantially free of clay, organic materials, loam, wood, trash and other objectionable material which may be compressible or which cannot be compacted properly and shall not contain broken concrete, masonry, rubble, or other similar materials. It shall have physical properties such that it can be readily spread and compacted during filling.
- B. Common Fill: Common fill shall be sand and shall not contain stones or rock, larger than six (6) inches in diameter and containing no more than 15% by weight passing a No. 200 sieve.
- C. Select Common Fill: Select common fill shall be as specified above for common fill, except that the material shall contain no stones larger than 1-1/2 inches in largest dimension and shall be no more than 5 percent by weight finer than the No. 200 mesh sieve.
- D. Material falling within the above specifications, encountered during the excavation may be stored in segregated stockpiles for reuse. All material which, in the opinion of the Engineer, is not suitable for reuse, shall be spoiled as specified herein for disposal of unsuitable materials.
- E. Bedding Rock: Bedding rock shall meet the requirements of FDOT Standard Specifications for FDOT #57 washed and graded stone.

PART 3 - EXECUTION

3.01 PROTECTION

- A. Pre-Construction Survey:
 1. Prior to commencing excavation or dewatering, the Contractor shall conduct a survey of those existing structures and buried piping or ducts which may be subject to settlement or distress resulting from excavation, backfill or dewatering operations.
 2. The Contractor shall monitor the structures surveyed to ascertain evidence of settlement or distress. If settlement or distress becomes evident, the Contractor shall be responsible to repair the structures to the previous condition. Costs shall be paid by the Contractor.
- B. Sheet piling and Bracing:
 1. Furnish, put in place, and maintain such sheet piling and bracing as may be required to support the sides of excavations, to prevent any movement which could in any way diminish the width of the excavation below that necessary for proper construction, and to protect adjacent structures, power poles, etc. from undermining, and to protect workers from hazardous conditions or other damage. Such support shall consist of braced steel sheet piling, braced wood lagging and soldier beams or other approved methods. If the Owner/Engineer is of the opinion that at any points sufficient or proper supports have not been provided, he may order additional supports put in at the expense of the Contractor, and compliance with such order shall not relieve or release the Contractor of responsibility for the sufficiency of such supports. Care shall be taken to prevent voids outside of the sheet piling, but if voids are formed, they shall be immediately filled and rammed. Where soil cannot be properly compacted to fill a void, lean concrete shall be used as backfill at no additional expense to the Owner.

2. The Contractor shall construct the sheeting outside the neat lines of the foundation unless indicated otherwise to the extent he deems if desirable for his method operation. Sheeting shall be plumb and securely braced and tied in position. Sheeting and bracing shall be adequate to withstand all pressure to which the structure or trench will be subjected. Any movement or bulging which may occur shall be corrected by the Contractor at his own expense so as to provide the necessary clearances and dimensions.
3. Where sheeting and bracing is required to support the sides of excavations, the Contractor shall engage a Professional Geotechnical Engineer, registered in the State of Florida, to design the sheeting and bracing. The sheeting and bracing installed shall be in conformity with the design, and certification of this shall be provided by the Professional Geotechnical Engineer.
4. The installation of sheeting, particularly by driving or vibrating, may cause distress to existing structures. The Contractor shall evaluate the potential for such distress and, if necessary, take all precautions to prevent distress of existing structures because of sheeting installation.
5. The Contractor shall leave in place to be embedded in the backfill all sheeting and bracing not shown on the Drawings but which the Owner/Engineer may direct him in writing to leave in place at any time during the progress of the work for the purpose of preventing injury to structures, utilities, or property, whether public or private. The Owner/Engineer may direct that timber used for sheeting and bracing be cut off at any specified elevation.
6. All sheeting and bracing not left in place shall be carefully removed in such manner as not to endanger the construction or other structures, utilities, or property. All voids left or caused by withdrawal of sheeting shall be immediately refilled with sand by ramming with tools especially adapted to that purpose, or otherwise as may be directed by the Owner/Engineer.
7. The right of the Owner and Engineer to order sheeting and bracing left in place shall not be construed as creating any obligation on his part to issue such orders, and his failure to exercise his right to do so shall not relieve the Contractor from liability for damage to persons or property occurring from or upon the work occasioned by negligence or otherwise, growing out of a failure on the part of the Contractor to leave in place sufficient sheeting and bracing to prevent any caving or moving of the ground.
8. No wood sheeting is to be withdrawn if driven below mid-diameter of any pipe, and under no circumstances shall any wood sheeting be cut off at a level lower than 1 foot above the top of any pipe.

3.02 EXCAVATION

- A. Excavation shall be made to such dimensions as will give suitable room for maintenance of traffic, building the foundations and the structures, installing pipe and appurtenances, for bracing and supporting, for pumping and draining, and for all other work required.
 1. Excavation for precast or prefabricated structures shall be carried to an elevation 2 feet lower than the proposed outside bottom of the structure to provide space for the select backfill material.
 2. Excavation for structures constructed or cast in place in dewatered excavations shall be carried down to the bottom of the structure where dewatering methods are such that a dry excavation bottom is exposed and the naturally occurring material

at this elevation leveled and left ready to receive construction. Material disturbed below the founding elevation in dewatered excavation shall be replaced with 3000 psi concrete.

3. Footings: Cast-in-place concrete footing sides shall be formed immediately after excavation. Forming for footing sides is specified elsewhere.
- B. Immediately document the location, elevation, size, material type and function of all new subsurface installations, and utilities encountered during the course of construction.
 - C. Excavation equipment operators and other concerned parties shall be familiar with subsurface obstructions as shown on the Drawings and should anticipate the encounter of unknown obstructions during the course of the Work.
 - D. Encounters with subsurface obstructions shall be hand excavated.
 - E. Excavation and dewatering shall be accomplished by methods which preserve the undisturbed state of suborder soils. Subgrade soils which become soft, loose, "quick" or otherwise unsatisfactory for support as a result of inadequate dewatering or other construction methods, shall be removed and replaced by bedding rock as required by the Engineer at the Contractor's expense.
 - F. All pavements shall be cut to removal, with saws and approved power tools.
 - G. The Contractor shall not open more trench in advance of pipe laying than is necessary to expedite the work. Three hundred (300) feet shall be the maximum length of open trench on any line under construction.
 1. Alignment, Grade, and Minimum Cover: The alignment and grade or elevation of each pipeline shall be fixed and determined from offset stakes. Vertical and horizontal alignment of pipes and the maximum joint deflection used in connection therewith shall be in conformity with requirements of the section covering installation of pipe.
 2. Where pipe grades or elevations are not definitely fixed by the Drawings, trenches shall be excavated to a depth sufficient to provide a minimum depth of backfill cover over the top of the pipe of 36 inches. Greater pipe cover depths may be necessary on vertical curves or to provide necessary clearance beneath existing pipes, conduits, drains, drainage structures, or other obstructions encountered at normal pipe grades. Measurement of pipe cover depth shall be made vertically from the outside top of pipe to finished ground or pavement surface elevation.
 3. Bell Holes: Bell holes shall provide adequate clearance for tools and methods used in installing pipe. No part of any bell or coupling shall be in contact with the trench bottom or when the pipe is jointed.
 4. If hardpan soils are encountered at the pipe invert depth, these soils should be over excavated to a minimum depth of 12 inches below the pipe invert and backfilled with select common fill.
 5. If unsuitable soils are encountered at the pipe invert depth, those soils shall be over excavated below the pipe invert and backfilled as indicated herein and as shown on the Drawings.
 6. Trenching for pipe installation shall be in accordance with Figures A101 and A102 on sheet C-06.

H. Mechanical Excavation:

1. The use of mechanical equipment will not be used in locations where its operation would cause damage to trees, buildings, culverts, and other existing property, utilities, or structures above or below ground. In all such locations, hand excavating methods shall be used.
 2. Mechanical equipment used for trench excavation shall be of the type, design, and construction, and shall be so operated that the rough trench excavation bottom elevation can be controlled, that uniform trench widths and vertical side walls are obtained at least from an elevation one foot above the top of the installed pipe to the bottom of the trench, and that trench alignment is such that pipe, when accurately laid to specified alignment, will be centered in the trench with adequate clearance between the pipe and side walls of the trench. Undercutting the trench side wall to obtain clearance will not be permitted.
- I. Excavated material shall be stockpiled in such a manner as to prevent nuisance conditions. Surface drainage shall not be hindered.
- J. All locations and elevations as required herein must be permanently documented by the Contractor, on the Record Drawings prior to the Owner/Engineer approval of the Application for Payment for that work.

3.03 DEWATERING, DRAINAGE AND FLOTATION

- A. The Contractor shall at all times during construction provide and maintain proper equipment and facilities to remove promptly and dispose of all water entering excavations. The Contractor keep excavations dry so as to obtain a satisfactory undisturbed subgrade foundation condition. Groundwater levels shall be maintained at least 2 feet below compacted surfaces including the bottom of excavations. No construction shall be allowed in water. Refer to Section 02140: Dewatering (During Construction).

3.04 UNDERCUT

- A. If the bottom of any excavation is below that shown on the Drawings or specified because of Contractor error, convenience, or unsuitable subgrade due the Contractor's excavating method, he shall refill to normal grade with fill at his own cost. Fill material and compaction method shall be as directed by the Owner/Engineer.

3.05 FILL AND COMPACTION

- A. Control soil compaction during construction to provide the percentage of maximum density specified. In-situ soils may require moisture conditioning to achieve a moisture content near optimum for the specified degree of compaction. Compact footing subgrade bearing soils to a depth of 12 inches below the foundations bearing elevation to the density specified in the schedule below.
- B. Compact and backfill excavations and construct embankment according to the following schedule:

AREA	MATERIAL	COMPACTION
Beneath Utility or Drainage Structures, Asphalt Pavement and Sidewalks	Select Common Fill or Bedding Rock	12" lifts, compacted to 98% maximum density by Modified Proctor method. Fill should not be placed until in-place soils have been compacted to 98% Modified Proctor.
Around Utility or Drainage Structures and beneath Buildings	Select Common Fill	8" lifts, 98% of maximum density by Modified Proctor method.
Pipe Bedding (Envelope)	Select Common Fill or Bedding Rock	12" lifts, 95% of maximum density by Modified Proctor method. 98% of maximum density under roadways and driveways by Modified Proctor.
Trench Backfill and Fill Areas	Common Fill	12" lifts, 95% of maximum density by Modified Proctor method. 98% of maximum density under roadways and driveways by Modified Proctor.

- C. Excavations shall be backfilled to the original grade or as indicated on the Drawings. Deviation from this grade because of settling shall be corrected by the Contractor. Backfill operation shall be performed to comply with all rules and regulations and in such a manner that it does not create a nuisance or safety hazard. All trenches shall be filled, compacted, and completely reinforced within one (1) week of trench digging.
- D. Embankments shall be constructed true to lines, grades and cross sections shown on the Drawings or ordered by the Engineer. Embankments shall be placed in successive layers of not more than 8 inches in thickness, loose measure, for the full width of the embankment. As far as practical, traffic over the work during the construction phase shall be distributed so as to cover the maximum surface area of each layer.
- E. If the Contractor requests approval to backfill material utilizing lifts and/or methods other than those specified here, such request shall be in writing to the Engineer. Approval will be considered only after the Contractor has performed tests, at the Contractor's expense, to identify the material used and density achieved throughout the backfill area utilizing the method of backfill requested. The Engineer's approval will be in writing.
- F. See Figures A101 and A102 on sheet C-06 for additional details.

3.08 DRAINAGE MAINTENANCE

- A. Trenches across roadways, driveways, walks, or other trafficways adjacent to drainage ditches or water courses shall not be backfilled prior to completion of backfilling the trench on the upstream side of the trafficway to prevent impounding water after the pipe has been laid. Bridges and other temporary structures required to maintain traffic across such unfilled trenches shall be constructed and maintained by the Contractor. All material deposited in roadway ditches or other water courses crossed by the line of trench shall be removed immediately after backfilling is completed and the original sections, grades, and contours of ditches or water courses shall be restored. Surface drainage shall not be obstructed longer than necessary.

3.09 SETTLEMENT

- A. The Contractor shall be responsible for all settlement of backfill, fills, and embankments which may occur within the correction period stipulated in the General Conditions.
- B. The Contractor shall make, or cause to be made, all repairs or replacements made necessary by settlement within 30 days after notice from the Owner.

End of Section

TEMPORARY EROSION AND SEDIMENTATION CONTROL

PART 1 - GENERAL

1.01 DESCRIPTION

A. Scope of Work:

1. The Work specified in this Section consists of designing, providing, maintaining and removing temporary erosion, sedimentation and turbidity controls as necessary.
2. Temporary erosion controls include, but are not limited to, grassing, mulching, setting, watering and reseeding on-site surfaces and soil and borrow area surfaces and providing interceptor ditches at ends of berms and at those locations which will ensure that erosion during construction will be either eliminated or maintained within acceptable limits as established by federal, state and local requirements and by the Owner.
3. Temporary sedimentation controls include, but are not limited to, silt fence, silt dams, traps, barriers, and appurtenances at the foot of sloped surfaces which will ensure that sedimentation pollution will be either eliminated or maintained within acceptable limits as established by federal, state and local requirements and by the Owner.
4. Temporary turbidity controls include, but are not limited to, floating or staked turbidity barriers which will ensure that turbidity pollution will be either eliminated or maintained within acceptable limits as established by Federal, state, and local requirements and by the Owner.
5. Contractor is responsible for providing effective temporary erosion, sediment, and turbidity control measures during construction or until permanent controls become effective.

B. Related Work Described Elsewhere: FDOT Standard Specifications for Road and Bridge Construction and FDOT Design Standards.

C. NPDES Permitting – The Contractor shall apply and pay for all Florida Department of Environmental Protection (FDEP) NPDES Permits. The Contractor shall prepare and supply all exhibits, application material, and Stormwater Pollution Prevention Plans to FDEP.

PART 2 - PRODUCTS

2.01 EROSION CONTROL

A. Silt Fence – fabricated of material acceptable to Owner.

2.02 SEDIMENTATION CONTROL

A. Bales - clean, seed-free cereal hay type.

B. Silt Fence - fabricated of material acceptable to the Owner.

- C. Filter stone - crushed stone conforming to Florida Department of Transportation specifications.
- D. Concrete block - hollow, non-load bearing type.
- E. Concrete - exterior grade not less than one inch thick.
- F. Rock Bags – conforming to FDOT Specifications.

2.03 TURBIDITY CONTROL

- A. Conforming to FDOT Design Standards Index 103 - Turbidity Barriers.

PART 3 - EXECUTION

3.01 EROSION CONTROL

- A. Minimum Procedures for Grassing Are:
 - 1. Scarify slopes to a depth of not less than six inches and remove large clods, rock, stumps and roots larger than 1/2 inch in diameter and debris.
 - 2. Sow seed within twenty-four (24) hours after the ground is scarified with either mechanical seed drills or rotary hand seeders.
 - 3. Apply mulch loosely and to a thickness of between 3/4 inch and 1 1/2 inches.
 - 4. Apply netting over mulched areas on sloped surfaces.
 - 5. Roll and water seeded areas in a manner which will encourage sprouting of seeds and growing of grass. Reseed areas which exhibit unsatisfactory growth. Backfill and seed eroded areas.

3.02 SEDIMENTATION CONTROL

- A. Install and maintain silt fence, silt dams, traps, barriers and appurtenances as shown on the approved descriptions and working drawings. Hay bales which deteriorate and filter stone which is dislodged shall be replaced.

3.03 TURBIDITY CONTROL

- A. Install and maintain turbidity barriers daily and as described in FDOT Index103, and FDOT Standard Specifications

3.04 PERFORMANCE

- A. Should any of the temporary erosion and sediment control measures employed by the Contractor fail to produce results which comply with the requirements of the State of Florida, the Owner or Engineer, Contractor shall immediately take whatever steps are necessary to correct the deficiency at his own expense.

End of Section

CLEANING AND DISINFECTION OF WATER SYSTEMS

PART 1 - GENERAL

1-1. SCOPE. This section covers cleaning and disinfection of all wells, raw water, and potable water lines installed, modified, or otherwise contaminated as a result of Work performed under this contract.

In addition, the existing raw water main between the Meadow Woods WSF and the Southern Regional WSF shall be flushed and disinfected under this contract. The main was flushed and disinfected when it was constructed, but has remained inactive since that time. Construction Record drawings of the raw water main to be flushed and disinfected have been included with the Contract Documents.

Reclaimed water lines shall be cleaned and flushed as specified for raw and potable lines, but disinfection of reclaimed piping is not required.

1-2. GENERAL.

1-2.01. Coordination. Contractor shall coordinate flushing and disinfection work with adjacent work as necessary to preclude work interferences or duplication of effort and to expedite the overall progress of the work.

Contractor shall provide all necessary piping, piping connections, temporary valves, backflow preventers, flowmeters, sampling taps, pumps, disinfectant, neutralization agents, chlorine residual test apparatus, and all other items of equipment or facilities necessary to complete the disinfection work.

In the case of the existing raw water main, the accuracy of the Construction Record drawings cannot be guaranteed. The Contractor shall be responsible for locating existing sample taps and fittings for flushing, regardless of where they are shown on Construction Record drawings, or provide new sample taps and connections for flushing.

Water for flushing and disinfection work will be provided as stipulated in the Temporary Facilities section.

In all cases where it is necessary to interrupt service, permission of Owner shall be obtained at least two days before the service will be interrupted.

Unless otherwise specified, final cleaning work shall not be performed until after hydrostatic testing of the lines and any resulting repair work completed.

Contractor shall notify Orange County Utilities prior to the work to allow their representatives to be present during cleaning and/or disinfection of the water lines.

1-2.02. Related Work. Other sections directly related to Work covered in this section are:
02704 – Pipeline Pressure and Leakage Testing
15061 – Ductile Iron Pipe
15067 – Miscellaneous Plastic Pipe, Tubing, and Accessories

1-2.03. Governing Standard. All disinfection work shall conform to the requirements of ANSI/AWWA C651 pipelines and ANSI/AWWA C654 for wells, and the requirements of Florida Department of Environmental Protection, except as modified herein. If any state or local requirements conflict with the provisions of this section, the state and local requirements shall govern.

1-3. SUBMITTALS.

1-3.01. Disinfection Plan. Prior to starting any disinfection work, Contractor shall submit to Engineer a detailed disinfection plan. The plan shall cover the method and procedure proposed, necessary coordination, qualification of personnel performing the disinfection, sequence of operations, equipment to be used, manner of filling and flushing, chlorine injection points, sample points, testing schedule, water source, neutralization, and disposal of wasted water. Personnel performing the disinfection shall demonstrate a minimum of 5 years experience in the chlorination and dechlorination for similar applications.

1-3.02. Testing. Bacteriological testing shall be performed by Owner's staff.

The chlorine residual test shall be performed by Contractor. The test log shall be made available to Owner or Engineer upon request and shall be provided to Engineer upon completion of all chlorine residual testing.

1-4. QUALITY ASSURANCE.

1-4.01. Chlorine Residual Tests. Contractor shall provide the necessary apparatus for making the chlorine residual tests by the drop dilution method as set forth in Appendix A of ANSI/AWWA C651. Test results shall be recorded in a logbook that includes for each test: the location, date, time, test results, and test kit manufacturer.

1-4.02. Bacteriological Tests. Sampling and testing of water in the lines shall be performed after final flushing in accordance with Section 5 of ANSI/AWWA C651.

1-4.03. Redisinfection. Should the bacteriological tests indicate the presence of coliform organisms at any sampling point, the lines shall be reflashed, resampled and retested. If check samples show the presence of coliform organisms, then the lines shall be rechlorinated until acceptable results are obtained.

PART 2 - PRODUCTS

2-1. MATERIALS. All materials furnished by Contractor shall conform to the requirements of ANSI/AWWA C651 and shall be clean and free of debris which could infer questionable test results.

- 2-1.01. Liquid Chlorine. Liquid chlorine shall conform to AWWA B301.
- 2-1.02. Calcium Hypochlorite (Dry). Calcium hypochlorite shall conform to AWWA B300.
- 2-1.03. Sodium Hypochlorite (Solution). Sodium hypochlorite shall conform to AWWA B300.
- 2-1.04. Chlorine Residual Test Kit. Chlorine, residual concentration shall be measured using an appropriate range, drop count, titration kit or an orthotolidine indicator comparator with wide range color discs. The color disc range shall be selected to match chlorine concentration limits. Test kits shall be maintained in good working order and available for immediate test of residuals at point of sampling. Test kits manufactured by Hach Chemical or Hellige are acceptable.

PART 3 - EXECUTION

3-1. CLEANING. The water lines installed under this contract, including all associated valves and fittings, shall be flushed or cleaned to the satisfaction of Owner and Engineer.

All new and existing piping affected by the Work under this contract shall be cleaned by flushing with water at the maximum velocity that can be developed until the piping is free of dirt, debris, and other foreign materials. Cleaning shall precede disinfection. Flushing shall be accomplished through the installed valves or fittings, or through corporation cocks furnished and installed for that purpose.

3-2. DISINFECTION PROCEDURE.

3-2.01. Pipelines. The new lines shall be disinfected by the tablet method, continuous feed method, or slug method. Potable or raw water may be used in conjunction with the chlorination agent.

For the continuous feed or slug method, the chlorination agent shall be injected into the line at the supply end of each new line or valved section thereof.

Admission of disinfectant solution into or the flushing thereof through existing mains shall be held to the minimum possible, and then only after adequate measures have been taken to prevent any such solution of wastewater from entering branch service connections to water customers.

During disinfection, all valves and hydrants shall be operated to ensure that all appurtenances are disinfected. Valves shall be operated such that the chlorine solution in the line being chlorinated will not flow back into the supply line. Check valves shall be used if needed.

Existing mains which may become contaminated during work requiring connections to the new water line, involving either tapping or cutting into operations, shall be flushed and disinfected in accordance with Section 4 of ANSI/AWWA C651.

3-2.02. Wells. The method of chlorination to be used shall consist of treating the water in each well casing and open hole to provide a chlorine residual of no less than 100 mg/L. The chlorine

solution shall be allowed to remain in the well for 24 hours, circulating the chlorinated water within each well casing and pump column; and pumping each well to waste to remove chlorinated water. The quantity of chlorine compounds required to produce a chlorine residual of 100 mg/L may be calculated by multiplying the appropriate quantity shown in ANSI/AWWA C654, Appendix A, Table A.1 by the appropriate factor.

3-3. FINAL FLUSHING. Upon completion of chlorination, but before sampling and bacteriological testing, all heavily chlorinated water shall be removed from the lines by flushing with potable or raw water until the chlorine residual in the lines is not higher than that generally prevailing in the adjacent existing system.

All chlorinated water to be discharged shall be neutralized by chemical treatment and disposed in accordance with the requirements of the governing agency. Rates of flow and locations of discharge of disinfection and flushing water shall be coordinated with state and local regulatory agencies to ensure compliance with all applicable rules and regulations.

3-4. BACTERIOLOGICAL TESTS.

3-4.01. Pipelines. The County will collect one sample per day at each sample point on two consecutive days, and deliver to the County laboratory within six hours of obtaining the samples, and obtain a bacteriologic quality test to demonstrate the absence of coliform organisms in each separate section of the pipeline after chlorination and refilling. At each connection to an existing pipeline, take two additional samples.

3-4.02. Wells. The County will collect 20 samples, two per day provided samples are taken a minimum of six hours apart, and deliver to the County laboratory within six hours of obtaining the samples, and obtain a bacteriological quality test to demonstrate the absence of coliform organisms.

3-4.03. Repetition of Procedure. If the initial chlorination fails to produce required residuals and passing bacteriologic tests, repeat the chlorination and retesting until satisfactory results are obtained. All retesting will be paid for by Contractor.

3-4.04. Test Facility Removal. After satisfactory disinfection, plug/cap sample taps as required by the County and complete the pipeline where temporary disinfection or test facilities were installed.

End of Section

PIPELINE PRESSURE AND LEAKAGE TESTING

PART 1 - GENERAL

1-1. SCOPE. This section covers field hydrostatic pressure and leakage testing of piping. The term "piping" shall be used in this section to refer to piping systems, pipelines, or sections thereof.

Testing of other piping is covered in the Miscellaneous Piping and Accessories Installation section. Cleaning and disinfection of piping is covered in another section if required.

1-2. GENERAL. Unless otherwise specified, testing of piping shall be completed prior to final cleaning and disinfection.

Contractor shall notify federal, state, and local regulatory agencies to determine if any special procedures or permits are required for disposal of water used for pressure and leakage testing and to identify acceptable locations for disposal of the water. All requirements and costs associated with notifications and obtaining any discharge permit or approvals shall be responsibility of Contractor.

Engineer or Engineer's representative shall be present during testing and shall be notified of the time and place of testing at least 3 days prior to commencement of the work. All work shall be performed to the satisfaction of Engineer.

1-2.01. Testing Schedule and Procedure. A testing schedule and test procedure shall be submitted to Engineer for review and acceptance not less than 21 days prior to commencement of testing. The schedule shall indicate the proposed time and sequence of testing of the piping. The testing procedure shall establish the limits of the piping to be tested, the positions of all valves during testing, the locations of temporary bulkheads, and all procedures to be followed in performing the testing.

1-2.02. Special Testing Requirements. Special testing requirements include the following:

Unless otherwise acceptable to Engineer, the general sequence of work for each pipeline, or valved or bulkheaded section thereof, shall be as follows:

- Initial flushing and cleaning of pipeline.
- Filling pipeline.
- Hydrostatic pressure and leakage testing.
- Disinfection.
- Final cleaning, flushing, and neutralization of heavily chlorinated water.
- Bacteriological tests.

Unless otherwise acceptable, temporary bulkheads shall be provided during testing so that the test pressures are not applied to existing or new valves and hydrants, or to existing water lines, or to any portion of water lines installed under this Contract that have already been put into service.

A temporary pressure gauge shall be installed at each end of the limits of the pipeline to be tested.

The tests shall be conducted before connections are made to existing water lines, or to any portion of water lines installed under this Contract that have already been put into service.

All auxiliary hydrant valves shall be closed during pressure testing so that the test pressure is not applied to the hydrant valves.

Unless otherwise acceptable, upon completion of testing and disinfection, connections made to existing water lines or to any portion that has been put into service of new water lines installed under this Contract, shall be visually inspected for leakage after placing the water line into service and before backfilling the connection.

1-2.03. Water. Water for testing shall be furnished as stipulated in the Temporary Facilities section. Following completion of testing, the water shall be disposed of in a manner acceptable to Engineer. Unless otherwise permitted, the water shall be kept out of the remainder of the piping.

PART 2 - PRODUCTS

2-1. TEST EQUIPMENT. All necessary connections between the piping to be tested and the water source, together with pumping equipment, water meter, pressure gauges, and all other equipment, materials, and facilities required to perform the specified tests, shall be provided. All required flanges, valves, bulkheads, bracing, blocking, and other sectionalizing devices shall also be provided. All temporary sectionalizing devices shall be removed upon completion of testing. Vents shall be provided in test bulkheads where necessary to expel air from the piping to be tested.

Test pressures shall be applied by means of a force pump sized to produce and maintain the required pressure without interruption during the test.

Water meters and pressure gauges shall be accurately calibrated and shall be subject to review and acceptance by Engineer.

Permanent gauge connections shall be installed at each location where test gauges are connected to the piping during the required tests. Drilling and tapping of pipe walls will be permitted. Upon completion of testing, each gauge connection shall be fitted with a removable plug or cap acceptable to Engineer.

PART 3 - EXECUTION

3-1. FILLING AND VENTING. Before filling the piping with water, care shall be taken to ensure that all air release valves and other venting devices are properly installed and in the open position. Hand-operated vent valves shall not be closed until an uninterrupted stream of water is flowing from each valve. The rate of filling the piping with water must not exceed the venting capacity of the installed air vent valves and devices.

3-2. BLOCKING AND BACKFILLING. Piping shall be adequately blocked, anchored, and supported before the test pressure is applied.

3-3. PRESSURE TESTING. After the piping to be tested has been filled with water, the test pressure shall be applied and maintained without interruption within plus or minus 5 psi of test pressure for 2 hours plus any additional time required for Engineer to examine all piping being tested and for Contractor to locate any defective joints and pipe materials. The test pressure shall be in accordance with the requirements specified for pipeline or plant piping.

3-3.01. Pipeline Test Pressure. Not used.

3-3.02. Plant Piping Test Pressure. Unless otherwise noted, piping shall be subjected to the test pressure as follows:

Piping downstream of the High Service Pumps – 150 psi

Modified sections of the existing 16" reclaimed water main and piping from the main to the fill valve – 150 psi

Well discharge piping – 100 psi

All other plant piping – 100 psi

3-4. PLANT PIPING LEAKAGE. All plant piping shall be watertight and free from leaks. Each leak which is discovered within the correction period stipulated in the General Conditions shall be repaired by and at the expense of Contractor.

3-5. PIPELINE LEAKAGE TESTING. Following completion of pressure testing and acceptance by Engineer, the pipeline piping shall be subjected to a leakage test. The duration of the leakage test shall be 2 hours plus the additional time required for Engineer to make an accurate determination of leakage.

3-5.01. Leakage Test Pressure. The hydrostatic pressure applied during the leakage test shall be the pressure specified for pressure testing of the piping. The pressure shall be maintained within plus or minus 5 psi [35 kPa] of the test pressure during the entire time that leakage measurements are being performed.

3-5.02. Leakage Measurement. Measurement of leakage shall not be attempted until all trapped air has been vented and a constant test pressure has been established. After the pressure has stabilized, piping leakage shall be measured with a suitable water meter installed in the pressure piping on the discharge side of the force pump.

3-5.03. Allowable Leakage. The term "leakage", as used herein, refers to the total amount of water which must be introduced into the piping during the leakage test to maintain the test pressure.

No piping will be accepted if and while it exhibits a leakage rate in excess of that determined by the indicated formulas:

$$Q = 0.0075 \text{ DLN (using inch-pound units)}$$

Where

Q = allowable leakage in gallons per hour

D = nominal diameter of pipe in inches

L = length of section tested in thousand feet

N = square root of average test pressure in pounds per square inch

$$Q = 1.4 \times 10^{-6} \text{ DLN (using SI units)}$$

Where

Q = allowable leakage in liters per hour

D = nominal diameter of pipe in millimeters

L = length of section tested in meters

N = square root of average test pressure in kilopascals

Whenever the piping to be tested contains pipe of different diameters, the allowable leakage shall be calculated separately for each diameter and the corresponding length of piping. The resulting allowable leakage rates shall be added to obtain the total allowable leakage for the entire piping.

All joints in piping shall be watertight and free from visible leaks during the leakage test. Each leak which is discovered within the correction period stipulated in the General Conditions shall be repaired by and at the expense of Contractor regardless of the amount that the total leakage may have been below the specified allowable leakage rate during the leakage test.

If the leakage test indicates a higher than allowable leakage rate, Contractor shall locate and repair leaking joints and other defective work to the extent necessary to reduce the leakage to an acceptable value.

End of Section

CHAIN LINK FENCING

PART 1 - GENERAL

1-1. SCOPE. This section covers chain link fencing and gates. Fencing shall be provided in the alignment indicated on the drawings and for the following locations:

Site perimeter around water supply wells

1-2. SUBMITTALS. Complete detail drawings and specifications for the fence, gates, and accessories shall be submitted in accordance with the Submittals section.

PART 2 - PRODUCTS

2-1. FENCE TYPES. Fencing shall conform to the specifications and shall be of the following general types.

2-1.01. Site Perimeter. Fencing around site perimeters shall consist fabric as specified herein, with a top rail, bottom tension wire, and three strands of barbed wire mounted on 45 degree extension arms. The upper strand of barbed wire shall be approximately the 18 inches [0.5 m] out from the fence and the same distance above the top of the fabric. Posts shall be set in concrete.

2-1.02 Fencing Fabric and Heights. Fencing heights, unless otherwise specified on the drawings, shall be as follows:

<u>Location</u>	<u>Fabric</u>	<u>Height</u>
Plant perimeter	PVC coated steel wire.	8 ft [1.8 m]

Fence posts shall be set in earth.

2-2. MATERIALS.

2-2.01. Steel Fencing. All steel or malleable iron parts and accessories shall be as follows hot-dip galvanized or aluminum coated after fabrication.

Fabric	9 gage [3.80 mm] thick, 2 inch [50 mm] mesh. PVC coated per ASTM F 668 ,Galvanized per ASTM A392, Class 2, or aluminum coated per ASTM A491. PVC color shall be black.
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Fabric Finish	Knuckled both edges for fabric widths of 60 inches [1500 mm] or less. Knuckled one edge and twisted one edge for fabric widths of 72 inches [1800 mm] or more.
Posts	Steel pipe, ASTM F1043, Group IC, with ASTM F1043, Type B or D interior and Type B exterior protective coating.
Line Posts	2-3/8 inch [60 mm] OD pipe, 3.12 lb/ft [4.6 kg/m].
Terminal Posts (End, corner, and pull posts)	2-7/8 inch [73 mm] OD pipe, 4.64 lb/ft [6.9 kg/m].
Gate Posts	
For gate or leaf wider than 12 feet [4 m]	6-5/8 inch [168 mm] OD pipe, 18.97 lb/ft [28.2 kg/m].
Top Rails	1-5/8 inch [41 mm] OD pipe, 1.40 lb/ft [2.1 kg/m].
Rail Couplings	Sleeve type, 6 inches [150 mm] long, ASTM F626.
Bracing, required when fence height is greater than 6 feet [1.8 m].	Pipe brace same as top rail, with 3/8 inch [10 mm] diameter steel rod truss and tightener.
Post Tops (with barbed wire)	Pressed steel, malleable iron with pressed steel extension arm, or one-piece aluminum casting, ASTM F626.
Barbed Wire	Each strand shall consist of two 12.5 gage [2.51 mm thick] steel wires with four-point barbs; galvanized per ASTM A121, Class 2, or aluminum coated per ASTM A585, Type I.
Stretcher Bars	Steel, ASTM F626, 3/16 by 3/4 inch [5 by 19 mm], or equivalent area.
Fabric Ties	Aluminum bands or wire, ASTM F626.
Gate Frames	Steel tubing, 1-7/8 inch [48 mm] OD, 2.28 lb/ft [3.3 kg/m].
Tension Wire	ASTM A824, galvanized or aluminum coated coil spring wire, 7 gage [4.5 mm thick].

2-2.02. PVC Coating

Class 1 PVC-coated wire shall have the PVC coating extruded onto wire that is zinc-coated or zinc-5% aluminum alloy coated. The PVC coating shall be of black color.

1. Fabric shall be woven in 2-inch mesh from 9-gauge steel wire conforming to the "Standard Specification for Polyvinyl Chloride (PVC) – Coated Steel Chain-Link Fence Fabric".
2. The 9-gauge diameter vinyl fabric woven in a 2-inch mesh shall have a minimum coating thickness of 20 mils bonded to high quality galvanized steel wire having a minimum tensile strength of 100,000 psi with a minimum zinc weight of .3 oz per square foot of uncoated wire surface in accordance with ASTM A116.
3. The vinyl coating shall be bonded over the galvanized steel wire to insure a dense and impervious bonded coating having a smooth and lustrous surface in accordance with RR-F- 191/1C, Type IV. The wire shall be galvanized and vinyl-bonded before weaving and shall be free and flexible at all joints. Ungalvanized wire and non-bonded extruded vinyl coatings are unacceptable. Fabric shall be imprint branded with the manufacturer's name, tensile strength, gauge and country of origin.
4. Plasticized PVC coating shall be stabilized and colorfast to withstand 1500 hour WEATHERO-METER tests ASTM D1499, E 42, Type E. The vinyl-bonded galvanized steel fabric shall be insulated for 12,000 volts, shall be a self-extinguishing character, and shall have a minimum hardness of Durometer A90 \pm 5.

2-2.03. Padlocks. A padlock shall be provided for each gate latch and shall be Schlage "45-102-26D", with two keys. All padlocks shall be keyed alike.

2-3. GATES. Gates shall be swing type, hinged to swing an angle of 90 degrees from closed to open, complete with frames, latches, hinges, braces, three strands of barbed wire if specified for fencing, and fabric. Stops, keepers, and padlocks shall be provided where specified.

Gate leaves shall have intermediate members and diagonal truss rods where necessary for rigid construction and shall be free from sag or twist. When adjacent fence is topped with barbed wire, gates shall be fitted with vertical extension arms or shall have frame end members extended to carry barbed wire. Joints between frame members shall be made by welding or by means of heavy fittings, and shall be rigid and watertight. Gate fabric shall be same as fence fabric and shall be attached to frame ends by stretcher bars, bolt hooks, or other mechanical means.

Hinges shall be of heavy pattern, with large bearing surfaces, and shall not twist or turn under the action of the gate. Latches shall be plunger bar type, full gate height, and arranged to engage the gate stop, except single gates less than 10 feet [3 m] wide shall be provided with a forked latch. Latches shall be arranged for padlocking, with the padlock accessible from both sides of the gate.

Stops shall consist of a roadway plate with anchor set in concrete and arranged to engage the plunger.

Keepers shall consist of mechanical devices for securing and supporting the free end of the gates when in the fully open position.

PART 3 - EXECUTION

3-1. INSTALLATION. The installed fence shall conform to the alignment and finished grade indicated. All posts shall be plumb. Unless otherwise indicated on the drawings, posts shall be spaced approximately 10 feet [3 m] apart for plant perimeter. Where necessary, the fence grade shall be adjusted to fit the ground contour by slipping the fence fabric links. Ground surface irregularities shall be graded to maintain not more than 2 inch [50 mm] clearance below the bottom of the fence fabric.

Where posts are set in earth, concrete foundations 36 inches [900 mm] deep shall be provided. If bedrock is encountered, post excavation shall be continued to the 36 inch [900 mm] depth or 18 inches [450 mm] into the rock, whichever is less. Concrete foundations shall be circular in horizontal section, not less than 10 inches [250 mm] in diameter for line posts, and with a diameter not less than the post OD plus 9 inches [220 mm] for terminal and gate posts, except that foundations in bedrock shall be at least 6 inches [150 mm] larger than the outside dimension of the post. Foundations shall extend above the ground surface and shall be crowned approximately 1 inch [25 mm]. Concrete for foundations shall be a 3000 psi concrete mix. Each foundation shall be cured for at least 72 hours before further work is done on the post.

Top rails and bottom tension wires shall be installed before the fabric. Top rails shall be furnished in at least 18 foot [5.5 m] lengths and shall be securely connected to gate and terminal posts. Tension wires shall be installed approximately 6 inches [150 mm] above grade and shall be attached to each post and securely anchored at terminal and gate posts. Straight runs between braced posts shall not exceed 1,500 feet [460 m]. A terminal post shall be provided at each change in slope.

Fabric shall be attached to the top rail and bottom tension wire at 24 inch [600 mm] centers, and to the line posts at 15 inch [375 mm] centers. Barbed wire, when necessary, shall be fastened to each extension arm by internal clips or external fabric ties. Stretcher bars shall be provided at each gate post and terminal post. Each stretcher bar shall be threaded through the fabric and anchored to the post at 15 inch [375 mm] centers by positive mechanical means.

When necessary, each gate post and terminal post shall be braced by a horizontal pipe brace and an adjustable truss extending to an adjacent line post. Corner posts shall be braced in both directions.

Fabric shall be stretched taut and anchored so that a pull of 150 lbs [670 N] at the middle of a panel will not lift the bottom of the fabric more than 6 inches [150 mm].

Gates shall be installed so that they cannot be removed without disassembly of the hardware. Hardware attachment bolts shall be peened so that removal will be difficult.

Interior and exterior surfaces of aluminum which will be in contact with concrete, mortar, or dissimilar metals shall be given a heavy coat of coal tar paint. The end of each aluminum post to be set in concrete shall be dipped in a container of coal tar paint before installation.

End of Section

PLANT MOTORIZED GATE

PART 1 - GENERAL

1-1. SCOPE. This section covers design, furnishing, and installation of a motorized entrance gate which includes, but is not limited to, security control panels, power supplies, gate and gate operators, gate control panels and Plant Control System (PCS) interface.

The motorized gate shall be compatible with OWNER existing Plant Control System (PCS) interface. The System Supplier shall be responsible to provide all equipment specified herein, and shall subcontract the gate and gate control system to an OWNER approved, certified installer.

All associated equipment, devices, cabling (fiber-optic and copper), system configuration, and controls necessary for proper operation shall be included.

1-2. GENERAL. The System Supplier shall furnish all installation drawings, tools, equipment, conduit, wiring, materials, and supplies and shall perform all labor to complete the work as specified, and in compliance with all applicable codes, standards, and regulations.

System Supplier shall coordinate with CONTRACTOR and any sub-contractors (including electrical) to provide all additional conduit and wiring required for a complete operable system beyond the use of conduit marked for security use as shown on drawings.

The System Supplier shall review the specifications and supply equipment that meets the functional requirements indicated, and shall furnish and install additional or differing components if required.

1-2.01. Supplier's Qualifications. The design, equipment, installation, and installation supervision furnished under this section shall be provided by a manufacturer or supplier who has been engaged in the business of supplying these types of equipment for at least 5 years.

1-2.02. Governing Standards. All wiring and components shall meet the applicable requirements of the NEC.

1-2.03. Nameplates. Major components of equipment shall be identified with a permanently affixed nameplate bearing the manufacturer's name and address, and type or style and catalog number of the item. Name plates shall be as specified in the Equipment, Valve, and Piping Identification section.

1-2.04. Tags. Keys and locks, where required, shall be furnished with tags bearing stamped identification number. Cable and conduit runs, wiring circuits, and all spare parts supplied to maintain the equipment shall be furnished with tags. Tags shall be as specified in the Equipment, Valve, and Piping Identification section.

1-2.05. Power Requirements. Primary power supply to all components will be 120 volts, 60 Hz,

single phase, or 208 volt, 60 Hz. single phase. The System Supplier shall be responsible for meeting all additional power supply requirements and shall furnish any transformers or other power supply equipment needed.

1-3. SUBMITTALS. Complete wiring diagrams; assembly and installation drawings; detailed specifications; and data covering the materials used and the parts, devices, and other accessories forming a part of the equipment furnished shall be submitted in accordance with the submittals section. The equipment submittals shall include the following:

- A complete description of all components, including certification of listing by UL.
- Complete sequence of operation for all functions of the equipment.
- Complete wiring diagram for all components and interfaces to equipment supplied under other sections or by the Owner.
- Location drawings for all components.
- A listing of the manufacturer's representatives responsible for installation and servicing.
- Conduit and cabling to all equipment locations.
- Recommended spare parts list.

1-4. ELECTRIC MOTORIZED GATE.

1-4.01. The facility gate system shall be furnished as a complete package by the System Supplier consisting of a vehicular motorized slide gate as shown on the drawings and as specified herein. The gate system shall include the slide gate, automatic gate operator, and all required structural and safety equipment. Facility ingress shall be by through the Plant Control System (PCS) initiated by the SCADA operator at the Southern or Eastern Regional WSF. Facility egress shall be by road imbedded proximity vehicle detector. The gate controller and gate operation shall be integrated with the Plant Control System (PCS). The gate shall be provided with battery backup.

1-4.02. Slide Gate. The slide gate shall meet the following mechanical specifications.

- The gate shall be "V-track" style rolling gate where two "V" grooved style wheels ride on an angle embedded in a concrete footing. Both "V" grooved wheels to be made of solid cold rolled steel, zinc-plated construction. Wheel to be of a 6" diameter and have a weight capacity of 5,000lbs. The wheel must be capable of continuous operation and must be maintenance free with two sealed bearings on a 5/8" axle. A two year limited warranty covers the wheels.
- "V-track" angle shall be set in concrete footing 1.5' wide x 8" deep, reinforced with 2 #5 continuous parallel to the track and #5 at 12" perpendicular to the track. Footing shall be monolithic with the driveway.
- Gates shall have 2"x 4" rectangular frame with a 2" vertical upright every four feet and 3/16" stainless steel aircraft cable "X" bracing throughout.

- Gates shall have two (2) 2"x 1-1/2" stringers set in frame with 1" pickets set 3-1/8" o.c with a between space of 2-1/8".
- Gate height shall be 8' from grade to top of frame. Provide extension arms at 45 degree angle with 3 strands of barbed wire on top of the gate matching the adjacent chain link fence.
- The width of the gate shall be based on 30 ft of travel and as indicated on the drawings.
- Provide crawl bar to eliminate crawl space under gate frame.
- Gate shall be coated with 6 mil DFT of TCI TG polyester powder coating. Verify color with OWNER.
- Gate construction shall comply with ASTM F2200 and UL 325.

1-4.03. Slide Gate Operator. Gate operation shall be by means of a metal rail passing between a pair of solid metal wheels with polyurethane treads. Operator motors shall be hydraulic, geroller type, and system shall not include belts, gears, pulleys, roller chains or sprockets to transfer power from operator to gate panel. The operator shall generate a minimum horizontal pull of 300 pounds without the drive wheels slipping and without distortion of supporting arms. Operator shall be capable of handling gates weighing up to 3000 pounds. Gate panel velocity shall not be less than 2.0 feet per second and shall be stopped gradually to prevent shock loads to the gate and operator assembly. The "soft stop" feature of the gate operator shall be controlled by two adjustable hydraulic brake valves (one for each direction). The "soft start" feature shall allow the pump to start at zero pressure, then progressively increase the pressure, over a period not less than two seconds, to 1,000 PSI. The gate operator shall be interfaced to the PCS for remote operation and override.

1-4.03.1. Operator Code Requirements. The gate operator shall meet the following regulatory requirements.

- Operators shall be built to UL325 standards.
- Current safety standards require the use of multiple external sensors to be capable of reversing the gate in either direction upon sensing an obstruction.
- Current safety standards require gate operators to be designed and labeled for specific usage classes. HySecurity Model 222 DX gate operators are to be used on Class III and Class IV installations only.

1-4.03.2. Functionality The gate operator shall include the following specifications components and functionality.

- Drive release: Must instantly release tension on both drive wheels, and disengage them from contact with drive rail in a single motion, for manual operation.
- Limit switches: Fully adjustable, toggle types, with plug connection to control panel for gate open and gate closed.
- Two (2) vehicle proximity detection loops for safety and/or free egress operation.
- Electrical enclosure: Oversized, metal, with hinged lid gasketed for protection from

intrusion of foreign objects, and providing ample space for the addition of accessories. Enclosure shall be NEMA Type 3R, pre-galvanized and polyester powder coat finish inside and outside.

- Hydraulic hose: Shall be 1/4" synthetic, rated to 2750 psi.
- Hydraulic valves: Shall be individually replaceable cartridge type, in an integrated hydraulic manifold.
- Hose fittings: At manifold shall be quick-disconnect type, others shall be swivel type.
- Hydraulic fluid: High performance type with a viscosity index greater than 375.
- A zero to 2000-PSI pressure gauge, mounted on the manifold for diagnostics, shall be a standard component.
- The hydraulic fluid reservoir shall be formed from a single piece of metal, non-welded, and shall be powder painted on the inside and the outside, to prevent fluid contamination.
- Pump motor: Shall be 2 HP, 24V DC, 56C, TEFC, continuous duty motor, with a service factor of 1.15, or greater.
- All components shall have overload protection and NEMA Type 4X local disconnect/enclosure.
- Heater with thermostat control for cold or damp climates.
- Gate controller: HySecurity Smart Touch Controller Board with 256K memory or approved equal containing:
 - a. inherent entrapment sensor;
 - b. built in "warn before operate" system;
 - c. built in timer to close;
 - d. liquid crystal display for reporting of functions;
 - e. 26 programmable output relay options;
 - f. anti-tailgate mode;
 - g. built-in power surge/lightening strike protection;
 - h. RS232 port for connection to laptop or other computer peripheral and RS485 connection of Master/Slave systems.
- Low voltage sensor to protect batteries from over discharge. Last operation can be programmed for fail secure or fail open.
- AC power loss operation: the operation can be programmed to open immediately or stay open after next normal operation, or remain in normal operation until batteries are low.
- Control circuit: 24VDC.
- Permanently sealed, maintenance free, lead acid batteries in separate insulated and ventilated enclosure.
- Battery enclosure is NEMA 3R 42"x30"x12" (1.07m x.91m x .30m), pre-galvanized and white polyester powder coat finish inside and outside.
- 20 amp, fully automatic, regulated battery charger.
- Required external sensors installed such that the gate is capable of reversing in either direction upon sensing an obstruction.
 - a. Radio controlled Miller safety edge or approved equal

- b. UL approved EMX IRB photo safety beam with rain shield and with NEMA Type 4X enclosure or approved equal
- c. Siren operated sensor for fire department emergency ingress. Fire department to specify sensor frequency.

The gate operator shall be HySecurity Model 222DX Heavy Duty Industrial Slide Gate Operator or approved equal.

1-4.03.3. Spare Parts. In addition to the Manufacturer's recommended spare parts, Contractor shall furnish one spare limit switch and one spare vehicle detection loop.

1-4.03.4. Warranty The gate and gate operator warranty is:

- System Supplier one (1) year warranty on all labor and materials.
- Manufacturer's warranty on gate operator for five (5) years
- Manufacturer's warranty on gate drive wheels for two (2) years
- Manufacturer's warranty on all labor for one (1) year.

Manufacturer's warranty to commence upon Substantial Completion.

1-5. OPERATION, MAINTENANCE AND INSTRUCTION MANUALS. Operation, Maintenance and Instruction Manuals for the equipment and systems identified in Section 16725 shall be furnished in accordance with Section 01300 – Submittals, and Section 01720 – Project Record Documents and Samples.

1-6. MANUFACTURERS' FIELD SERVICES AND TRAINING. Equipment manufacturers or suppliers shall provide the services of a factory-trained manufacturer's representative or agent and maintenance personnel as required to participate in installation, check-out, and testing of equipment and systems, and in the training of Owner plant operating personnel as required by Section 01650 – Startup Requirements and this section. The representative shall have complete knowledge of proper installation, operation, and maintenance of the equipment and systems supplied.

The manufacturer's representative or agent shall visit the site or classroom designated by the Owner, for the minimum person-days listed below, travel time excluded.

- Full time as required. The System Supplier shall provide on-site supervision of installation.
- 3 days. Inspection, checking, and adjustment of equipment, including submittal of Manufacturer's Certificate of Proper Installation in accordance with 01650 – Startup Requirements.
- 2 days. Participate in Functional Tests, Start-Up Tests, and Demonstration Tests and in preparation of required certifications in accordance with 01650 – Startup Requirements.
- 2 days. Participation in Manufacturer's Training Services of Owner's Personnel.

PART 2 - EXECUTION.

2-1. GENERAL. All work shall be installed in accordance with the manufacturer's diagrams and recommendations except where otherwise indicated.

After completion of the installation, the System Supplier shall clean the inside and the outside of the security equipment and shall remove any dirt and debris from the site.

2-1.01. Cable. Cable shall be installed in accordance with Section 16050. The conductors shall be installed in conduits or junction boxes separate from conductors of other systems. Conduit fill shall meet applicable NEC requirements.

2-1.02. Raceways. Conduit shall be installed in accordance with section 16050. Exposed conduit systems shall be rigid steel. Concealed conduit systems shall be PVC schedule 40.

2-2. FIELD QUALITY CONTROL, CHECKOUT AND TESTING. The Contractor shall perform field quality control, checkout, and testing, and shall submit required documentation in accordance with Section 01400, 01650, and any special field testing requirements as may be listed below or elsewhere in this section of these project specifications. Shop testing, if required, is addressed elsewhere in this section.

Prior to starting any on-site testing the Contractor shall submit a testing protocol to the PM in accordance with the requirements of Section 01650. The protocol shall address preparation, calibration, testing procedures, measurement, and documentation for the required Functional, Start-Up, and Demonstration tests.

End of Section

SEEDING AND SODDING

PART 1 - GENERAL

1.01 SUMMARY. All disturbed areas at the wastewater plant site shall be seeded. All other disturbed areas shall be sodded.

A. This section includes the following areas of Work:

1. Fine Grading
2. Seeding and sodding of new lawn areas
3. Preparation of lawn areas
4. Fertilizing of lawn areas
5. Maintenance

B. Related Work Specified Elsewhere:

1. Trenching and backfilling for utilities

1.02 SUBMITTALS

A. Certificates:

1. Fertilizer shall be accompanied by certificate from vendors certifying they meet requirements of these Specifications, stating botanical name, percentage by weight and percentage of purity.
2. A copy of supplier's invoices for all seed, mulch, and fertilizer which shows the quantity by weight purchased for the project and representative labels bearing the manufacturer's or vendor's guaranteed statement of analysis shall be submitted to Engineer for review and approval to assure compliance with specified requirements for quality and application rates.
- 3.

PART 2 - PRODUCTS

2.01. TOPSOIL Provide from off site borrow, or from project on-site excavation as approved by Engineer.

2.02. SEED The seed species shall be Argentine Bahia (Paspalum Notatum).

2.03. SOD Provide strongly rooted sod, not less than 2 years old and free of weeds and undesirable native grasses. Provide only sod capable of growth and development when planted (viable, not dormant) and in strips not more than 18" wide x 4' long. Sod species shall be Argentine

Bahia (Paspalum Notatum).

2.04 FERTILIZER

- A. Commercial fertilizer of neutral character, with some elements derived from organic sources, containing not less than 8% phosphoric acid, 8% potassium, and percentage of nitrogen required to provide less than 1.0 lb. of actual nitrogen per 1,000 square feet of lawn area. Provide nitrogen in form that will be available to the lawn during initial period of growth. The chemical designation shall be 12-8-8.
- B. Deliver to site in labeled bags or containers.
- C. Should commercial seed not be available with a minimum total germination percentage as specified herein, the contractor will increase the quantity of seed to achieve the quantities of pure live seed specified.

2.05 WATER FOR GRASSING

- A. Water shall be free of acid, alkali, or organic materials and shall have a pH of 7.0 to 8.5. Provide all water needed for grassing. Provide permanent or temporary piping valves, and temporary trucks to convey water from the source to the point of use. Provide any meters required and pay for water used if the water is taken from a public water system. Water shall be free of petroleum products, pesticides and any other deleterious constituents.

PART 3 - EXECUTION

3.01 COORDINATION OF WORK

- A. Coordinate all work activities to provide for establishment of grass cover at the earliest possible time in the construction schedule to minimize erosion of topsoil.

3.02 SOIL PREPARATION

- A. Dispose of any existing sod, growth, rocks, or other obstructions which might interfere with tilling, seeding, sodding, or later maintenance operations. Remove stones over 1-1/2 inches in any dimensions and sticks, roots, rubbish, and other extraneous matter. Remove from site, do not stockpile.
- B. Till to a depth of not less than 12 inches. Thoroughly loosen and pulverize topsoil.
- C. Grade lawn areas to a smooth, even surface with loose, uniformity firm texture. Roll and rake, remove ridges and fill depressions to meet finish grades. Limit fine grading to areas which can be planted within immediate future.
- D. Moisten prepared lawn areas before planting if soil is dry. Water thoroughly and allow surface to dry off before planting of lawns. Do not create a muddy soil condition.

- E. Restore prepared areas to specified condition if eroded or otherwise disturbed after the fine grading and prior to planting.
- F. Spread planting soil mixture to depth required to meet thickness, grades, and elevations indicated after light rolling and natural settlement. Do not spread if material is frozen or if subgrade is frozen.
- G. Preparation of Unchanged Grades:
 - 1. Where lawns are to be planted in areas that have not been altered or disturbed by excavating, grading, or stripping operations, prepare soil for lawn planting as follows:
 - a. Till to a depth of not less than 12 inches
 - b. Apply soil amendments and initial fertilizers
 - c. Remove high areas and fill in depressions
 - d. Till soil to a homogeneous mixture of fine texture, free of lumps, clods, stones, roots and other extraneous matter
- H. Allow for a 3" sod thickness in areas to be added adjacent paving.
- I. Prior to preparation of unchanged areas, remove existing grass, vegetation and turf. Dispose of such material outside of Owner's property: do not turn over into soil being prepared for lawn.
- J. Place approximately ½ of the total amount of planting soil required. Work into the top of the loosened subgrade to create a transition layer and then place the remainder of the planting soil.

3-2. SEEDING.

3-2.01 Seed Application. Seed shall be applied within 72 hours after preparation of the seedbed. Seed shall be applied with equipment designed to give uniform application. Any method or combination of methods which uniformly distributes the seed directly in contact with the soil, covers the seed, and firms the bed, may be selected. Seed shall be placed approximately 1/4 inch [6 mm] below the surface.

3-2.02. Mulching. All seeded areas shall be mulched within 24 hours following seed application. The mulching operation shall be in accordance with FDOT Standards.

3.03 SODDING NEW LAWNS

- A. Prior to laying sod, contact owner for inspection of soil preparation work. Lay sod within 24 hours from time of stripping. Do not plant dormant sod or if ground is frozen.
- B. Lay sod to form a solid mass with tightly fitted joints. Butt ends and sides of sod strips; do

not overlap. Stagger to offset joints in adjacent courses. Work form boards to avoid damage to subgrade or sod. Tamp or roll lightly to ensure contact with subgrade. Work sifted soil into minor cracks between pieces of sod; remove excess to avoid smothering of adjacent grass.

- C. Anchor sod on slopes with wood pegs as required to prevent slippage.
- D. Water sod thoroughly with a fine spray immediately after planting.

3.04 RECONDITIONING LAWNS

- A. Recondition lawn areas damaged by Contractor's operations, including storage of materials or equipment and movement of vehicles. Also recondition lawn areas where settlement or washouts occur or where minor regrading is required. Recondition other existing lawn areas where indicated.
- B. Provide fertilizer or sod, and soil amendments as specified for new lawns and as required to provide satisfactorily reconditioned lawn. Provide new planting soil as required to fill low spots and meet new finish grades.
- C. Cultivate bare and compacted areas thoroughly to provide a good, deep planting bed.
- D. Remove diseased or unsatisfactory lawn areas; do not bury into soil. Remove topsoil containing foreign materials resulting from Contractor's operations including oil drippings, stone, gravel, and other construction materials. Replace with new topsoil.
- E. Where substantial lawn remains (but is thin), mow, rake, aerate if compacted, fill low spots, remove humps and cultivate soil, fertilize, and seed. Remove weeds before seeding or, if extensive, apply selective chemical weed killers as required. Apply a seedbed mulch, if required, to maintain moist condition.
- F. Water newly planted areas and keep moist until new grass is established.

3.05 PROTECTION

- A. Erect barricades, warning signs and fencing to protect newly planted areas from traffic. Maintain barricade fencing and warning signs throughout maintenance period until substantial completion of project.

3.06 MAINTENANCE

- A. Mow sod to a height of 2 inches as soon as there is enough top growth to cut with mower. Remove no more than 40% of grass leaf growth in initial or subsequent mowing. Do not delay mowing until grass blades bend over and become matted.
- B. Maintain lawns by watering, fertilizing, weeding, mowing, trimming, and other operations such as rolling, re-grading, replanting as required to establish a smooth, acceptable lawn, free

from eroded or bare areas.

- C. Remove weeds by pulling or chemical treatment.
- D. Perform maintenance until the date of substantial completion of project.
- E. Apply second fertilizer application after first mowing and when grass is dry. Use fertilizer which will provide not less than 1.0 pound of actual nitrogen per 1,000 square feet of lawn area.
- F. Replant bare areas using same materials specified for lawns.
- G. Watering: Provide and maintain temporary piping, hoses, and lawn watering equipment as required to convey water from water sources and to keep lawn areas uniformly moist as required for proper growth.
- H. Layout temporary lawn watering system and arrange watering schedule to avoid walking over muddy areas. Use equipment and water to prevent puddling and water erosion and displacement of seed or mulch (if any).
- I. Maintain a balanced watering program. Maintain all grassed areas for a period of 90 days after the date of substantial completion and guarantee against all defects and faults of material and workmanship.
- J. Apply water in sufficient quantities and as often as seasonal conditions require to keep the grassed areas moist.
- K. Provide supplemental water and irrigation to sod areas when the rainfall is not adequate to maintain soil moisture necessary for growth of the grass. It is Contractor's responsibility to determine the quantities of water required and when to irrigate. This obligation shall remain in full force and effect until final acceptance of the work by Owner and shall be provided at no additional cost to Owner.
- L. Owner, at his discretion, may relieve Contractor of this obligation at such time as Owner is able to provide irrigation. This action, however, does not relieve Contractor of the provisions and guarantees set forth in the Contract Documents.

3.07 ACCEPTANCE OF LAWNS

- A. When lawn work is substantially complete, including maintenance, Engineer and Owner will, upon request, make an inspection to determine acceptability:
 - 1. Lawn Work may be inspected for acceptance in parts agreeable to Owner, provided Work offered for inspection is complete, including maintenance.
- B. Replant rejected Work and continue specified maintenance until re-inspected by Engineer and Owner and found to be acceptable.

- C. Sodded lawns will be acceptable provided requirements, including maintenance, have been complied with, and a healthy, well-rooted, even-colored, viable lawn is established, free of weeds, open joints, bare areas and surface irregularities.
- D. Seeded areas: perform all work necessary, including watering and fertilizing, to sustain an established turf until final acceptance, at no additional expense to the County. Provide the filling, leveling, and repairing of any washed or eroded areas, as may be necessary.
- E. Established turf is defined as follows:
 - a. An established root system (leaf blades break before seedlings or sod can be pulled from the soil by hand).
 - b. No bare spots.
 - c. No open joints.
 - d. No deformation of the turf areas caused by mowing or other Contractor equipment.
 - e. No pests or noxious weeds.
- F. Monitor turf areas and remove all competing vegetation, pest plants, and noxious weeds (as listed by the Florida Exotic Pest Plant Council, Category I “List of Invasive Species”, Current Edition, <http://www.fleppc.org>). Remove such vegetation regularly by manual, mechanical, or chemical control means, as necessary. When selecting herbicides, pay particular attention to ensure use of chemicals that will not harm desired turf or wildflower species.
- G. If at the time that all other work on the project is completed, but all turf areas have not met the requirements for established turf set forth in this section, continuously maintain all turf areas until the requirements for established turf set forth in this section have been met. During the entire establishment period and until turf is established in accordance with this specification, continue inspection and maintenance of erosion and sedimentation control items in accordance with Section 104. Take responsibility for the proper removal and disposal of all erosion and sedimentation control items after turf has been established.
- H. Notify the Engineer, with a minimum of seven calendar days advance notice, to conduct inspections of the turf at approximate 90-day intervals during the establishment period to determine establishment. Results of such inspections will be made available to the Contractor within seven calendar days of the date of inspection. Determination of an established turf will be based on the entire project and not in sections.
- I. Upon the determination by the Engineer that the requirements of this section have been met and an established turf has been achieved and all erosion and sedimentation control items have been removed, the Engineer will release the Contractor from any further responsibility provided for in this Specification.

3.08 GUARANTEE

- A. Guarantee all grass areas to be alive and in satisfactory growth 30 days after substantial

completion of planting.

- B. Replace any grass that is dead or not in satisfactory growth, as determined by the owner or Owner's representative. Guarantee new sod or seed for an additional 30 days.
- C. The term "Satisfactory Growth" as used in this section is defines as even plant growth in healthy conditions without bare spots larger then one square foot in seeded areas and without bare spots in sodded areas. Bare spots in sodded areas shall be resodded. All grassed and sodded areas shall be maintained until satisfactory growth has been demonstrated. In the event that the subsequent stand of grass is found contaminated with weeds or other obnoxious or undesirable growth, effectively eliminate such undesirable growth, at the Contractor's expense.
- D. Replace sod with the same variety as initially specified.

3.09 CLEANUP

- A. Promptly remove soil and debris created by lawn work from paved areas. Clean wheels of vehicles prior to leaving site to avoid tracking soil onto surfacing of roads, walks, or other paved areas.

End of Section

Section 03301

MISCELLANEOUS CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1-1. SCOPE. This section covers all cast-in-place concrete, including reinforcing steel, forms, finishing, curing, and appurtenant work. All concrete shall be air-entrained.

1-2. GENERAL. All cast-in-place concrete shall be accurately formed and properly placed and finished as indicated on the drawings and as specified herein.

1-3. SUBMITTALS. All submittals of drawings and data shall be in accordance with the Submittals Procedures section.

1-4. STORAGE AND HANDLING. Cement shall be stored in suitable moistureproof enclosures. Cement which has become caked or lumpy shall not be used.

Aggregates shall be stored so that segregation and the inclusion of foreign materials are prevented. The bottom 6 inches [150 mm] of aggregate piles in contact with the ground shall not be used.

Reinforcing steel shall be carefully handled and shall be stored on supports that will prevent the steel from touching the ground.

PART 2 - PRODUCTS

2-1. LIMITING REQUIREMENTS. Unless otherwise specified, concrete shall be controlled within the following limiting requirements.

2-1.01. Cement Content. The quantity of Portland cement in the concrete shall be not less than that indicated in the following table:

Quantity of Cement (lb/yd ³) [kg/m ³]			
Coarse Aggregate		Size	
from No. 4 [4.75 mm] Sieve to			
3/8 in. [9.5 mm]	1/2 in. [12 mm]	3/4 in. [19 mm]	1 in. [25 mm]
600 [355]	580 [344]	560 [333]	535 [318]

Fine Aggregate	Clean natural sand, ASTM C33. Artificial or manufactured sand will not be acceptable.
Coarse Aggregate	Non-reactive crushed rock, washed gravel, or other inert granular material conforming to ASTM C33, class 4S, except that clay and shale particles shall not exceed 1 percent.
Water	Potable.
Admixtures	
Water-Reducing	ASTM C494, Type A or D.
Air-Entraining	ASTM C260.
Superplasticizing	ASTM C494, Type F or G.
Reinforcing Steel	
Bars	ASTM A615, Grade 60, deformed.
Welded Wire Fabric	ASTM A185 or A497.
Bar Supports	CRSI Class 1, plastic protected; or Class 2, stainless steel protected.
Mechanical Connector (Couplers or Form Savers)	Classified Type 2 per ACI 318. Use only where indicated on the drawings.
Forms	
Plywood Product	Standard PS1, waterproof, resin-bonded, exterior type, Douglas fir.
Lumber	Straight, uniform width and thickness, and free from knots, offsets, holes, dents, and other surface defects.
Form Coating	Nonstaining and nontoxic after 30 days, VOC-compliant; Burke "Form Release (WB)", L&M Chemical "E Z Strip", Nox-Crete "Form Coating", or Symons "Thrift Kote E".
Pre-Cure Finishing Aid	Burke "Finishing Aid Concentrate", Euclid "Eucbar", L&M Chemical "E-Con", Master Builders "Confilm", or Sika "Sikafilm".

Polyethylene Film	Product Standard PS17 or ASTM D 4397, 6 mils [150 µm] or thicker.
Vapor barrier and seam tape	Polyolefin geomembrane, Stego Wrap, 15 mils [0.38 mm] Vapor Barrier. Stego Wrap Red polyethelene tape.
Membrane Curing Compound and Floor Sealer	
VOC – EPA	ASTM C1315, Type I, Class A, maximum VOC 5.8 lb/gal [700 g/L], minimum 25 percent solids, acrylic, nonyellowing, unit moisture loss 0.40 kg/m ² maximum in 72 hours.
VOC – Compliant	ASTM C1315, Type I, Class A, water based, VOC-compliant acrylic, maximum VOC 2.9 lb/gal [350 g/L], minimum 30 percent solids, nonyellowing, unit moisture loss 0.40 kg/m ² in 72 hours maximum.

2-3. PRELIMINARY REVIEW. The source and quality of concrete materials and the concrete proportions proposed for the work shall be submitted to Engineer for review before concrete is placed.

2-4. FORMS. Forms shall be designed to produce hardened concrete having the shape, lines, and dimensions indicated on the drawings. Forms shall be substantial and sufficiently tight to prevent leakage of mortar and shall be maintained in proper position and accurate alignment.

Forms for pavement, curbs, or gutters shall be made of steel and shall be supported on thoroughly compacted earth. The top face of pavement forms shall not vary from a true plane more than 1/4 inch in 10 feet [2 mm/m].

Forms shall be thoroughly cleaned and oiled before concrete is placed.

Where concrete is placed against gravel or crushed rock which does not contain at least 25 percent material passing a No. 4 [4.75 mm] sieve, such surfaces shall be covered with polyethylene film to protect the concrete from loss of water. Joints in the film shall be lapped at least 4 inches [100 mm].

2-4.01. Form Ties. Form ties shall be of the removable end, permanently embedded body type, and shall have sufficient strength and rigidity to support and maintain the form in proper position and alignment without the use of auxiliary spreaders.

2-4.02. Edges and Corners. Chamfer strips shall be placed in forms to bevel all salient edges and corners, except the top edges of walls and slabs which are to be tooled and edges which are to be buried. Unless otherwise noted, bevels shall be 3/4 inch [19 mm] wide.

2-4.03. Form Removal. Forms shall not be removed or disturbed until the concrete has attained sufficient strength to safely support all dead, live, and construction loads. Care shall be taken in form removal to avoid surface gouging, corner or edge breakage, and other damage to the concrete.

2-5. REINFORCEMENT. Reinforcement shall be accurately formed and positioned and shall be maintained in proper position while the concrete is being placed and compacted. Unless otherwise indicated on the drawings, the details of fabrication shall conform to ACI 315 and 318. In case of conflict, ACI 318 shall govern. Reinforcement shall be free from dirt, loose rust, scale, and contaminants. Mechanical connections shall be used only as indicated on the drawings.

2-6. BATCHING AND MIXING. Concrete shall conform to ASTM C94 and shall be furnished by an acceptable ready-mixed concrete supplier.

2-6.01. Consistency. The consistency of concrete shall be suitable for the placement conditions. Aggregates shall float uniformly throughout the mass, and the concrete shall flow sluggishly when vibrated or spaded. The slump shall be kept uniform.

2-6.02. Delivery Tickets. A delivery ticket shall be prepared for each load of ready-mixed concrete and a copy of the ticket shall be handed to Engineer by the truck operator at the time of delivery. Tickets shall indicate the name and location of the concrete supplier, the project name, the mix identification, the quantity of concrete delivered, the quantity of each material in the batch, the outdoor temperature in the shade, the time at which the cement was added, and the numerical sequence of the delivery.

PART 3 - EXECUTION

3-1. PLACEMENT. Contractor shall inform Engineer at least 24 hours in advance of the times and places at which he intends to place concrete.

Methods of conveying concrete to the point of final deposit and of placing shall prevent segregation or loss of ingredients. During and immediately after placement, concrete shall be thoroughly compacted and worked around all reinforcement and embedments and into the corners of the forms. Concrete shall be compacted by immersion-type vibrators, vibrating screeds, or other suitable mechanical compaction equipment. The use of "jitterbug" tampers to compact concrete flatwork will not be permitted.

3-2. WATER STOPS. Each water stop shall be continuous throughout the length of the joint in which it is installed. Water stops shall be clean, free from coatings, and shall be maintained in proper position until surrounding concrete has been deposited and compacted.

Junctions between adjacent sections of metal water stops shall be lapped 5 inches [130 mm] and securely bolted, screwed, or spot welded together.

Junctions between adjacent sections of elastomeric (PVC) water stops shall be spliced in strict conformity with the recommendations of the manufacturer. Directional changes and intersections shall be factory fabricated by the water stop manufacturer prior to delivery to the site of the work. Field splices will be acceptable only in straight sections.

3-3. FINISHING. Recesses from form ties shall be filled flush with mortar. Fins and other surface projections shall be removed from all formed surfaces, except exterior surfaces that will be in contact with earth backfill.

Unless otherwise specified, unformed surfaces shall be screeded and given an initial float finish as soon as the concrete has stiffened sufficiently for proper working. Any piece of coarse aggregate which is disturbed by the float or which causes a surface irregularity shall be removed and replaced with mortar. Initial floating shall produce a surface of uniform texture and appearance, with no unnecessary working of the surface.

Initial floating shall be followed by a second floating at the time of initial set. The second floating shall produce a finish of uniform texture and color and the completed finish for unformed surfaces unless indicated otherwise.

3-3.01. Troweling. Interior floor surfaces which will be exposed after construction is completed; exposed top surfaces of equipment bases and interior curbs; and other surfaces designated on the drawings shall be steel trowel finished. Troweling shall be performed after the second floating when the surface has hardened sufficiently to prevent an excess of fines being drawn to the surface. Troweling shall produce a dense, smooth, uniform surface free from blemishes and trowel marks.

3-3.02. Application of Pre-Cure Finishing Aid. Unless the concrete surface is to receive a finish coating system, concrete flatwork subject to rapid evaporation due to hot weather, drying winds, and sunlight may be protected with a pre-cure finishing aid. The finishing aid shall form a monomolecular film on the surface of fresh, plastic concrete to retard evaporation.

Immediately following screeding, pre-cure finishing aid shall be sprayed over the entire surface of fresh, plastic concrete flatwork at a rate of not less than 200 square feet per gallon [4 m²/L], in accordance with the manufacturer's recommendations. The spray equipment shall have sufficient capacity to continuously spray finishing aid at approximately 40 psi [275 kPa] with a suitable nozzle as recommended by the manufacturer.

The sprayable solution shall be prepared as recommended by the manufacturer.

Under severe drying conditions, additional applications of finishing aid may be required following each floating or troweling, except the last finishing operation.

3-3.03. Pavement. Following placement and consolidation, and the disappearance of bleed water, the concrete surface shall be broom finished with a broom acceptable to Engineer. The broom shall be not less than 18 inches [450 mm] wide and made from good quality bass or bassine fibers not more than 5 inches [125 mm] long. The broom finishing shall produce regular corrugations not over 1/8 inch [3 mm] deep. The broom shall be pulled square across the

surface, from edge to edge, with adjacent strokes slightly overlapped, and shall not tear the concrete surface.

The surface of pavements shall not vary more than 1/8 inch [3 mm] under a 10 foot [3 m] straightedge placed parallel to the center line.

3-3.04. Curb and Gutter. Curb and gutter shall be finished to the shape indicated on the drawings. After the forms have been removed, all exposed edges shall be rounded, using an edging tool with a 1/8 inch [3 mm] corner radius. Exposed surfaces shall be float finished and given a light broom finish applied at right angles to the curb at the time of initial set, using a horsehair broom.

3-3.05. Sidewalks. Concrete surfaces shall be screeded to the proper elevation and contour. All aggregates shall be completely embedded in mortar. Screeded surfaces shall be given an initial float finish as soon as the concrete has stiffened sufficiently for proper working. Any piece of coarse aggregate which is disturbed by the float or which causes a surface irregularity shall be removed and replaced with mortar. Initial floating shall produce a surface of uniform texture and appearance, with no unnecessary working of the surface. Initial floating shall be followed by a second floating at the time of initial set.

Floated surfaces shall be given a light broom finish, using a horsehair broom, to provide a nonslip surface. Brooming shall be done at right angles to the length of the walk.

Sidewalks shall be edged using a 3 or 4 inch [75 or 100 mm] wide edging tool with a 1/8 inch [3 mm] corner radius. Edger lap marks at corners of each slab shall be carefully removed. False joints shall be provided at right angles to the length of the walk, using a grooving tool with 1/8 inch [3 mm] radius. The finished edge on each side of the joint shall be the same width as the edging tool used. False joints shall divide each sidewalk into square sections.

The finished surface of all sidewalks shall be neat in appearance, shall be sloped to drain, and shall not pond water.

3-4. CURING. Concrete shall be protected from loss of moisture by water saturation or by membrane curing for at least 7 days after placement; however, when concrete is also being protected from low temperatures, the period of curing by saturation shall be 1 day less than the duration of the low temperature protection.

Water saturation shall be used on concrete which receive a finish coating system, or be covered by mortar or additional concrete. Water saturation or membrane curing compound may be used on all other concrete surfaces.

Water saturation of concrete surfaces shall begin as soon as possible after initial set. Unformed surfaces shall be covered with polyethylene film, tarpaulins, or sand to retain the water. Water shall be applied as often as necessary to keep the concrete saturated for the entire curing period. Acceptable methods of water curing are described in ACI 308.

Membrane curing compound shall be sprayed at a coverage rate of not more than 300 square feet per gallon [7 m²/L]. Unformed surfaces shall be covered with curing compound within 30 minutes after final finishing. If forms are removed before the end of the specified curing period,

curing compound shall be immediately applied to the formed surfaces. Curing compound shall be suitably protected against abrasion during the curing period.

Concrete shall be protected against freezing for at least 8 days after placement.

3-5. REPAIRING DEFECTIVE CONCRETE. Defects in concrete surfaces shall be repaired to the satisfaction of Engineer. All concrete which is honeycombed or otherwise defective shall be cut out and removed to sound concrete, with edges cut square to avoid feathering.

Concrete repair work shall conform to Article 5.3.7 of ACI 301 and shall be performed in a manner that will not interfere with thorough curing of surrounding concrete. Repair work shall be adequately cured.

3-6. FIELD CONTROL TESTING.

3-6.01. Air Content. An air content test shall be made on concrete from each batch of concrete from which concrete compression test cylinders are made. Contractor shall provide all equipment and supplies necessary for the testing. Air content shall be determined in accordance with ASTM C231.

3-6.02. Slump. A slump test shall be made on concrete from each batch of concrete from which concrete compression test cylinders are made. Slump shall be determined in accordance with ASTM C143.

3-6.03. Test Cylinders. Compression test specimens shall be made, cured, stored, and delivered to the laboratory in accordance with ASTM C31 and C39. Compressive strength tests will be evaluated in accordance with ACI 318 and as specified herein.

One set of 6 inch [150 mm] diameter by 12 inch [300 mm] concrete test cylinders shall be cast for each concrete pour. A set of test cylinders shall consist of four cylinders, two to be broken and to have compressive strengths averaged at 7 days, and two to be broken and to have compressive strengths averaged at 28 days. All concrete required for testing shall be furnished by, and at the expense of, Contractor.

The cured cylinders shall be tested by an independent testing laboratory at the expense of Owner.

End of Section

Section 03600

GROUTING

PART 1 - GENERAL

1-1. SCOPE. This section covers procurement and installation of grout. Unless otherwise specified, only nonshrink grout shall be furnished.

Epoxy grouting of anchor bolts, threaded rod anchors, and reinforcing bars is covered in the anchorage in concrete and masonry section. Grouting of masonry is covered in the building masonry section.

1-2. SUBMITTALS. A letter of certification indicating the types of grout to be supplied and the intended use of each type shall be submitted in accordance with the Submittals Procedures section.

1-3. DELIVERY, STORAGE, AND HANDLING. Materials shall be handled, transported, and delivered in a manner which will prevent damage of any kind. Materials shall be protected from moisture.

PART 2 - PRODUCTS

2-1. MATERIALS.

Nonshrink Grout	Precision cementitious grout with demonstrated non-shrinking properties; L&M "Crystex", Master Builders "Masterflow 713" or "Set Grout", Sauereisen "F-100 Level Fill Grout", Sonneborn "SonogROUT 10K", Hilti "CG 200 PC", or Five Star Products "Five Star Grout".
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Water	Clean and free from deleterious substances.
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2-2. CEMENTITIOUS GROUT. Cementitious grout shall be furnished factory premixed so that only water is added at the jobsite.

2-3. EPOXY GROUT. Epoxy grout shall be used in lieu of cementitious grout when required by the equipment manufacturer for performance or warranty requirements. Epoxy grout products and installation procedures shall be submitted to Engineer for approval.

PART 3 - EXECUTION

3-1. PREPARATION. The concrete foundation to receive nonshrink grout shall be saturated with water for at least 12 hours preceding grouting unless additional time is required by the grout manufacturer.

3-2. INSTALLATION.

3-2.01. Mixing. Grout shall be mixed in a mechanical mixer. No more water shall be used than is necessary to produce a flowable grout.

3-2.02. Placement. Unless otherwise specified or indicated on the Drawings, grout under baseplates shall be 1-1/2 inches [38 mm] thick. Grout shall be placed in strict accordance with the directions of the manufacturer so that all spaces and cavities below the baseplates are completely filled without voids. Forms shall be provided where structural components of baseplates will not confine the grout.

3-2.03. Edge Finishing. In all locations where the edge of the grout will be exposed to view, the grout shall be finished smooth after it has reached its initial set. Except where shown to be finished on a slope, the edges of grout shall be cut off flush at the baseplate.

3-2.04. Curing. Nonshrink grout shall be protected against rapid loss of moisture by covering with wet cloths or polyethylene sheets. After edge finishing is completed, the grout shall be wet cured for at least 3 days and then an acceptable membrane curing compound shall be applied.

End of Section

Section 04200

MASONRY

PART 1 - GENERAL

1-1. SCOPE. This section covers the furnishing and installing of building masonry. Ceramic tile and masonry water-repellant or stain coatings are covered in other sections.

1-2. GENERAL. Building masonry shall be constructed of units of the types, dimensions, arrangements, and coursing indicated on the Drawings and specified herein, complete with all materials, accessories, and appurtenances indicated and specified.

1-3. DELIVERY, STORAGE, AND HANDLING. Shipping shall be in accordance with the Product Delivery Requirements section. Handling and storage shall be in accordance with the Product Storage and Handling Requirements section.

All masonry units shall be handled in a manner which will prevent soiling, chipping, or damage of any kind. Broken, discolored, chipped, or otherwise damaged facing units will be rejected and shall be replaced with undamaged units.

Masonry units shall be stored on pallets, shall be protected against contamination and staining, and shall be kept covered and dry at all times. Lime and cement shall be stored under cover in a dry place.

Sand shall be stored so that the inclusion of foreign materials is prevented. Whenever sand is piled directly on the ground, the surface beneath the sand shall be smooth, well drained, and free from dust, mud, and debris. The bottom 6 inches of each pile shall not be used in mortar.

Insulation shall be stored under cover in a dry place, and shall be protected from the weather at all times.

1-4. SUBMITTALS. Before masonry construction is begun, the following drawings, data, specimens, and samples shall be submitted in accordance with the Submittals Procedures section. Additional data shall be submitted as needed. If the source of a material is changed during the course of the work, the tests and reports required for preliminary review of that material shall be resubmitted.

Specimens, performance data, and color selection kits for all masonry units which will be used in the Work, showing range of colors, textures, finishes, and dimensions.

Manufacturer information and data for any admixture, mortar coloring, or product added to the grout or mortar.

One sample, at least 6 inches long, of each type of nonmasonry joint material required.

Shop drawings or manufacturers' literature showing details of anchors, ties, and metal accessories to be used in masonry construction.

Bar lists and drawings for the fabrication and placement of reinforcement with

sufficient elevations and sections to adequately detail and label all reinforcement.

Cold and hot weather construction procedures.

Certificates for the following materials used in masonry construction, indicating compliance with the standards herein. Verification of f'_m will be required every 5000 square feet during construction of essential facilities.

Masonry units.

Mortar and grout materials.

Reinforcement.

Anchors, ties, fasteners, and metal accessories.

For each mortar mix, one of the following:

Mix designs indicating type and proportions of ingredients in compliance with the proportion specification of ASTM C270.

Mix designs and mortar tests performed in accordance with the property specification of ASTM C270.

For each grout mix, one of the following:

Mix designs indicating type and proportions of ingredients in compliance with the proportion requirements of ASTM C476.

Mix designs and grout strength tests performed in accordance with ASTM C476.

1-5. COLORS AND SAMPLES. Not used.

1-6. BRICK ALLOWANCE. Not used.

1-7. UNIT STRENGTH METHOD. The design compressive strength of masonry, f'_m shall be based on the unit strength method.

Masonry construction shall not begin until Engineer has reviewed the applicable submittals for strength of masonry units and mortar.

PART 2 - PRODUCTS

2-1. MATERIALS. All acceptable masonry products are indicated below. Products necessary for the work are as specified or as indicated on the Drawings. Sizes of masonry units are nominal, the actual size being slightly smaller to allow for mortar joints.

Concrete block	ASTM C90, (UBC Standard 21-4), 8 inch x 16 inch face dimensions, sizes with special shapes as indicated on the Drawings; lightweight or regular aggregate conforming to ASTM C331 or C33.
Regular type	Standard gray color, sizes, special shapes, and face pattern as indicated on the Drawings. Standard weight aggregate units.

Sand	ASTM C144, natural sand; 95 percent passing No. 16 sieve, for glazed tile and stone mortar; white, 95 percent passing No. 50 sieve, for pointing mortar.
Pea Gravel	ASTM C33, coarse aggregate, 90 percent passing 3/8 inch sieve, 90 percent retained on No. 4 sieve.
Portland Cement	ASTM C150, Type I.
Hydrated Lime	ASTM C207, Type S.
Quicklime	ASTM C5, pulverized.
Lime Putty	Quicklime, thoroughly slaked and stored for one day; kept moist until used.
Integral Waterproofing	Aluminum stearate, ammonium stearate, or calcium stearate, 2 percent of weight of cement; W. R. Grace "Dry Block Mortar Admixture", A. C. Horn "Hydratite", or Sonneborn "Hydrocide".
Prepared Joint Filler	ANSI A118.6 Sanded tile grout. Laticrete Series 500 joint filler, Bonsal "Sanded Grout" or Bostik "Hydroment Joint Filler".
Water	Clean and free from deleterious substances.
Joint Reinforcement	Dur-O-Wall or Hohmann and Barnard; fabricated from cold drawn steel wire, ASTM A82; galvanized, ASTM A153, Class B-2; type as indicated on the Drawings with prefabricated corners and tees.
Ladder Type	Two-rod and three-rod types as indicated on the Drawings.
Standard Weight	9 gage side rods and cross rods.
Heavy-Duty	3/16 inch side rods and 9 gage truss rods.
Thin Joint	11 gage side rods and cross rods.
Adjustable Type	Ladder type, 9 gage side rods and cross rods with 3/16 inch wire rectangular tabs and pintle ties at 16 inches on center.
Rebar Positioner	9 gage wire, sized for block thickness, single or double bar type, galvanized ASTM A153, Class B-2.
Reinforcing Steel	ASTM A615, Grade 60, except No. 3 bars which may be either Grade 40 or Grade 60, deformed.

Control Joint Material	ASTM D1056, Type 2, Class A-1, PVC foam with pressure-sensitive adhesive back; Dur-O-Wall "Rapid Soft-Joint" or Hohmann & Barnard "NS" Neoprene.
Preformed Control Joint	ASTM D2287, PVC Synthetic rubber; Dur-O-Wall "Rapid Control Joint" or Hohmann & Barnard "VS" Series.
Wicks	Nylon or polypropylene sash cord, 1/4 inch in diameter. Molded PVC type weephole for vertical mortar joint; Hohmann & Bernard "343".
Detergent Masonry Cleaner	ProSoCo "Vana-Trol" or National Chem-Search "DC-6", unless otherwise recommended by the masonry unit manufacturer and accepted by Engineer.

Wall flashings are covered in the Sheet Metal section.

2-2. MORTAR. The method of measurement of all mortar ingredients shall be accurate and shall ensure definite and uniform proportions. All mortar ingredients shall be mixed on site. The use of masonry cement or premixed ingredients will not be acceptable, unless authorized by Engineer.

2-2.01. Masonry Mortar. Masonry mortar shall conform to ASTM C270, except as modified herein. Mortar shall be machine mixed for at least 5 minutes and shall be used within 90 minutes after mixing. Mortar left when work is stopped shall be discarded. Remixing of mortar more than 90 minutes old with additional water, cement, or other materials will not be acceptable.

Unless otherwise indicated, mortar shall be cement-lime Type S, and shall conform to the proportion specifications of ASTM C270.

The sand content specified above is maximum quantity. White cement shall be substituted for Portland cement for cut stone mortar. Integral waterproofing shall be added to each mortar mixture.

2-3. GROUT FILL. Grout fill for filling bond beams and other reinforced masonry shall be concrete grout meeting the requirements of ASTM C476 . Grout shall be coarse and shall be proportioned by volume in accordance with Table 1 of ASTM C476. Only enough water shall be added to produce a mixture which is flowable, but which will not show an excess of water when placed. Unless otherwise specified, grout fill shall have a slump ranging from 8 to 11 inches .

PART 3 - EXECUTION

3-1. MORTAR JOINTS. Masonry shall be laid in straight, level, uniform courses, with mortar joints of uniform width. Head joints shall approximately equal the horizontal joints in width.

In laying up concrete block masonry, abutting surfaces of head joints shall be completely and solidly cemented together with mortar. All solid masonry units and hollow units with horizontal cells shall be laid on a full bed of mortar. All unfilled hollow masonry units with vertical cells shall be laid with face shell mortar bedding, except that starter courses shall be laid on a full bed of mortar. All units in masonry columns and pilasters shall be laid on a full bed of mortar. Web joints of all cores which will be subsequently filled with grout fill shall be fully mortared. Walls which are to be fully grouted may be laid with face shell bedding.

The filling of masonry joints shall mean that the entire space between abutting surfaces of units is full, and that the body of the mortar is forced against and into the porous surface of each unit.

All exterior and exposed interior mortar joints, except joints in glazed materials, joints in walls which are to be covered, and joints which are to be raked, shall be tooled to a smooth uniform surface and shall be finished free of voids using a rounded tool. Mortar joints specified to be caulked shall be raked to a depth of 1/2 inch . Tooling of joints shall be regulated so that the mortar for each wall space has a uniform appearance.

Joints in masonry surfaces which are to be covered or not exposed shall be struck flush.

3-2. BONDING AND REINFORCING. Except where otherwise indicated on the Drawings, all concrete block shall be laid in running bond. All masonry shall be reinforced and anchored as indicated on the Drawings and as specified herein.

3-2.01. Joint Bonding and Reinforcing. Horizontal masonry units shall be bonded and reinforced as specified, unless otherwise indicated on the Drawings. Joint reinforcing shall be discontinuous at control and expansion joints. Prefabricated corner and tee pieces shall be used at corners and tees indicated to be continuous on the Drawings.

Unless otherwise specified, all concrete block masonry shall be bonded and reinforced with continuous ladder type joint reinforcement spaced not more than 16 inches apart vertically. The joint reinforcement shall have one longitudinal rod at each face shell of the masonry units. Continuous ladder type joint reinforcement may be omitted in concrete block walls with reinforced bond beams at not more than 24 inches on centers.

Adjustable type reinforcement may be used only if specifically indicated on the Drawings.

Masonry parapets shall be reinforced with heavy-duty continuous joint reinforcement or reinforcing steel as indicated on the Drawings.

Except where a top bond beam is indicated on the Drawings, the top three courses of all masonry walls, including backup, shall have continuous joint reinforcement placed in each joint (8 inch on centers). Joint reinforcement shall be terminated at expansion joints and control joints. Openings in masonry walls shall have joint reinforcement placed in the two courses immediately

above lintels and in the two courses immediately below all sills. Joint reinforcement shall extend 24 inches past openings on each side.

The width of joint reinforcement (side rod to side rod) in each case shall be approximately 2 inches less than the nominal overall thickness of the wall in which it is placed. All joint reinforcement shall be fully embedded in mortar and shall be covered with at least 5/8 inch of mortar on the exterior face.

The ends of sections of joint reinforcement shall be lapped at least 8 inches . At corners and intersections, prefabricated corners and tees shall be used.

3-2.02. Masonry Anchorage. The extent and details of masonry anchorage to abutting structure or backup construction shall be as indicated on the Drawings and as specified.

3-2.03. Reinforcing Steel. Concrete block bond beam units shall be provided, installed and reinforced with reinforcing steel where required and as indicated on the Drawings. Bond beam units shall be filled with grout fill as specified herein. Reinforcing steel shall be continuous around corners. At expansion joints, all bond beam reinforcing shall be discontinuous. At control joints, 50 percent of the bond beam reinforcing shall be discontinuous unless otherwise indicated on the Drawings.

Vertically reinforced concrete block cores shall be provided as indicated on the Drawings. Reinforcing shall be accurately placed and securely tied to prevent shifting during core filling. Bar positioners shall be used for alignment. Positioners shall be placed in the bottom and top courses of walls and at not more than 4 feet centers between. Mortar fins which project into cores more than 1/2 inch and all loose mortar and debris shall be removed before filling the cores. Cores shall be filled with grout fill as specified herein.

When accepted by Engineer, open-ended concrete masonry units may be substituted for units with end webs in reinforced concrete masonry walls.

Special bond beam units with open or knockout webs and open vertical cells shall be used for bond beams. U-shaped lintel units shall be used only in bond beams over openings. If the cells beneath a bond beam are not required to be grouted, wire mesh material may be used in the joint to retain the grout fill.

3-2.04. Grout Fill. Unless otherwise acceptable to Engineer, grout fill shall be placed in lifts not to exceed 5 feet . Pours exceeding 12 inches in height shall be consolidated by mechanical vibration and reconsolidated after initial water loss and settlement. Bond beam fill shall not be mechanically vibrated. Grout fill shall be placed in reinforced block cores, bond beams, lintels, and in other locations indicated on the Drawings.

3-3. LAYING MASONRY UNITS. All masonry units shall be free from dust, dirt, and surface moisture when laid. Concrete blocks shall be dry when laid.

All masonry shall be laid to a line. Walls shall be plumb and straight and in level courses. At no time shall any part of masonry construction project more than 8 feet above adjacent work. When work is suspended, the tops of exterior masonry walls shall be covered and protected from the weather.

Care shall be taken in corner construction and at jambs to maintain uniformity of appearance and to ensure that only whole, undamaged units are used.

Unless otherwise indicated on the Drawings, concrete block masonry shall have bullnose units installed at door jambs, window and louver jambs and sills, and all exterior corners.

Unless otherwise indicated, masonry units laid in running bond in exposed locations shall be so constructed that vertical joints in alternate courses lie in the same vertical lines, midway between the vertical joints in adjacent courses to provide a regular and uniform joint pattern. All custom scored units shall be aligned as detailed on the Drawings.

Masonry units shall be saw-cut to provide openings and to accommodate embedded items. Anchors shall be securely embedded in mortar. Door and window frames shall be maintained plumb and true. Masonry shall be built tightly against interior door frames. A caulking space shall be provided between exterior door frames and masonry in accordance with the details indicated on the Drawings. The jambs of built-in hollow metal door frames shall be completely filled with grout fill or mortar.

Lintels shall be provided over all openings wider than the length of a masonry unit. Lintels shall be of the types and sizes indicated on the Drawings or as needed, and shall be acceptable to Engineer. Lintels longer than 3 feet shall bear on solid masonry units or on grout-filled cells of hollow units at least one masonry course in height, unless otherwise indicated on the Drawings.

Reinforced lintels and other wall reinforcing as needed and indicated on the Drawings shall be provided and installed hereunder. Reinforced lintels shall be filled with grout fill.

All embedded items shall be set and securely anchored in the masonry work as indicated on the Drawings or as acceptable to Engineer. Joints between masonry and embedded items shall be pointed.

Masonry units shall be selected and laid so that the exposed face of each unit is free of broken corners, chipped edges, or other defects which would be detrimental to the appearance of the wall surface.

3-4. FLASHINGS. Wall flashings shall be installed where and as indicated on the Drawings. Flashings in horizontal joints shall be in the center of the joints, with mortar below and above them and shall extend to within 3/8 inch of the exterior masonry face unless otherwise indicated on the Drawings. Flashings shall drain toward the exterior surface of the wall. Weeps consisting of wicks installed when the masonry is laid shall be provided at not more than 2 foot centers and shall be cut off flush after the mortar has set.

Flashings shall be kept from actual contact with steelwork.

3-5. EXPANSION AND CONTROL JOINTS. Expansion and control joints in masonry walls and in masonry walls abutting concrete wall surfaces shall be constructed as indicated on the Drawings. Where indicated on the Drawings, preformed control joint strips shall be placed in the wall as construction proceeds, with masonry units laid tight against the strips. Where required, joint filler strips shall have a thickness equal to at least 1-1/2 times the nominal width

of the joint. The filler strips shall be firmly bonded to one joint face by the adhesive backing, and shall be of required width to be held back 1/2 inch from each face for caulking, and placed under compression by the abutting masonry. All joints in filler strips shall be tightly butted.

3-6. ANCHORS, INSERTS, AND OTHER PENETRATIONS. All necessary ties, anchors, bolts, inserts, bucks, flashings, sleeves for piping, conduits of every kind, window and door frames, and other work shall be accurately set and securely held in the masonry work as indicated on the Drawings or in a manner acceptable to Engineer. Sleeves shall be provided where small piping passes through the masonry.

Unless noted otherwise on the Drawings, structural shapes, joists, and decking passing through or over the masonry, but not bearing on the masonry, shall be isolated from the masonry as specified or as indicated on the Drawings. At a minimum, a 1 inch expansion joint shall separate the structure from the masonry. This separation is not applicable at appurtenances specially designed to provide lateral support from the structure or decking to the masonry.

3-7. LOW TEMPERATURES. When the temperature of the surrounding air is below 40°F , or when the outdoor temperature is likely to fall below freezing at any time during the 24 hour day, the following precautions shall be taken to prevent freshly laid masonry from freezing:

- a. In addition to the protection specified for ordinary conditions, masonry materials shall also be kept from contact with snow, ice, or dampness of any kind.
- b. The temperature of the mixed mortar shall be between 70 and 120°F . Mixing water shall be warm, but not above 165°F . If necessary, sand shall be heated also. Mortar mixing equipment shall be heated before it is used. The use of salt or calcium chloride is not acceptable.
- c. Masonry units shall be free of ice and snow and shall be above freezing when laid. If the outdoor temperature is below 30°F . units shall be heated to at least 40°F . If the temperature is below 0°F , units shall be heated to at least 60°F . Heating shall be done so that the units are not damaged.
- d. Masonry units shall not be laid on surfaces that are frozen or covered with snow or ice.
- e. Masonry laid during freezing weather shall be kept warm for at least 3 days after laying. The air temperature at the masonry surface shall be kept between 45°F and 90°F , using heating methods that will not unduly dry out or otherwise damage the masonry. Heat shall be applied to both sides of the wall, with provisions for proper circulation of air. The masonry shall be suitably housed or covered.

3-8. HIGH TEMPERATURES. When the ambient air temperature exceeds 99°F in the shade and the relative humidity is less than 50 percent, masonry shall be protected from direct exposure to wind and sun during and for 48 hours after erection.

3-9. FINISH TUCK POINTING. On completion of the work, all exposed masonry shall be pointed where necessary and all voids and holes in the mortar shall be filled to match adjacent joint surfaces. Defective joints shall be cut out and repointed with mortar. Care shall be taken to produce a uniform overall appearance. Spottiness due to variations in either materials or workmanship will not be acceptable.

3-10. PAVING BRICK. Not used.

3-11. PROTECTION FROM DAMAGE. Masonry and all embedded or built-in items shall be carefully protected from damage. Masonry walls discolored by paint, mortar, or concrete shall be rebuilt with new materials.

Where concrete is placed adjacent to on top of previously constructed masonry, the masonry shall be adequately protected against splashing of concrete paste and from other damage.

3-12. CLEANING. Following finish pointing, all exposed masonry surfaces shall be cleaned to remove all surface stains and smears.

Mortar smears or droppings on concrete blocks shall be removed with a steel trowel after they have hardened to the extent that removal will not cause additional smearing. Any remaining mortar shall be removed to the extent possible by rubbing with a small piece of block. All surfaces shall then be thoroughly brushed.

If stains and smears cannot be removed by the specified methods, Contractor may propose alternative methods or cleaning products. These alternatives shall be acceptable to Engineer before they are used.

3-13. OWNER'S FIELD CONTROL TESTING. When required, field control tests will be performed by Engineer or a testing laboratory. Contractor shall provide all facilities and the services of one or more employees as necessary to assist with the field control testing.

As stipulated in the Quality Control section, tests required during the progress of work will be made at the expense of Owner.

The frequency specified for each field control test is approximate and subject to change as determined by Engineer.

3-13.01. Grout. Grout sampled during placement will be tested in accordance with ASTM C1019 (UBC Standard 21-18) at the rate of three specimens per 5,000 square feet of wall. Compressive strength test shall be at 28 days after sample collection. Alternatively, grouted prisms may be constructed and tested in accordance with ASTM C1314 modified in accordance with ACI 530.1 (UBC Standard 21-17) at the rate of three specimens per 5,000 square feet of wall.

End of Section

ANCHORAGE IN CONCRETE AND MASONRY

PART 1 - GENERAL

1-1. SCOPE. This section covers the procurement and installation of anchors in concrete and masonry. It includes cast-in-place anchor bolts, adhesive anchors, expansion anchors, undercut anchors, and reinforcing bars to be installed in concrete and masonry.

1-2. GENERAL. Unless otherwise specified or indicated on the Drawings all anchors and anchor bolts shall be cast-in-place anchor bolts with forged heads or embedded nuts and washers. Unless otherwise indicated, anchors and anchor bolts in concrete shall have a diameter of at least 3/4 inch [19 mm], and anchors and anchor bolts in masonry shall have a diameter of at least 1/2 inch [12.7 mm].

Unless otherwise indicated on the Drawings, anchors and anchor bolts used in the following locations and applications shall be of the indicated materials. Anchors and anchor bolts in other locations and applications shall be as indicated on the Drawings.

Cast-In-Place Anchor Bolts.

Submerged locations	Stainless steel.
Locations subject to splashing	Stainless steel.
Buried locations	Stainless steel.
Anchorage of structural steel columns	Galvanized steel.
Other exterior locations	Galvanized steel.
Other interior locations	Carbon steel.

Adhesive, Expansion, and Undercut Anchors.

Submerged locations	Stainless steel.
Locations subject to splashing	Stainless steel.
Buried locations	Stainless steel.
Anchorage of structural steel columns	Stainless steel.
Other exterior locations	Stainless steel.
Other interior locations	Carbon steel.

Adhesive, expansion, and undercut anchors may be used instead of cast-in-place anchors where specifically indicated or permitted on the Drawings or with the specific acceptance by Engineer.

Expansion Anchors in Grouted Masonry	Products shall be single component anchors tested in accordance with ICC AC01, and shall have an ICC ESR report in compliance with the International Building Code (2006 or later edition). Hilti “Kwik-Bolt 3”, Simpson “Wedge-All”, Powers Fasteners “Power-Stud+ SD1”.
Undercut Anchors in Concrete	Products shall be tested in accordance with ICC AC193, and shall have an ICC ESR report in compliance with the International Building Code (2006 or later edition). Hilti “HDA Undercut Anchor”, USP Structural Connectors “DUC Undercut Anchor”, Powers Fasteners “Atomic+ Undercut Anchor”.
Adhesive Anchors in Concrete	Products shall be tested in accordance with ICC AC308, and shall have an ICC ESR report in compliance with the International Building Code (2006 or later edition). The anchors shall be approved for use in cracked concrete, and for resisting seismic forces.
Threaded Rods and Nuts	As recommended by the adhesive manufacturer; materials as indicated on the Drawings or in this specification.
Adhesive	Hilti “HIT-RE 500-SD” or "HIT-HY 150 MAX-SD", Powers Fasteners “PE1000+”, Simpson “Set-XP”.
Adhesive Anchors in Grouted Masonry	Products shall be tested in accordance with ICC AC58, and shall have an ICC ESR report in compliance with the International Building Code (2006 or later edition).
Threaded Rods and Nuts	As recommended by the adhesive manufacturer; materials as indicated on the Drawings or in this specification.
Adhesive	Hilti "HIT HY 150 MAX", Simpson “SET Epoxy”.
Adhesive Anchors in Hollow Masonry	Products shall be tested in accordance with ICC AC60, and shall have an ICC ESR report in compliance with the International Building Code (2006 or later edition).

Threaded Rods and Nuts	As recommended by the adhesive manufacturer; materials as indicated on the Drawings or in this specification.
Adhesive	
Type 1 System	Hilti “HIT HY 20” system.
Type 2 System	Simpson “SET Epoxy” system.
Screen Tubes	As recommended by the manufacturer.

2-2. ANCHORS.

2-2.01. Cast-in-Place Anchor Bolts. Cast-in-place anchor bolts shall be delivered in time to permit setting before the structural concrete is placed. Unless installed in pipe sleeves, anchor bolts shall be provided with sufficient threads to permit a nut to be installed on the concrete side of the concrete form or the supporting template. Two nuts, a jam nut, and a washer shall be furnished for cast-in-place anchor bolts indicated on the Drawings to have locknuts; two nuts and a washer shall be furnished for cast-in-place anchor bolts without locknuts.

2-2.02. Adhesive, Expansion, and Undercut Anchors. When adhesive, expansion, or undercut anchors are indicated on the Drawings, only acceptable systems shall be used. Acceptable systems shall include only those systems and products specified or specifically indicated by product name on the Drawings. Alternative anchoring systems may be used only when specifically accepted by Engineer.

Unless otherwise required, single nuts and washers shall be furnished for adhesive anchors, expansion anchors, and undercut anchors. Adhesive anchors shall be free of coatings that would weaken the bond with the adhesive.

Adhesive anchors in hollow masonry shall utilize screen tubes as recommended by the manufacturer.

PART 3 - EXECUTION

3-1. GENERAL. Anti-seize thread lubricant shall be liberally applied to projecting, threaded portions of stainless steel anchors immediately before tightening of the nuts.

3-1.01. ESR Report Compliance. Anchors shall be installed in accordance with all applicable requirements of the ESR report for the anchoring system. If conflicts are found between the Drawings and the ESR report installation requirements, Contractor shall notify Engineer for resolution.

3-1.02. Special Inspection. Special inspection shall be performed by Engineer or Owner’s representative during installation of all anchors covered in this section. Anchorage work shall be performed in a manner that allows the inspections to take place without adversely impacting the schedule.

For cast-in-place anchor bolts, bolts shall be positioned in advance of the concrete placement so that the inspector will have sufficient time to inspect the bolts prior to placing concrete.

For other types of anchors, the minimum frequency and extent of the inspections shall be as indicated in the anchor system's ESR report.

3-2. CAST-IN-PLACE ANCHOR BOLTS. Cast-in-place anchor bolts shall be carefully positioned with templates and secured in the forms prior to placing concrete. Contractor shall verify that anchorage devices are positioned in accordance with the Drawings and with applicable equipment or structure submittal drawings.

Threads, bolts, and nuts spattered with concrete during placement shall be cleaned prior to final installation of the bolts and nuts.

3-3. ADHESIVE ANCHORS. The embedment depth for adhesive anchors or reinforcing bars shall be at least 15 rod or bar diameters unless otherwise indicated on the Drawings.

Adhesive shall be statically mixed in the field during application. All proportioning and mixing of the components shall be in accordance with the manufacturer's recommendations.

Anchors or bars shall be installed in holes drilled into hardened concrete or grout filled masonry. Diameter of holes shall be 1/16 inch [1.5 mm] larger than the outside diameter of the rod or bar unless recommended otherwise by the anchor system manufacturer. Holes shall be prepared by removing all dust and debris using procedures recommended by the adhesive manufacturer.

Adhesive anchors and holes shall be clean, dry, and free of grease and other foreign matter at the time of installation. The adhesive shall be placed and the rods or bars shall be set in accordance with the recommendations of the manufacturer. Care shall be taken to ensure that all spaces and cavities are filled with adhesive, without voids.

3-4. EXPANSION AND UNDERCUT ANCHORS. Expansion and undercut anchors shall be installed in accordance with the Drawings, but in no case shall the embedment depth be less than six bolt diameters. The minimum distance between the center of any anchor and an edge or exterior corner of concrete shall be at least six times the diameter of the bolt. Unless otherwise indicated on the Drawings, the distance between the centers of anchors shall be at least 12 times the diameter of the bolt.

End of Section

DAMPPROOFING

PART 1 - GENERAL

1-1. SCOPE. This section covers furnishing and installation of dampproofing for concrete.

Dampproofing of concrete surfaces exposed to water in potable water treatment, distribution, or pumping facilities, shall be with NSF certified epoxy enamel, and shall be in accordance with the Protective Coatings section. Waterproofing is covered in the Elastomeric High-Solids Urethane Lining Systems section.

PART 2 - PRODUCTS

2-1. MATERIALS. Materials to be used shall be as follows:

Medium Consistency Coal Tar	Carboline "Bitumastic 50", Polyguard "CA-14 Coating", or Tnemec "46-465 H. B. Tnemecol".
Coal Tar Epoxy	Ameron "Amercoat 78HB Coal Tar Epoxy, Carboline "Bitumastic 300 M", Tnemec "46H-413 Hi-Build Tneme-Tar", or Sherwin-Williams "Hi-Mil Sher-Tar Epoxy"
Emulsified asphalt	Henry "HE 107-Asphalt Emulson"
Epoxy Enamel	As specified in the Protective Coatings section
Membrane	Grace "Bituthene 3000 and Bituthene Low Temperature" "

Emulsified asphalt shall be solvent free and made from asphalt emulsified with bentonite clay and water.

Membrane shall be a self-adhesive rubberized asphalt/polyethylene waterproofing material with a minimum thickness of 1/16 inch (1.5 mm).

2-2. SURFACES TO BE DAMPPROOFED. Exterior wall surfaces which are poured against sheeting or undisturbed earth need not be dampproofed. The following concrete surfaces that are not in contact with treated or potable water shall be dampproofed:

- a. All exterior concrete wall surfaces forming a part of an interior room or dry pit which will be in contact with earth backfill below finished grade and above the top of the footings or bottom slabs.
- b. All exterior wall surfaces of cast-in-place and precast concrete electrical manholes and handholes below finished grade and above the top of the

footings or bottom slabs.

- c. All walls in contact with liquid where the opposite face is above grade or exposed in an interior room, except when waterproofing is specified.

PART 3 - EXECUTION

3-1. SURFACE PREPARATION. When dampproofing is applied, concrete surfaces shall be clean and dry. All dirt, dust, sand, grit, mud, oil, grease, and other foreign matter shall be removed in accordance with ASTM D4258 and the surface abraded when recommended by the manufacturer of the dampproofing material. Abrading shall be done in accordance with ASTM D4259. Prior to application of the coating, the surfaces shall be thoroughly washed, or cleaned by air blasting, to remove all dust and residue.

3-2. APPLICATION. Dampproofing materials shall not be thinned unless recommended by the manufacturer. Dampproofing using medium consistency coal tar or coal tar epoxy shall be applied in at least two coats, with a total dry film thickness of at least 20 mils [510 µm].

Surfaces not intended to be dampproofed shall be protected from contamination, discoloration, or other damage. Such surfaces shall be masked as necessary to protect uncoated areas and to confine the dampproofing to the intended limits.

Surfaces shall be dry and at recommended temperature when dampproofing is applied. Unless properly protected, coatings shall not be applied in wet, damp, or foggy weather or when windblown dust, dirt, or debris, or insects would collect on the coating. Dampproofing shall not be applied when the temperature of the air or the surface is below 40°F [4°C].

Dampproofing shall be applied by brush, high pile rollers, or spray equipment complying with the manufacturer's recommendations. If blistering occurs, all blisters larger than 1/4 inch [6 mm] in diameter shall be broken before the subsequent coat is applied.

Emulsified asphalt shall be installed in accordance with manufacturer's recommendations and at the maximum coverage rate recommended by manufacturer that is acceptable to Engineer.

Membrane shall be installed in accordance with manufacturer's recommendations including the recommended primer.

End of Section

Section 07600

SHEET METAL

PART 1 - GENERAL

1-1. SCOPE. This section covers sheet metal for flashings and moisture protection. The following sheet metal items are covered in other sections:

- a. Ductwork, louvers, and other sheet metal for the heating, ventilating, and air conditioning system.
- b. Metal curbs.
- c. Fire extinguishers.
- d. Roof scuttles.
- e. Metal roof panels.
- f. Steel roof deck.

1-2. GENERAL. Installation of wall and roof flashings shall be as indicated on the drawings and as specified in the building masonry and roofing sections.

Flashing members to be built into masonry, concrete, or roofing shall be delivered at the proper time for incorporation into the work.

When installing sheet metal items, care shall be taken to avoid marring and improper bending. All components shall be stored in clean, dry storage areas. Contact with corrosive or staining materials shall be prevented. All damaged sections shall be replaced and only undamaged units shall be installed.

1-3. SUBMITTALS. Complete specifications, data, and catalog cuts or drawings covering the items furnished under this section shall be submitted in accordance with the submittals section.

PART 2 - PRODUCTS

2-1. MATERIALS.

Galvanized Steel	ASTM A366 or A569; hot-dip galvanized in accordance with ASTM A525, G90 minimum.
Sheet Aluminum	ASTM B209, Alloy 3003-H14, mill finish.
Extruded Aluminum	ASTM B221, Alloy 6053 or 6063.
Stainless Steel	ASTM A167, Type 302 or 304, AISI 2B finish unless otherwise specified.
Solder	ASTM B32, Alloy Grade 50A (50-50).

Soldering Flux

For Stainless Steel

Zinc chloride type, Fed Spec 0-F-506, Type II.

For Other Metals

Acid type, Fed Spec O-F-506, Type I, Form A.

Fasteners

Same metal as sheet metal being fastened.

Plastic Cement

Asphalt roof cement, asbestos-free;
ASTM D4586, Type II.

2-2. EXPOSED METAL. All exposed or contacting metal shall be of the same material.

2-2.01. Types and Materials.

Counterflashings

Stainless steel, 26 gage, Architectural Steel, Cheney or equal, with 4 inch wall flat and hook dam for masonry wall installation or with snap lock for reglet installation.

Reglets

Stainless steel, 26 gage, designed to retain counterflashing by snap action or friction fit; Cheney "RL Quick Lock Surface Mount" or equal.

Cap Flashing

Stainless steel, 26 gage.

Metal Coping

Pre-finished, pre-manufactured .050 inch aluminum. Metal-Era "Perma-Tite Double Tapered Coping". Color to be selected by Engineer.

2-3. PARAPET COPINGS. Copings on parapet walls shall be Metal-Era Perma-Tite coping. Copings shall be complete with welded miter corners, joint covers and flashing, hold-down clips, and anchors and fasteners necessary for proper installation.

Finish shall be a 20-year "Kynar 500" based fluoropolymer coating. The coping color will be selected from manufacturer's standard and custom colors on manufacturer provided color charts or samples. Generically printed color charts will not be acceptable for color selection.

2-4. CAP FLASHINGS. Cap flashings shall be provided at all roof ventilators, skylights, and elsewhere as indicated on the drawings. Cap flashings shall be fabricated in sections not exceeding 10 feet in length; sections shall overlap at least 3 inches and shall form a slip joint, but shall not be interlocked. All corners and all joints other than slip joints shall be closed watertight as specified herein.

2-5. COUNTERFLASHINGS. Counterflashings shall be provided at the locations indicated on the drawings to overlap membrane base flashings and fit into flashing reglets or receivers. Counterflashings shall be fabricated in sections not exceeding 10 feet in length; sections shall

overlap at least 3 inches and shall form a slip joint, but shall not be interlocked. End joints between counterflashing sections shall be offset from underlying joints between reglet or receiver sections. Corners in counterflashings shall be closed watertight as specified herein.

2-6. MISCELLANEOUS METAL FLASHINGS. Metal flashings shall be provided for vents, sleeves, and similar projections through the roof.

PART 3 - EXECUTION

3-1. WATERTIGHT JOINTS. Joints in sheet metal work shall be closed watertight unless slip joints are specifically required. Watertight joints shall be mechanically interlocked and then thoroughly soldered for metals other than aluminum. Joints in aluminum or between aluminum and other metals shall be sealed with acrylic sealant.

All joints shall be wiped clean of flux after soldering. Acid flux shall be neutralized by washing the joints with sodium bicarbonate.

3-2. FLASHINGS.

3-2.01. Cap Flashings. Cap flashings shall be installed after membrane base flashings have been completed. Cap flashings shall be anchored in place as indicated on the drawings.

3-2.02. Reglets. Reglets to be set in concrete to receive counterflashings shall be nailed into the forms in accordance with the manufacturer's recommendations, with care being taken to maintain precise alignment of abutting sections. After the forms are stripped, the temporary form filler strip shall be removed from the reglet, and the form securing nails shall be clipped flush.

3-3. PARAPET COPINGS. Unless otherwise indicated on the Drawings or specified, parapet copings shall be installed in conformity with the instructions and recommendations of the copings manufacturer. Copings shall be installed with 1/2 inch space between the end sections. The finished installation shall have a uniformly smooth vertical face in accurate alignment.

3-4. MISCELLANEOUS METAL FLASHINGS. Metal flashings shall be installed as specified in the roofing section.

3-5. PROTECTION. Adequate protection shall be provided during shipment, site storage, and installation, to prevent damage to materials or finished work.

Aluminum to be placed in contact with concrete, mortar, or dissimilar metals shall be given a heavy coat of coal tar paint.

End of Section

STANDING SEAM METAL ROOFING

PART 1 - GENERAL

1-1. SCOPE. This section covers the furnishing and erection of standing seam metal roofing, including sheathing, insulation, trim, flashings, clips, and appurtenances, as indicated on the drawings and as specified herein.

Metal decking is covered in the steel roof deck section and steel framing is covered in the structural steel section.

1-2. GENERAL. The materials to be furnished and installed under this section include, but are not limited to, the following:

- Standing seam roof
- Fascias
- Soffits
- Flashings, trim, and closures
- Plywood and wood blocking
- Rigid insulation
- Clips, spacers, and shims
- Caulking and sealing materials
- Fasteners

1-3. SUBMITTALS. Before fabrication, detailed fabrication and erection drawings shall be submitted in accordance with the submittals section. Submittals shall include jointing, trim, and flashing details, including terminations and penetrations.

1-3.01. Florida Product Approvals. As required by Florida law, building envelope components and systems shall have either a state or local product approval for demonstrating resistance to the structural wind loads required in the current code edition as a condition for site specific permit verification. The Contractor shall be responsible for obtaining and providing approvals demonstrating compliance with this requirement as it relates to products covered under this section.

1-4. HANDLING AND STORAGE. The roofing materials shall be handled in a manner which will prevent bending, dents, scratches, or damage of any kind. Damaged units and accessories will be rejected, and shall be replaced by and at the expense of the Contractor promptly after rejection. Materials shall be stored under cover at all times.

1-5. FINISH. Panels, trim, seam corners, flashings, and all exposed appurtenances shall have a “Kynar 500” fluoropolymer oven-baked coating conforming to AAMA 2605.2.

1-5.01. Color Selection. Colors shall be selected by the Engineer from the manufacturer’s full range of standard and special colors, minimum 18. All color options available shall have a minimum Solar Reflectance Index (SRI) of 23. Manufacturer supplied samples or color cards

shall be submitted for color selection. Generically printed color charts will not be acceptable.

1-6. WARRANTY. The manufacturer of the metal roof systems shall furnish to the Owner a warranty covering materials and finish for a period of 20 years from the date of acceptance.

The applicator of the roof system shall provide a warranty covering installation and workmanship for a period of 3 years from the date of acceptance.

PART 2 - PRODUCTS

2-1. MATERIALS. Materials shall conform to the following:

Roof panels	Shop formed, .032 inch aluminum by 16 inches wide, in continuous lengths; Petersen Aluminum PAC-CLAD “Tite-Loc Plus” roof panels or equal, with 2 inch high standing seam and factory installed sealant strip. Seam pattern as indicated on the Drawings. UL-90, ASTM 1592, Florida Building Code Product Approvals, Miami-Dade NOA, FL DOE Hurricane Tested.
Fascias	Shop formed, pre-finished flat 032 inch aluminum with smooth surface with interlocking joints.
Soffit panels	Shop formed, .032 inch aluminum by 12 inches wide; Peterson Aluminum PAC-CLAD “Flush Panel” smooth finish soffit panels. Seam pattern to align perpendicular with building facade.
Hold-down Clips	Concealed anchorage system, standard with the roofing manufacturer, designed to permit thermal movement and to assure positive and negative loading in compliance with UL90.
Trim, Flashing, and Seam Covers	Same material, finish, and color as the as adjacent sheet products.
Finish	Roof panels, fascia metal, soffit panels, trim, seam covers, flashing, and appurtenances shall have a 70 percent “Kynar 500” fluoropolymer coating; both prime coat and finish coat shall be oven baked. Color from manufacturer’s full color line shall be selected after award of contract.

Rigid Thermal Insulation	ASTM C 1289 Type V, Class 2, Grade 3, rigid roof insulation composite panel. Closed cell polyiso foam core with fiber reinforced facers on one side and 5/8" OSB on the other. 3-inch thickness, R=15.9 minimum. Hunter Panels "H-Shield-NB" or approved equal.
Roof Underlayment	Composite membrane of rubberized asphalt laminated to polyethylene layer, self-adhering waterproofing underlayment. ASTM D-1970, ASTM D-412, ASTM E-96, Carlisle "CCW WIP 300HT."
Lumber	American Standard Lumber conforming to PS20, moisture content 19 percent or less; sized dry, SPF Structural No. 2 or better.
Pressure Treated	Southern Yellow Pine, Structural No. 1 or better, pressure treated with waterborne preservative in accordance with AWWA C2 and AWPB LP-22. (CCA IS NOT ALLOWED) alkaline copper quat (ACQ types B and D) or copper azole (CBA-A, CA-B). All anchors, nails, or screws in contact with pressure treated lumber shall be hot dipped or stainless steel.
Plywood (general purpose)	PS1, waterproof, resin-bonded, exterior type; APA Group 1, Grade Ext-BB, or better unless specified.
Fasteners	Self-tapping stainless steel screws for wood to sheet metal or metal to metal connections.

PART 3 - EXECUTION

3-1. **INSPECTION.** The applicator shall examine the surfaces on which the roof panels and fascias are to be applied and shall obtain and verify all field measurements prior to fabrication of the roof panels and fascia metal. If the surfaces are not suitable for receiving the metal roof panels and/or fascia metal, the applicator shall notify the Engineer in writing.

3-2. **FABRICATION.** Panels shall be field assembled. Roof panels, fascias, soffit panels, flashings, trim, and accessories shall be fabricated in accordance with the details on the drawings to tolerances which will ensure proper fit, appearance, and weathertightness when erected.

Side joints shall be of interlocked construction, shall be sealed full or gasketed at the factory, and shall be completely resistant to moisture and air infiltration when erected. Panels shall be fabricated in lengths which will eliminate horizontal joints in the completed construction.

The panel systems shall be fabricated so that no fasteners are exposed after erection, except where exposed fasteners are incorporated into the design or are required for securing flashing and trim.

Flashings shall include all materials referred to on the drawings as flashings, trim, or closures.

3-3. INSTALLATION. Workmanship shall conform to standards set forth in the Architectural Sheet Metal Manual published by SMACNA.

Materials shall be installed by experienced mechanics who are directly employed by the roof panel manufacturer or by an erector currently franchised by the panel manufacturer and who has experience in installing projects of similar or greater complexity.

Rigid insulation, sheathing, wood blocking, and roof underlayment shall be installed as indicated on the drawings and shall be placed before installation of metal roofing is started.

Metal roof panels shall be installed complete with all hold-down clips, fasteners, flashings, and accessories, in accordance with the manufacturer's instructions. All horizontal lines shall be true and vertical lines shall be plumb and in alignment.

All trim, closure panels, and flashings shall be installed to provide watertight joints. All penetrations shall be coordinated with the work of other trades. Any damaged materials shall be replaced; only minor scratches and abrasions may be touched up.

3-4. CLEANING. After installation is complete, all exposed surfaces of the roofing system, including flashings and accessories, shall be cleaned of all dust, dirt, grease, and other foreign material to the satisfaction of the Engineer.

End of Section

ROOF SPECIALTIES AND ACCESSORIES

PART 1 - GENERAL

1-1. SCOPE. This section covers miscellaneous roof accessories.

1-2. GENERAL. Roof accessories shall be provided and installed at the locations indicated on the drawings. Fasteners as required for mounting the accessories shall be provided.

1-3. SUBMITTALS. Complete specifications, detailed drawings, and setting and erection drawings covering roof accessories shall be submitted in accordance with the Submittals section.

1-3.01. Florida Product Approvals. As required by Florida law, building envelope components and systems shall have either a state or local product approval for demonstrating resistance to the structural wind loads required in the current code edition as a condition for site specific permit verification. The Contractor shall be responsible for obtaining and providing approvals demonstrating compliance with this requirement as it relates to products covered under this section.

PART 2 - PRODUCTS

2-1. ROOF HATCH ASSEMBLIES. Hatch shall be 48"x 48" with aluminum cover and curb, and 316 stainless steel hardware. Hatch cover shall be insulated with 12" insulated raised curb, with integral cap flashing and weatherstripping to seal air tight. Provide interior provisions for installation of owner's padlock. Hatch shall be Bilco Type "F" or equal.

PART 3 - EXECUTION

3-1. INSTALLATION. All products provided under this section shall be installed in accordance with the manufacturers' instructions. Unless otherwise noted, all anchors shall be non-corrosive.

All installations interfacing with standing seam metal roofing and sheet metal flashings shall be coordinated with those sections.

End of Section

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JOINT SEALANTS

PART 1 - GENERAL

1-1. SCOPE. This section covers caulking and sealing. Fire rated caulking is covered in the Fireproofing section.

1-2. GENERAL. The terms "caulking" and "sealing", as used on the Drawings and in these Specifications, are synonymous. Both terms indicate the materials specified herein. Oil-base caulking shall not be used on this Project.

1-3. APPROVALS. All caulking shall meet the requirements of the standards specified herein. All caulking and sealing to be used in contact with potable water shall meet the requirements of ANSI/NSF Standard 61.

1-4. SUBMITTALS. Specifications and data covering the materials proposed for use, together with samples or color cards showing the manufacturer's full line of sealant colors, shall be submitted in accordance with the Submittals Procedures section.

PART 2 - PRODUCTS

2-1. MATERIALS.

Thiokol Sealants (polysulfides)	Fed Spec TT-S-00227E, Class A or ASTM 920 Type M; polysulfide rubber, two component.
Nonsag	
Submerged Service, Non potable water	Pecora "Synthacalk GC-2+".
Nonsubmerged Service	Pecora "Synthacalk GC-2+"; Polymeric Systems "PSI-350".
Self-Leveling, nonsubmerged	A. C. Horn "Hornflex Traffic Grade"; Polymeric Systems "PSI-350".
Urethane Sealants (Polyurethanes)	Fed Spec TT-S-00227E, Class A, Type 2 and ASTM C920, Type M, Grade NS, two component.
Nonsag	
Nonsubmerged Service	Bostik "Chem-Calk 500"; Tremco "Vulkem 227"; Pecora "Dynatrol II"; Tremco "DYmeric 240"; Sika "Sikaflex-2cNS".

Self-Leveling, Nonsubmerged Service	Bostik "Chem-Calk 550"; Tremco "Vulkem 245"; Pecora "Urexpan NR-200"; Polymeric Systems "RC-2SL"; Tremco "THC-900".
Acrylic Sealant	Fed Spec TT-S-230; ASTM C834. Bostik "Chem-Calk 600"; Pecora "AC20"; Tremco "Mono 555".
Primer	As recommended by the sealant manufacturer.
Backup Material	Polyethylene or polyurethane foam as recommended by the sealant manufacturer; Dow "Ethafoam SB" or Plateau "Denver Foam".
Bondbreaker Tape	Adhesive-backed polyethylene tape as recommended by the sealant manufacturer.

2-2. COLORS. Colors of sealants shall be as selected by Engineer from the manufacturer's standard line of colors. Different colors may be required for different locations.

2-3. LOCATIONS TO BE CAULKED.

2-3.01. With Thiokol or Urethane Sealant (Nonsag) - Submerged Service. Not used.

2-3.02. With Thiokol or Urethane Sealant (Nonsag) - Nonsubmerged Service.

Entire perimeter of frames for exterior metal doors.

Entire perimeter of metal louvers.

Entire perimeter of metal dampers and metal shutters.

Control joints in masonry walls.

Other locations where caulking is indicated on the Drawings, specified in other sections, or required for weatherproofing.

2-3.03. With Thiokol or Urethane Sealant (Self-Leveling).

Horizontal joints in walks or drives.

Horizontal joints in traffic-bearing decks and slabs.

Annular space around handrail posts set in sleeves.

2-3.04. With Acrylic Sealant.

Watertight joints in sheet metal work.

2-3.05. With Silicone Sealant. Not used.

PART 3 - EXECUTION

3-1. JOINT PREPARATION. All surfaces to receive sealant shall be clean, dry, and free from dust, grease, oil, or wax. Concrete surfaces which have been contaminated by form oil, paint, or other foreign matter which would impair the bond of the sealant to the substrate shall be cleaned by sandblasting. All surfaces shall be wiped with a clean cloth saturated with xylol or other suitable solvent, and shall be primed before the sealant is applied.

Unless otherwise recommended by the sealant manufacturer and permitted by the Engineer, the depth of sealant in a joint shall be equal to the width of the joint, but not more than 1/2 inch. Backup material shall be provided as necessary to control the depth of sealant and shall be of suitable size so that, when compressed 25 to 50 percent, the space will be filled. Backup material shall be rolled or pressed into place in accordance with the manufacturer's installation instructions, avoiding puncturing and lengthwise stretching. If depth of the joint does not permit use of backup material, bondbreaker tape shall be placed at the bottom of the joint to prevent three-sided adhesion.

3-2. SEALING. Sealing work shall be done before any field painting work is started. The air temperature and the temperature of the sealed surfaces shall be above 50°F when sealing work is performed.

Upon completion of the sealing work, each sealed joint shall have a smooth, even, tooled finish, flush with the edges of the sealing recess, and all adjacent surfaces shall be clean. Sealant shall not lap onto adjacent surfaces. Any sealant so applied as to prevent the painting of adjacent surfaces to a clean line, or with an excess of material outside the joint and feathered onto surfaces, shall be removed and the joint resealed.

End of Section

Section 08110

STEEL DOORS AND FRAMES

PART 1 - GENERAL

1-1. SCOPE. This section covers the furnishing and installation of hollow metal doors and frames. Unless otherwise indicated or specified, all steel doors shall be flush type.

Structural steel door frames and finish hardware are covered in the Structural and Miscellaneous Metals section and the Finish Hardware section, respectively.

1-2. GENERAL. Doors, frames, and appurtenances shall be furnished and installed as specified herein and in accordance with the details and arrangements indicated on the Drawings.

Doors, frames, and appurtenances furnished under this section shall be fabricated and assembled and erected, in full conformity with Drawings, specifications, engineering data, instructions, and recommendations of the manufacturer unless exceptions are noted by Engineer.

1-3. SUBMITTALS.

A. General Submittals:

Complete detail drawings of all items specified herein shall be submitted in accordance with the Submittals Procedures section. Drawings shall show elevations of each door type; details of each frame type; location or identification of each item; typical and special details of construction; methods of assembling sections; location and installation requirements for hardware; size, shape, and thickness of materials; joints; connections; and finish.

B. Florida Product Approvals:

As required by Florida law, building envelope components and systems shall have either a state or local product approval for demonstrating resistance to the structural wind loads required in the current code edition as a condition for site specific permit verification. The Contractor shall be responsible for obtaining and providing approvals demonstrating compliance with this requirement as it relates to products covered under this section.

1-4. DELIVERY, STORAGE, AND HANDLING. Shipping shall be in accordance with the Product Deliver Requirements section. Handling and storage shall be in accordance with the Product Storage and Handling Requirements section.

Materials shall be handled, transported, and delivered in a manner which will prevent bends, dents, scratches, or damages of any kind. Damaged materials shall be promptly replaced.

PART 2 - PRODUCTS

2-1. PERFORMANCE AND DESIGN CRITERIA.

2-1.01. Governing Standard. Except as modified or supplemented herein, all steel doors and frames shall conform to the requirements of ANSI/SDI 100, Level 2, Model 2.

2-1.02. Metal Thicknesses. Metal thicknesses and gages of steel sheet metal specified herein are the minimum required. Gages refer to US Standard gage.

2-1.03. Nomenclature. The nomenclature used herein conforms to ANSI/SDI A250.8.

2-2. ACCEPTABLE PRODUCTS. Internally reinforced doors and accompanying frames shall be equivalent to the following or approved equal:

The Ceco Corporation "Trio" with minimum 60% recycled steel content.

Curries Manufacturing Company "Series 777" with minimum 60% recycled steel content.

2-3. MATERIALS. Materials used in the manufacture of steel doors and frames shall be as follows:

Doors and Frame	ASTM A1008/A1008M or A1011/A1011M, stretcher leveled, commercial quality sheet steel with smooth, clean surface.
Internal Reinforcing	ASTM A1008/A1008M, cold-rolled steel.
Fillers for Internally Reinforced Doors	Injected polyurethane foam, CFC and HCFC free.
Thermal Characteristics	R Factor: 11.0 (ASTM C518).
Anchoring Devices	Zinc-plated where exposed; zinc-plated or galvanized where concealed.
Expansion Anchors	As specified in the Anchorage in Concrete and Masonry section.
Tape Sealant	PVC or neoprene closed-cell foam, black, 1/2 inch wide by 1/4 inch thick strip with pressure-sensitive adhesive back; Williams "Everlastic NN-1" or approved equal.

2-4. FRAMES. Frames for doors, transoms, sidelights, mullions, and interior glazed panels shall be formed of steel to the sizes, 14 gage, and shapes required.

2-4.01. Workmanship. The finished work shall be strong, rigid, neat, and free from defects. Molded members shall be fabricated straight and true, with corner joints well formed, and with fastenings concealed where practicable.

2-4.02. Joints. Joints for frames shall be mitered or butted and continuously welded on the reverse side to produce rigid joints which are invisible on the face of the frame. Frame bottoms shall be held rigidly in position by spreader bars to maintain proper alignment during shipment and erection.

2-4.03. Hardware Provisions. Frames shall be prepared at the factory for the specified hardware. Frames shall be mortised, reinforced, drilled, and tapped for mortised hardware, and shall be reinforced for surface-applied hardware. Cover boxes shall be provided in back of all hardware cutouts. Frames for all doors except weatherstripped doors shall be punched to receive silencers, three holes on the lock side of single door frames and one hole for each leaf in heads of double door frames. Lock strikes shall be set out and adjusted to provide clearance for silencers.

Concealed metal reinforcements shall be provided for hardware in at least the following thicknesses:

Hinge reinforcement	10 gage
Strike reinforcement	14 gage
Closer reinforcement	12 gage
Other reinforcement	14 gage

2-4.04. Mullions and Transom Bars. Not used.

2-4.05. Reinforcing. Not used.

2-4.06. Wall and Floor Anchors. Metal anchors of the sizes and shapes required for the adjoining type of wall construction shall be provided. Jamb anchors shall be fabricated from steel, of at least the same thickness as the frames. Anchors shall be located near the top and bottom of each frame and at intermediate points spaced not more than 32 inches apart.

For frames set in masonry, jamb anchors shall be at least 10 inches long, adjustable, and corrugated or other deformed type.

For frames set in hardened concrete or existing masonry walls, anchorage shall be provided as indicated on the Drawings.

Door frames shall be provided with a 16 gage thick base clip at each jamb for floor anchorage. Clips shall be sized and drilled for at least two 3/8 inch diameter anchoring devices. Where floor fill occurs at a door opening, the bottom of the frame shall terminate at the indicated finished floor level and shall be supported by adjustable extension clip angles anchored to the structural slab.

2-4.07. Stops and Beads. Metal glazing beads shall be furnished with hollow metal frames at transoms, sidelights, interior glazed panels, and other locations where glazed frames are

indicated on the Drawings. Glazing stops shall be formed as an integral part of the frames, and the frames shall be prepared to receive the glazing beads. Where frames are exposed to weather, the integral stops shall be located on the exterior side of the frames. Beads having a molded shape shall be mitered at corners. Rectangular beads may be either mitered or butted at corners.

2-5. DOORS. Doors indicated on the Drawings as hollow metal, including doors with glazed and louvered openings, shall be as specified herein. Doors shall be prepared to receive the hardware specified in the Finish Hardware section.

2-5.01. Workmanship. Doors shall be rigid, neat in appearance, and free from defects. Molded members for glazed doors shall be formed straight and true, with joints coped or mitered, well formed, and in true alignment. All welded joints on exposed surfaces shall be dressed smooth so that they are invisible after finishing.

2-5.02. Sizes and Clearances. Doors shall be of 1-3/4 inch thickness, and type indicated on the Drawings, of the sizes and design indicated. Clearances for doors, except fire doors, shall be 1/8 inch at jambs and heads, 1/4 inch at meeting stiles of pairs of doors, and 3/4 inch at bottom, unless otherwise indicated.

2-5.03. Construction. Doors shall have 18 gage thick seamless outer sheets. Side edges of doors shall be flush and closed watertight. All seams shall be continuously welded and ground smooth. Doors shall be prepared at the factory for hardware, for glazing, and for louvers as indicated on the Drawings. Door edges shall be beveled or rounded.

Flush internally reinforced doors shall have fillers placed in the spaces between reinforcing members and shall be reinforced by 22 gage thick or thicker vertical steel stiffeners installed on 6 inch centers and welded to face sheets.

Outswinging exterior doors shall be finished flush at the top, with all seams and joints closed watertight as specified for side edges.

2-5.04. Hardware Provisions. Doors shall be mortised, reinforced, drilled, and tapped for mortised hardware. Reinforcing units shall be provided for locksets. Reinforcing plates shall be provided for mortised and surface-applied hardware in at least the following thicknesses:

Hinge reinforcement	10 gage
Surface-applied closers and hold-open arms	12 gage
Other reinforcement	14 gage

Where concealed overhead door closers are required, the necessary cutouts, reinforcement, and provisions for fasteners shall be made in the heads of doors.

The locations of hardware items shall be in accordance with DHI "Recommended Locations for Builders' Hardware for Standard Steel Doors and Frames".

2-5.05. Stops and Beads. Metal glazing beads shall be furnished with hollow metal doors where glazed doors are indicated on the Drawings. Glazing stops may be formed as an integral part of

the doors, or separate glazing beads provided for both sides of the glass. Doors shall be prepared to receive the glazing beads. Beads shall be snapped into place, or shall be fastened with oval-head machine screws spaced at 9 inch centers maximum. Beads having a molded shape shall be mitered at corners. Rectangular beads may be either mitered or butted at corners.

Where glazed doors are exposed to weather, all seams and joints on all sides of the glass panel, except joints in removable beads, shall be closed watertight as specified for side edges.

2-6. FIRE DOORS AND FRAMES. Not used.

2-7. SHOP FINISH. A primer shall be applied to all surfaces of ferrous metal furnished under this section. Metal surfaces shall be cleaned and given a phosphate or equivalent treatment to ensure maximum corrosion protection and paint adherence. A dip or spray coat of synthetic resin, rust-inhibitive metallic oxide, or rust-inhibitive zinc chromate primer shall be applied to all surfaces, then baked or oven-dried. Finished surfaces shall be smooth and free from irregularities.

PART 3 - EXECUTION

3-1. INSTALLATION. Frames shall be set in position, plumbed, aligned, and braced securely until permanent anchors are set. Frames shall be anchored to floors with expansion anchors or as indicated on the Drawings. Jamb anchors shall be built into walls and secured to adjoining construction. Spreader bars shall remain in place until frames have been built into the walls.

End of Section

OVERHEAD COILING STEEL DOORS

PART 1 - GENERAL

1-1. SCOPE. This section covers the furnishing and installation of insulated rolling steel doors. Doors shall be overhead coiling type, of the sizes indicated on the Drawings, complete with necessary guides, hoods, hardware, fastenings, mechanisms, and accessories as specified and as indicated on the Drawings.

Motor operated doors shall be installed complete and in proper operating condition in the openings indicated on the Drawings. Electrical conduit and wiring from the power source to the door control equipment, to motors, and to disconnect switches will be furnished and installed under the electrical sections.

1-2. GENERAL. Equipment furnished under this section shall be fabricated and assembled in full conformity with Drawings, Specifications, engineering data, instructions, and recommendations of the equipment manufacturer, unless exceptions are noted by Engineer.

Details of doors, guides, hoods, and accessories shall be as indicated on the Drawings and as specified herein. Doors shall be the product of a manufacturer who is regularly engaged in manufacturing the items specified.

1-2.01. General Equipment Stipulations. The General Equipment Stipulations shall apply to all equipment furnished under this section. If requirements in this specification differ from those in the General Equipment Stipulations, the requirements specified herein shall take precedence.

1-2.02. Power Supply. Power supply to electric operators will be 480 volts, 60 Hz, 3 phase, unless otherwise indicated on the Drawings.

1-2.03. Metal Thicknesses. Metal thicknesses and gages of sheet metal specified herein are the minimum required. Gages refer to US Standard gage.

1-3. SUBMITTALS. Complete detail and installation drawings shall be submitted in accordance with the Submittals Procedures section. Drawings shall indicate construction details, clearance requirements, metal thicknesses, finish, balancing and method of anchoring, locations of guides, fusiblelinks, motors, switches, controls, power requirements, and wiring diagrams.

1-3.01. Florida Product Approvals. As required by Florida law, building envelope components and systems shall have either a state or local product approval for demonstrating resistance to the structural wind loads required in the current code edition as a condition for site specific permit verification. The Contractor shall be responsible for obtaining and providing approvals demonstrating compliance with this requirement as it relates to products covered under this section.

1-3.02. Operation and Maintenance Manuals. Operation and maintenance manuals shall be submitted in accordance with the Submittals Procedures section.

1-4. DELIVERY, STORAGE AND HANDLING. Shipping shall be accordance with the Product Delivery Requirements section. Handling and storage shall be in accordance with the Product Storage and Handling Requirements section.

Doors shall be protected from damage during transportation. Damaged items will be rejected and shall be replaced.

PART 2 - PRODUCTS

2-1. ACCEPTABLE MANUFACTURERS. Rolling doors shall be of the types, models, and operation specified herein and indicated on the Drawings.

2-1.01. Uninsulated Rolling Doors. Not used.

2-1.02. Insulated Rolling Doors. Insulated rolling doors shall be Atlas "Insulated Thermal Door Series T", Overhead "Stormtite Insulated Series 625", or Wayne Dalton "Thermotite Series 800C".

2-1.03. Rolling Fire Doors. Not used.

2-2. MATERIALS. Materials used in rolling steel doors shall be as follows:

Curtain and Hood	Sheet steel, galvanized, cold roll formed.
End Locks	Malleable iron.
Bottom Bar and Guides	Steel angles or channels at least 3/16 inch [4.8 mm] thick.
Bottom Weather Seal	Rubber or vinyl.
Roller Shaft	Steel pipe or tubing.
Roller Ends	Cast iron, ASTM A48
Spring	Oil-tempered steel.
Brackets and Gearing	Cast iron or steel.
Operating Chain	Steel; hot-dip galvanized, ASTM A153 and A385; or zinc plated, ASTM B633, SC4.
Slat Insulation	Polyurethane, foamed in place
Anchor Bolts	As specified in the anchorage in concrete and masonry section.

2-3. ROLLING DOOR FABRICATION.

2-3.01. Mounting. Doors shall be fabricated for installation on the face of the wall, with the hood mounted above the opening as indicated on the Drawings.

2-3.02. Uninsulated Door Curtain. Not used.

2-3.03. Insulated Door Curtain. The curtain for insulated doors shall be formed of interlocking insulated slats and shall be designed to resist the wind loads indicated on the structural Drawings. The curtain shall roll up on a drum supported at the head of the opening and shall be balanced by helical springs. Slats shall be 3/4 inch [19 mm] thick, formed of an outside face of 22 gage [0.76 mm] galvanized steel, with interlocking 22 gage [0.76 mm] galvanized steel inside face totally enclosing foamed-in-place polyurethane insulation.

The ends of each slat in the insulated curtain shall be equipped with a combination end lock and wind lock. Combination end locks shall have a flat surface engaging a seal of metal or of other suitable material mounted on or in the guides, in a manner which will provide an effective seal against wind and water.

Each insulated curtain shall be provided with a bottom bar attached in a manner to suit sill construction. Each exterior insulated door shall be furnished with a replaceable, compressible weather seal fastened to the bottom bar.

2-3.04. Vision Panels. Not used.

2-3.05. Guides. Guides shall form a pocket of sufficient depth to retain the curtain in place under the specified maximum wind pressure. Guides shall be attached to adjacent construction with 3/8 inch [9.5 mm] bolts spaced at not more than 30 inches [750 mm] and near each end.

2.3.06. Roller Shaft. The roller shaft shall be designed so that deflection does not exceed 0.03 inch per foot [2.5 mm/m] of span. Ends of the roller shall be closed with plugs machined to fit and fastened with pins or screws. Welding will not be acceptable. The counterbalancing spring installed inside the roller shall be capable of producing sufficient torque to permit easy operation of the curtain from any position. The spring tension shall be adjustable from outside the bracket without removing the hood, except for manual push-up doors, which may have the spring adjusting device inside the hood.

2-3.07. Brackets. Brackets shall close the ends of roller-shaft housing and shall support the hood. Ends of the roller shaft shall be journaled into bracket hubs. The shaft shall be fitted with self-lubricating, sintered bronze bearings or double sealed, grease lubricated ball bearings.

2-3.08. Hood. The hood shall be fabricated of at least 24 gage [0.60 mm] steel, shall be formed to fit the contours of the brackets, and shall be reinforced with steel rods, rolled beads, or a stiffening flange at top and bottom edges. Hoods at openings larger than 12 feet [3.7 m] wide shall be fitted with intermediate supporting brackets. A flexible weather baffle, mounted internally or externally, shall be provided to prevent airflow around the coil, and provisions shall be included in the design of the hood to prevent the ingress of birds.

2-3.09. Locking Device. Manual push-up doors shall be fitted with a chain or bar type locking device designed to receive a padlock. For chain operated doors, provisions shall be made to secure the chain against travel by means of a padlock. Padlocks are covered under the finish hardware section.

2-3.10. Door Operation. Doors indicated on the Drawings to be motor operated shall be provided with electric motor operators and auxiliary chain gear operation.

2-3.11. Finish. Curtain slats, hood, and bottom rails shall be galvanized and primed in the shop. All other exposed metal parts of the door and accessories, except bearings and chains, shall be shop-primed.

Galvanizing shall comply with ASTM A653 for commercial steel sheets and ASTM A123 for assembled steel products. Galvanized surfaces shall be phosphatized before painting.

2-4. ROLLING STEEL FIRE DOORS. Not used.

2-5. ELECTRIC MOTOR OPERATORS. Electric motor operators shall be of a type recommended by the door manufacturer and shall be complete with an electric motor, reduction gearing, magnetic brake, brackets, push-button controls, limit switches, magnetic reversing starters, and other accessories required for proper operation. Each operator shall be designed so that the motor may be removed without disturbing the limit switch adjustment and without affecting the emergency auxiliary operators. Provisions shall be made for immediate manual operation of the door in case of electric power failure. The emergency operating mechanism shall be arranged to be activated and deactivated from the floor, and its use shall not affect the adjustment of the limit switches. Whenever the mechanism is engaged, the motor shall be disconnected from the manual operating mechanism. Electric motor operators shall be wall-mounted near the head of the door, unless indicated on the Drawings.

2-5.01. Motors. Motors shall be of sufficient horsepower to move doors in either direction from any position at a rate between 0.5 foot and 1 foot per second [150 and 300 mm/s] when operating under full wind load conditions.

Motors shall be of open drip proof construction and rated 460 volts, 60 Hz, 3 phase.

2-5.02. Control System. Each motor operated door shall be equipped with an automatic control system arranged to control the opening, closing, and stopping of curtain travel, and to automatically reverse closing travel when the lower edge of the door curtain meets an obstruction. The control system shall be mounted in a NEMA Type 1 enclosure, or as indicated on the Drawings.

2-5.03. Motor Controller. The motor controller shall be a full voltage, reversing, magnetic type, with 480 volt, 60 Hz, 3 phase contactors; automatically reset thermal overload relays; 120 volt ac operating coils; and 480 to 120 volt dry-type control transformer complete with one secondary lead fused and the other secondary lead grounded. Starters shall not be smaller than NEMA Size 1.

Reversing starters shall be mechanically interlocked so that only one set of contacts can be closed at any one time.

Three thermal overload relays, rated to protect the motor from damage due to overload, shall be furnished with each motor starter.

The motor controller enclosure shall be sized and arranged to house the control power transformer and fuses, relays if required, and a marked terminal block on which all control wiring from all devices shall be terminated. The terminal block shall be located for easy installation and maintenance. All control wiring shall be 14 AWG [2.5 mm²] or larger.

2-5.04. Control Switches. Remote control switches shall be located on the interior or exterior of the openings as indicated on the Drawings. Each switch control station shall be of the three-button, momentary contact type, with the buttons marked "Open", "Close", and "Stop". When the door is in motion and the "Stop" button is pressed, the door shall stop instantly and remain in the stopped position until the "Open" or "Close" button is pushed. Push buttons shall be of the fully guarded type to prevent accidental operation. Control switches located on the building exterior shall be mounted in NEMA Type 4 enclosures. Exterior control switches shall be provided with a key-operated locking device, unless indicated otherwise on the Drawings. Limit switches shall automatically stop the doors in their fully open and fully closed positions. The limit switches shall be readily adjustable.

2-5.05. Safety Device. Each motor operated door shall be equipped with safety edges complying with UL 325, Usage Class III. All safety edges shall be monitored. The primary and secondary entrapment protection provided shall be a combination of Type A, Type B1, or Type B2 per UL 325. Entrapment protection that requires a constant pressure actuating device to operate the door motor will not be acceptable. Entrapment protection that requires continuous actuation of an audible alarm during door operation will not be acceptable.

Upon sensing an obstruction, the door operator shall respond as prescribed in UL 325. The safety device shall be connected with the "closed" limit switch to prevent opening a closed door by tripping the safety device. The safety device shall not serve as a substitute for a limit switch. Type S cable equipped with a spring-loaded automatic take-up reel, or an equivalent device, shall be provided between the safety device and the fixed cable supports.

2-5.06. Electrical Work. All manual or automatic control devices necessary for proper operation of the doors shall be provided. Motors and accessories shall be prewired at the factory to the extent practicable, with connections brought to terminal strips in the controller enclosure.

PART 3 - EXECUTION

3-1. INSTALLATION. Doors shall be installed in accordance with details, drawings, and manufacturer's directions. All anchors and inserts for guides, brackets, motors, controls, switches, and other devices shall be accurately located. After installation, doors shall be free from warp, twist, or distortion, and shall be lubricated and properly adjusted to operate freely and smoothly.

3-2. CLEANING. After installation, factory finished metal surfaces shall be thoroughly cleaned and touched-up as recommended by the manufacturer. Abrasive, caustic, or acid cleaning agents shall not be used.

End of Section

Section 08700

FINISH HARDWARE

PART 1 - GENERAL

1-1. SCOPE. This Section covers finish hardware for steel doors.

1-2. GENERAL. Items included in this section shall conform with the following:

International Building Code, with local amendments
NFPA 70, NFPA 80, NFPA 101
ANSI/BHMA Certified Product Standards – A156 Series

1-3. SUBMITTALS. Contractor shall submit a complete schedule of finish hardware in accordance with the requirements specified in the Submittals section. The schedule shall indicate each item of hardware required for each opening, manufacturer's name, manufacturer's number or symbol, and finish.

1-4. PACKAGING. Each item of hardware shall be packaged separately in an individual container complete with screws, keys, special wrenches, instructions, and installation templates necessary for accurately locating, setting, adjusting, and attaching the hardware. Each container shall be marked with the number of the opening to which the hardware item is to be applied.

1-5. COORDINATION.

1-5.01. Templates. Obtain and distribute to the parties involved templates for doors, frames, and other work specified to be factory prepared for installing standard and electrified hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing hardware to comply with indicated requirements.

1-5.02. Door and Frame Preparation. Related Division 08 Section Steel Doors and Frames are to be prepared, reinforced and pre-wired (if applicable) to receive the installation of the specified electrified, monitoring, signaling and access control system hardware without additional in-field modifications.

1-6. WARRANTY.

1-6.01. General Warranty. Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

1-6.02. Warranty Period. Written warranty, executed by manufacturer(s), agreeing to repair or replace components of standard and electrified door hardware that fails in materials or workmanship within specified warranty period after final acceptance by the Owner. Failures include, but are not limited to, the following:

1. Structural failures including excessive deflection, cracking, or breakage.
2. Faulty operation of the hardware.
3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.

1-6.03. Standard Warranty Period. One year from date of Substantial Completion, unless otherwise indicated.

1-6.04. Special Warranty Periods.

1. Seven years for heavy duty cylindrical (bored) locks and latches.
2. Five years for exit hardware.
3. Ten years for manual door closers.

PART 2 - PRODUCTS

2-1. ACCEPTABLE MANUFACTURERS. The catalog numbers which appear in the Hardware Schedule identify products of the listed manufacturers herein for each hardware item. Equivalent products of the other manufacturers listed herein will also be acceptable.

Hinges	McKinney, Hager, Stanley
Locksets and Cylinders*	Sargent, Yale, Corbin Russwin
Exit Devices	Sargent, Yale, Corbin Russwin, Von Duprin
Closers	Norton, LCN, Sargent, Corbin Russwin
Thresholds, Cast Abrasive	Pemko, Wooster, American Abrasive or Stubbs.
Drip Caps, Extruded	Pemko, Reese, Zero
Gasketing/Weatherstripping	Pemko, Reese, Zero

* Locksets for the well houses shall be Corbin Russwin, without exception and shall be keyed to match existing wells at Southern Regional. Locksets provided at the High Service Pump Station shall match the keying used on the existing doors.

2-2. FINISH. The required finish shall be as indicated by the catalog number listed in the Hardware Schedule herein. Exterior surfaces of door closers shall be finish painted with shop-applied powder coated finish, plated finishes, or special coatings as indicated in the schedule. Machine screws, bolts, and other exposed attachments shall be finished to match hardware.

2-3. KEYING. All cylinder locks shall be keyed in groups to match the existing key system already established. All cylinders shall be furnished with interchangeable cores. After the finish hardware submittals have been accepted by the Engineer, the Owner will meet with the

Contractor and the hardware consultant to determine the keying groups. All locks in each group shall be keyed alike and each group shall be keyed differently. Two "Do Not Duplicate" keys shall be provided with each lock.

PART 3 - EXECUTION

3-1. **INSTALLATION**. Hardware shall be accurately fitted, securely applied, carefully adjusted, and lubricated in accordance with the manufacturer's instructions.

3-1.01. **Location**. Unless otherwise directed by the Engineer, the locations of hardware items shall be in accordance with DHI "Recommended Locations for Builders' Hardware for Standard Steel Doors and Frames".

3-1.02. **Thresholds**. The ends of thresholds shall be notched to fit the applicable door frame profile. Thresholds shall be field drilled to receive flush bolts where required. Thresholds shall be anchored to concrete by means of 5/16-inch diameter stainless steel flat head countersunk machine screws and expansion anchors spaced at 8-inch centers. Thresholds shall be set in asphalt roofing cement conforming to ASTM D4586, Type II.

3-2. **ADJUSTING**. Each supplier of finish hardware shall provide the services of a trained and experienced hardware consultant to service and adjust installed hardware.

3-3. **PROTECTION**. Special care shall be taken to protect finished surfaces of hardware during installation. Hardware on which the finish has been damaged prior to final acceptance of the work shall be replaced with new hardware at no additional cost to the City.

3-4. **HARDWARE SCHEDULE**. Hardware shall be furnished in accordance with the following schedule. Doors are listed by group number. A complete set of hardware is listed for each group, as follows:

Set #1 (Exterior, 3'-0" x 7'-10" & 3'-0" x 7'-2", Locked, Panic) Doors 701, 801, & E01				
Item	# Req'd	Catalog No.	Finish	Manufacturer
Hinges	4	T4A3386 SSF 4-1/2" x 4-1/2"		McKinney
Exit Device	1	8804-ET-L	US32D	Sargent
Closer	1	SRI 351 CPS	EN	Sargent
Threshold	1	252X3-A-FG		Pemko
Gasketing	1	2891AS		Pemko
Raindrip	1	346 C		Pemko
Bottom Sweep	1	18061CNB		Pemko
Note: Only 3 hinges are required for Door E01 (3'-0" x 7'-2")				

Set #2 (<i>Interior, Existing door, Locked, Panic</i>) Door E02				
Item	# Req'd	Catalog No.	Finish	Manufacturer
Exit Device	1	8804-ET-L	US32D	Sargent
Note: Only replace existing latchset with new panic device, all other existing hardware to remain.				

End of Section

SEAMLESS FLOOR COVERING

PART 1 - GENERAL

1-1. SCOPE. This section covers the furnishing and installation of seamless floor covering systems, including moisture vapor emission reduction sealer, and cove bases on the entire floor area, including equipment pads and pump bases, inside well houses 7 and 8.

1-2. GENERAL. All seamless flooring systems provided shall be the product of one manufacturer. The seamless flooring systems shall be furnished complete with all hardware and appurtenances necessary for a complete and satisfactory installation.

1-3. SUBMITTALS. Complete specifications, detailed drawings, color samples, and setting and installation drawings covering seamless flooring shall be submitted in accordance with the submittals section. The following additional information shall be required with the submittals:

- a. The manufacturer's printed specifications for application of the flooring.
- b. Data verifying that the applicator has been trained and licensed by the manufacturer of the seamless flooring.
- c. Data verifying that the applicator has not less than 5 years experience in installation of the flooring systems specified.
- d. Listing of installations completed by the applicator in the last 5 years including project name, size, owner contact name and phone number.

1-4. COLOR SELECTION. Color selections will be made by Engineer from the complete line of manufacturer's custom and standard color formulations after the award of contract.

After the color formulations and patterns have been selected, the following additional samples and data shall be submitted in accordance with the submittals section:

Two 6 by 6 inch samples of each color pattern of floor covering selected, showing proposed color and finish.

1-5. SAMPLE PANEL. Before the installation of any seamless flooring, a 4 foot square sample panel of each color selected shall be prepared at the building site, showing proposed color, finish, and workmanship for seamless flooring. The samples shall include special pattern treatment, cove bases and shower curbs if required in the finished floor system. All panels required shall consist of seamless flooring placed over a cement board 1/4 inch thick mounted on a rigid framework backing. The seamless flooring shall be applied in accordance with the recommendations of the manufacturer and as specified herein. Installation of seamless flooring shall not begin until Engineer has accepted the sample panels. The panels shall then become the standard of comparison for color, pattern, and finish of the seamless flooring. All required panels shall not be destroyed until the seamless flooring work is completed.

1-6. DELIVERY, STORAGE, AND HANDLING. Shipping shall be in accordance with the Shipping section. Handling and storage shall be in accordance with the Handling and Storage section.

Seamless flooring products shall be protected from damage during transportation, at the jobsite, and during construction. All containers and packages shall be unopened at delivery and shall contain the name and address of the manufacturer. All metal items shall be protected from rusting. Damaged items will be rejected and shall be replaced.

1-7. WARRANTY. The applicator of the flooring system shall supply, jointly with the flooring system manufacturer, a warranty covering the flooring system materials and installation for a period after installation of 5 years.

PART 2 - PRODUCTS

2-1. FLOORING SYSTEM. The flooring systems shall conform to the following requirements. The flooring system shall be trowel applied. Broadcast systems will not be acceptable. No other manufacturer will be considered.

Flooring System Products	Florock Seamless Flooring System “Floropoxy 4805”
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2-2. MATERIALS. All materials shall be blended and packaged in the factory. The addition of water or other loose or foreign matter at the jobsite will not be permitted.

Materials for the flooring system shall conform to the following:

Moisture Vapor Emissions Reduction Sealer	As recommended by the flooring system manufacturer.
Primer	Florock Floropoxy 4700 Epoxy Primer @ 8 mils
Intermediate Coat	Florock Floropoxy 4805 Epoxy @ 12 mils
Finish Coats, Two Coats Required	Florock Florothane CR 250 @ 310 sf/gallon per coat
Edge and Divider Strips	Extruded aluminum, size and shape as recommended by the manufacturer.

PART 3 - EXECUTION

3-1. APPLICATION. Seamless flooring shall be applied by experienced, fully trained applicators licensed by the manufacturer of the flooring materials. Applicators shall have not less than 5 years experience in the installation of the types of flooring systems specified. Methods of application shall be in accordance with the recommendations of the manufacturer of the materials and the following requirements:

- a. The base material will be new concrete and shall be prepared as specified.
- b. Seamless flooring shall be applied and completed prior to painting and the installation of objects that may obstruct the application.

3-1.01. Preparation of Surfaces. Concrete slabs shall have a finish as recommended by the flooring system manufacturer. Concrete shall be clean and dry and at a surface temperature of

at least 55°F when application is started. All contaminants and laitance shall be removed. Existing concrete surfaces shall be abraded as recommended. All bug holes and voids shall be filled and any protrusions ground off.

The moisture vapor emission rate of the concrete shall be tested in accordance with ASTM F 1869 using anhydrous calcium chloride. Alternatively, the moisture content of the concrete shall be tested in accordance with Section 8 of ASTM F2170, "Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs using in situ Probes". Application may be started when the moisture vapor emission rate or moisture content of the concrete is acceptable to the manufacturer. Test results and written acceptance from the manufacturer shall be submitted to the Engineer prior to applying flooring.

All surfaces which are not to receive the flooring system shall be protected by masking or other similar methods.

3-1.02. Moisture Vapor Emission Reduction Sealer. A moisture vapor emission reduction sealer shall be provided as recommended by the flooring system manufacturer based on the results of the concrete moisture vapor emission rate testing or moisture content testing.

3-1.03. Priming. Materials, method and rate of application, and the interval between priming and the application of the finish flooring shall be in accordance with the manufacturer's recommendations. Primer shall be uniformly spread and shall not be allowed to collect in surface depressions.

3-1.04. Edge Strips. Edge strips shall be set at all discontinuous edges of flooring. Edge strips at doorways shall be centered under the door. Divider strips may be installed at the toe of cove bases and elsewhere if recommended by the manufacturer.

3-1.05. Cove Bases. Cove bases at abutting vertical surfaces such as walls and curbs shall consist of a 1 inch radius cove formed of a mixture of epoxy and flint shot silica sand to be built up and overlaid with the finish flooring material. The cove base height shall be 4 inches, and shall be uniform, straight, and true. Top edges of cove bases shall be finished with a slight radius to the wall, unless otherwise indicated or detailed on the drawings.

3-1.06. Finish Flooring. Materials shall be mixed to match the accepted standard sample. Adjacent surfaces shall be masked or protected as needed. Flooring materials shall be machine mixed and applied in accordance with the manufacturer's instructions.

The finish coat shall be applied in accordance with the manufacturer's recommendations, and shall produce a uniform satin finish over the entire floor area, including equipment pads. Surfaces shall be inspected for irregular or lumpy areas prior to application of the finish coat. All irregular, uneven, and misaligned floor, curb, and base surfaces shall be repaired as recommended by the flooring manufacturer and to the satisfaction of Engineer prior to finish coat application.

3-1.07. Equipment Pads and Pump Bases. Contractor shall follow above requirements for cove bases for vertical surfaces of equipment pads and pump bases. Horizontal surfaces shall follow above requirements for finish flooring.

3-2. THICKNESS VERIFICATION. If requested by Engineer, prior to the application of the finish coat, Contractor shall take a minimum of four 1 inch diameter core samples through the flooring system into the substrate to verify proper system thickness. Cored areas found to have less than the specified thickness shall be removed and replaced and additional core samples may be taken as necessary to verify the thickness of the entire floor area. Core holes shall be filled in with floor material to match the surrounding floor elevation prior to application of the seal coat.

3-3. ACCEPTANCE. The finished floor system may be rejected for any of the following reasons:

- a. Uneven or patchy color and inconsistency in the color granular mix.
- b. Uneven application of the seal coat or uneven application of the slip resistant coatings.
- c. Variations in flooring system thickness.
- d. Cracking, discoloration, blisters, unusual roughness of the floor system; or separation of the flooring system from the subbase.

3-4. PROTECTION AND FINAL CLEANING. Seamless floor covering shall be protected from damage until acceptance by Owner. Areas that are subject to traffic or over which materials or equipment are to be moved shall be temporarily covered with durable nonstaining paper, such as St. Regis "Seekure", or otherwise adequately protected.

Just before final acceptance, seamless floor covering shall be mopped clean with water and mild detergent, rinsed, and dried.

End of Section

PROTECTIVE COATINGS

PART 1 - GENERAL

1-1. SCOPE. This section covers field applied protective coatings, including surface preparation, protection of surfaces, inspection, and other appurtenant work for equipment and surfaces designated to be coated with heavy-duty maintenance coatings. Regardless of the number of coats previously applied, at least two field coats in addition to any shop coats or field prime coats shall be applied to all surfaces unless otherwise specified.

1-2. GENERAL. Cleaning, surface preparation, coating application, and thickness shall be as specified herein and shall meet or exceed the coating manufacturer's recommendations. When the manufacturer's minimum recommendations exceed the specified requirements, Contractor shall comply with the manufacturer's minimum recommendations. When equivalent products are acceptable to Engineer, Contractor shall comply with this Specification and the coating manufacturer's recommendations.

1-2.01. Governing Standards. All cleaning, surface preparation, coating application, thickness, testing, and coating materials (where available) shall be in accordance with the referenced standards of the following AWWA, ANSI, NACE, SSPC, NSF, and ASTM.

1-2.02. Delivery and Storage. All coating products shall be received and stored in accordance with the coating manufacturer's recommendations.

1-2.03. Coatings, Painting, and Linings Covered in Other Sections. Not used.

1-3. SUBMITTALS. Contractor shall submit color cards for all coatings proposed for use, together with complete descriptive specifications, manufacturer's product data sheet and the completed Coating System Data Sheets, to Engineer for review and color selection. Each product data sheet shall include application temperature limits including recoat time requirements for the ambient conditions at the site, including temperatures up to 130°F . Requests for review submitted directly to Engineer by coating suppliers will not be considered.

When the proposed products will be in contact with treated or raw water in potable water treatment facilities, Contractor shall submit certifications that the proposed systems are in compliance with ANSI/NSF 61.

Contractor shall submit a Coating System Data Sheet for each separately identified surface in the Metal Surfaces Coating Schedule, Concrete and Masonry Surfaces Coating Schedule, and the Miscellaneous Surfaces Coating Schedule that will be used in the Project, using the appropriate Coating System Data Sheet forms (Figures 1-09940 and 2-09940) at the end of this section. Each field coating system shall be acceptable to the coating material manufacturer.

Coating System Data Sheets shall be assigned a unique number with a prefix letter based on the following:

Prefix	Surfaces	Fig.09940
A	Iron and steel (coated entirely in field)	1
A	Iron and steel (shop primed)	2
C	Concrete and concrete block	1
E	Equipment - submerged	1
E	Equipment – nonsubmerged	2
F	Nonferrous metal	1
G	Galvanized	1
H	High temperature	1
P	PVC and FRP	1

Each coating system that will be applied entirely in the field shall be assigned only a prefix letter and no suffix letter. Fig.1-09940 shall be submitted for each surface coated entirely in the field.

Each shop-applied coating system that includes one or more field applied coats shall be assigned both a prefix letter and suffix letter “F”. Fig.2-09940 shall be submitted for each surface having a shop applied coating and one or more field applied finish coats.

A separate Coating System Data Sheet shall be developed and submitted for each surface scheduled to be coated or variation or change in a coating system. The number identifying the surface and coating system shall be of the form A1₁ or A1₂-F. The subscript number shall be assigned by the Contractor so that each surface and coating system combination is uniquely identified. For example:

A1₁-F may be assigned to “Epoxy – one coat to metal curbs for skylights and power roof ventilators that have been shop primed.”

A2₁ may be assigned to “Epoxy – two coats to non-galvanized structural and miscellaneous steel exposed to view inside buildings.”

C2₁ may be assigned to “Epoxy – two coats to all concrete and concrete block in corrosive area (Except floors and surfaces scheduled to receive other coatings) which are exposed to view.”

C2₂ may be assigned to “Epoxy – two coats to walls, floors, and curbed areas, adjacent to corrosive chemical storage and feed equipment as indicated on the Drawings.”

The manufacturer’s standard colors will be acceptable for all coatings.

1-4. QUALITY ASSURANCE.

1-4.01. Coating System Data Sheet Certifications. The coating applicator and coating manufacturer shall review and approve in writing the coating manufacturer's written recommendations for the coating system and the intended service. Any variations from the Specifications or the coating manufacturers published recommendations shall be submitted in writing and approved by the coating manufacturer. The coating manufacturer shall observe the surface preparation, mixing, and application of the coating systems and submit a written report of his observations and any additional recommendations.

1-4.02. Special Interior Coating Systems. Not used.

1-5. DELIVERY AND STORAGE. All coating products shall be received and stored in accordance with the coating manufacturer's recommendations.

PART 2 - PRODUCTS

2-1. ACCEPTABLE MANUFACTURERS.

2-1.01. Alternative Manufacturers. In addition to the coatings listed herein, equivalent products of other manufacturers that distribute globally will also be acceptable:

ICI Devoe	Rust-Oleum
PPG	Sherwin-Williams
MAB	

2-1.02. Equivalent Coatings. Whenever a coating is specified by the name of a proprietary product or of a particular manufacturer or vendor, it shall be understood as establishing the desired type and quality of coating. Other manufacturers' coatings will be accepted, provided that sufficient information is submitted to enable Engineer to determine that the proposed coatings are equivalent to those named. Information on proposed coatings shall be submitted for review in accordance with the Submittals Procedures section. Requests for review of equivalency will be accepted only from Contractor, and will be considered only after the contract has been awarded.

2-2. MATERIALS. All coatings shall be delivered to the job in original, unopened containers, with labels intact. Coatings shall be stored indoors and shall be protected against freezing. No adulterant, unauthorized thinner, or other material not included in the coating formulation shall be added to the coating for any purpose.

All coatings shall conform to the air quality regulations applicable at the location of use. Coating materials that cannot be guaranteed by the manufacturer to conform, whether or not specified by product designation, shall not be used.

With the exception of heat resistant coatings, the coatings specified have been selected on the basis of the manufacturer's statement that the VOC content of the product is 2.8 lbs per gallon or less; however, it shall be the Contractor's responsibility to use only coating materials that are in compliance with the requirements of all regulatory agencies. Local regulations may require some coatings to have a lower VOC content than specified herein. The coatings specified may meet the VOC limits in the unthinned (as shipped) condition, but may exceed the limits if thinned according to the manufacturer's recommendations. In such case, the coatings shall not

be thinned beyond the 2.8 lbs per gallon limit, and if the product cannot be thinned to suit the application method or temperature limits, another manufacturer's coating shall be used, subject to acceptance by Engineer.

Contractor shall be responsible for ensuring the compatibility of field coatings with each other or with any previously applied coatings. Coatings used in successive field coats shall be produced by the same manufacturer. The first field coat over shop coated or previously coated surfaces shall cause no wrinkling, lifting, or other damage to underlying coats.

All coatings used on surfaces that will be in contact with potable or treated water shall be certified as being in compliance with ANSI/NSF 61. Coatings that cannot be so certified, whether or not specified by manufacturer and by product designation, shall not be used.

All intermediate and finish coating materials that will be in contact with wastewater atmosphere shall be guaranteed by the manufacturer to be fumeproof and suitable for wastewater plant atmosphere that contains hydrogen sulfide. Coatings that cannot be so guaranteed shall not be used. Lead-free, chromium-free, and mercury-free coatings shall be used.

2-2.01 Primers.

Universal Primer (tie coat)	PPG Amercoat "Amercoat 385 Epoxy", Carboline "Rustbond", ICI Devoe "Devran 224HS", Tnemec "Series 27 F.C. Typoxy", or Sherwin-Williams "Dura Plate 235".
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2-2.02. Fillers and Surfacer.

Epoxy Concrete Block Filler	PPG Amercoat "Amerlock 400BF Epoxy Block Filler", Carboline "Sanitile 600", ICI Devoe "Truglaze 4015", Tnemec "Series 54-562", or Sherwin-Williams "Kem Cati-Coat HS".
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Epoxy Concrete Filler and Surfacer	Tnemec "Series 218 MortarClad", PPG Amercoat "NuKlad 114A", Carboline "Carboguard 510", or Sherwin-Williams "Steel Seam FT910".
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2-2.03. Intermediate and Finish Coatings.

Epoxy (NSF certified systems)

Ferrous Metal Surfaces and Concrete Surfaces in Contact with Treated or Raw Water in Potable Water Facilities	PPG Amercoat "Amerlock 400 High-Solids Epoxy Coating", Carboline "Carboguard 891", ICI Devoe "Bar-Rust 233H" Tnemec "Series N140 Pota-Pox Plus", or Sherwin-Williams "Dura Plate 235 NSF"; immersion service.
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Epoxy

Concrete Floors	PPG Amercoat "Amerlock 400", Carboline "Carboguard 890", ICI Devoe "Devran 224HS", Tnemec "Series N69 Hi-Build Epoxoline II", or Sherwin-Williams "Armorseal 1000HS"; nonskid.
Ferrous Metal Surfaces and Masonry or Concrete Surfaces Other Than Floors	PPG Amercoat "Amercoat 385 Epoxy", Carboline "Carboguard 890", ICI Devoe Devran "224HS", Tnemec "Series N69 Hi-Build Epoxoline II", or Sherwin-Williams "Dura Plate 235".
Epoxy	
Concrete Floors	Ameron "Amercoat 385 Epoxy", Carboline "Carboguard 890", or Tnemec "Series 69 Hi-Build Epoxoline II"; nonskid.
Ferrous Metal Surfaces, and Masonry or Concrete	Ameron "Amercoat 385 Epoxy", Carboline "Carboguard 890", or Tnemec "Series 69 Hi-Build Epoxoline II".
Aliphatic Polyurethane	PPG Amercoat "Amercoat 450H", Carboline "Carbothane 134HG", ICI Devoe "Devthane 379H" Tnemec "Series 1074 Endura-Shield II", or Sherwin-Williams "Acrolon 218HS".
Coal Tar Epoxy	High-build coal tar epoxy; PPG Amercoat "Amercoat 78HB Coal Tar Epoxy", Carboline "Bitumastic 300 M", Tnemec "46H-413 Hi-Build Tneme-Tar", or Sherwin-Williams "Hi-Mil Sher-Tar Epoxy".
Medium Consistency Coal Tar	Carboline "Bitumastic 50" or Tnemec "46-465 H.B. Tnemecol".
Vinyl Ester	Tnemec "Series 120 Vinester" Carboline "Plasite 4110" or Sherwin-Williams "Magnalux 304FF".

PART 3 - EXECUTION

3-1. SURFACE PREPARATION. All surfaces to be coated shall be clean and dry and shall meet the recommendations of the coating manufacturer for surface preparation. Freshly coated surfaces shall be protected from dust and other contaminants. Oil and grease shall be completely removed by use of solvents or detergents before mechanical cleaning is started. The gloss on previously coated surfaces shall be dulled if necessary for proper adhesion of topcoats.

Surfaces shall be free of cracks, pits, projections, or other imperfections that would interfere with the formation of a smooth, unbroken coating film, except for concrete block construction where a rough surface is an inherent characteristic.

When applying touchup coating or repairing previously coated surfaces, the surfaces to be coated shall be cleaned as recommended by the coating manufacturer, and the edges of the repaired area shall be feathered by sanding or wire brushing to produce a smooth transition that will not be noticeable after the coating is applied. All coatings made brittle or otherwise damaged by heat of welding shall be completely removed.

3-1.01. Galvanized Surfaces. Galvanized surfaces shall be prepared for coating according to the instructions of the manufacturer of the epoxy. Any chemical treatment of galvanized surfaces shall be followed by thorough rinsing with clean water.

3-1.02. Ferrous Metal Surfaces. Ungalvanized ferrous metal surfaces shall be prepared for coating by using one or more of the following cleaning procedures specified here-in: solvents (SSPC-SP1); abrasive blasting (SSPC-SP5, -SP10, -SP6, or -SP7) power tools (SSPC-SP3 or -SP11); or hand tools (SSPC-SP2). Oil and grease shall be completely removed in accordance with SSPC-SP1 before beginning any other cleaning method. Surfaces of welds shall be scraped and ground as necessary to remove all slag and weld spatter. Tools which produce excessive roughness shall not be used.

All components of equipment that can be properly prepared and coated after installation shall be installed prior to surface preparation. Components that will be inaccessible after installation shall have the surfaces prepared and coated before installation. Motors, drive trains, and bearings shall be protected during surface preparation in accordance with the equipment manufacturer's recommendations.

All cut or sheared edges shall be ground smooth to a 1/8 inch minimum radius for all material 1/4 inch thickness and larger. For material thickness less than 1/4 inch all cut or sheared edges shall be ground smooth to a radius equal to 1/2 the material thickness. Grinding of rolled edges on standard shapes with a minimum radius of the 1/16 inch will not be required.

All ferrous metal surfaces shall have all welds ground smooth and free of all defects in accordance with NACE Standard SP0178, Appendix C, Designation C and sharp edges ground smooth, if not previously prepared in the shop. Instead of blending of the weld with the base metal as required by the NACE standard, it will be acceptable to furnish a welded joint that has a smooth transition of the weld to the base metal. All welds shall be ground smooth to ensure satisfactory adhesion of paint.

The cleaning methods and surface profiles specified herein are minimums, and if the requirements printed in the coating manufacturer's data sheets exceed the limits specified, the value printed on the data sheets shall become the minimum requirement.

3-1.02.01. Ferrous Metal Surfaces – Non-immersion Service. Ferrous metal surfaces, including fabricated equipment, in non-immersion service shall be cleaned to the degree recommended by the coating manufacturer for surfaces to be coated with coal tar epoxy, epoxy, and heat-resistant coatings, except galvanized surfaces. Surface preparation of ferrous metal surfaces in non-immersion service shall consist of abrasive blast cleaning to SSPC-SP6, and the first application of coating shall be performed on the same day. If more surface area is prepared than can be coated in one day, the uncoated area shall be blast cleaned again to the satisfaction of Engineer. Surface profile shall be as recommended by coating manufacturer, but not less than 2.0 mils .

3-1.02.02. Ferrous Metal Surfaces - Immersion Service. Surface preparation of ferrous metal surfaces in immersion service shall consist of abrasive blast cleaning to at least SSPC-SP10 and the first application of coating shall be performed on the same day. If more surface area is prepared than can be coated in one day, the uncoated area shall be blast cleaned again to the satisfaction of Engineer. Surface profile shall be as recommended by coating manufacturer, but not less than 3.5 mils .

3-1.03. Concrete Surfaces. All concrete surfaces shall be free of objectionable substances and shall meet the coating manufacturer's recommendations for surface preparation. Concrete surfaces shall be prepared in accordance with SSPC-SP13/NACE 6. Any other surface preparation recommended by the coating material manufacturer shall be brought to Engineer's attention and may be incorporated into the work if acceptable to Engineer.

All concrete surfaces shall be dry when coated and free from dirt, dust, sand, mud, oil, grease, and other objectionable substances. Oil and grease shall be completely removed by use of solvents or detergents before mechanical cleaning is started.

New concrete shall have cured for at least 4 weeks before coating is applied as recommended by the material manufacturer. Concrete surfaces shall be tested for capillary moisture in accordance with ASTM D4263. There shall be no capillary moisture when coatings are applied on concrete.

All surfaces to be coated shall be cleaned in accordance with ASTM D4258 and abraded in accordance with ASTM D4259. Surface profile shall be at least 25 percent of the dry film thickness specified for the coating system. Prior to application of the coating, the surfaces shall be thoroughly washed or cleaned by air blasting to remove all dust and residue. Spalled areas, voids, and cracks shall be repaired in accordance with the Concrete section and as acceptable to the Engineer. Fins and other surface projections shall be removed to provide a flush surface before application of coating.

Except where epoxy is applied as damp-proofing, the concrete surfaces, including those with bug holes less than 1 inch in any dimension, shall be prepared as recommended by the manufacturer, using an epoxy concrete filler and surfacer. Where coating with a vinyl ester the concrete filler and surfacer shall be as recommended by the manufacturer to be compatible with vinyl ester.

3-1.04. Concrete Block Surfaces. Voids and openings in concrete block surfaces shall be pointed. All exposed exterior surfaces and surfaces to be coated with epoxy, including the joints, shall be filled so that a continuous unbroken coating film is obtained.

3-1.05. Copper Tubing. All flux residue shall be removed from joints in copper tubing. Immediately before coating is started, tubing shall be wiped with a clean rag soaked in xylol.

3-1.06. Plastic Surfaces. All wax and oil shall be removed from plastic surfaces that are to be coated, including PVC and FRP, by wiping with a solvent compatible with the specified coating.

3-1.07. Hardware. Hardware items such as bolts, screws, washers, springs, and grease fittings need not be cleaned prior to coating if there is no evidence of dirt, corrosion, or foreign material.

3-1.08. Aluminum. When a coating system is required, remove all oil or deleterious substance with neutral detergent or emulsion cleaner or blast lightly with fine abrasive.

3-1.09. Stainless Steel. When a coating system is required, surface preparation shall conform to the coating manufacturer's recommendations.

3-2. MIXING AND THINNING. Coating shall be thoroughly mixed each time any is withdrawn from the container. Coating containers shall be kept tightly closed except while coating is being withdrawn.

Coating shall be factory mixed to proper consistency and viscosity for hot weather application without thinning. Thinning will be permitted only as necessary to obtain recommended coverage at lower application temperatures. In no case shall the wet film thickness of applied coating be reduced, by addition of coating thinner or otherwise, below the thickness recommended by the coating manufacturer. Thinning shall be done in compliance with all applicable air quality regulations.

3-3. APPLICATION. Coating shall be applied in a neat manner that will produce an even film of uniform and proper thickness, with finished surfaces free of runs, sags, ridges, laps, and brush marks. Each coat shall be thoroughly dry and hard before the next coat is applied. Each coat shall be a different color, if available. In no case shall coating be applied at a rate of coverage greater than the maximum rate recommended by the coating manufacturer.

Coating failures will not be accepted and shall be entirely removed down to the substrate and the surface recoated. Failures include but are not limited to sags, checking, cracking, teardrops, fat edges, fisheyes, or delamination.

3-3.01. Priming. Edges, corners, crevices, welds, and bolts shall be given a brush coat (stripe coat) of primer before application of the primer coat. The stripe coat shall be applied by a brush and worked in both directions. Special attention shall be given to filling all crevices with coating. When using zinc primers the stripe coat shall follow the initial prime coat.

Abraded and otherwise damaged portions of shop-applied coating shall be cleaned and recoated as recommended by the manufacturer of the finish coating. Welded seams and other uncoated surfaces, heads and nuts of field-installed bolts, and surfaces where coating has been damaged by heat shall be given a brush coat of the specified primer. Before the specified spot or touchup coating of metal surfaces, edges, corners, crevices, welds, and bolts in the area of the spot or touchup coating shall be given a brush coat of primer. This patch, spot, or touchup coating shall be completed, and the paint film shall be dry and hard, before additional coating is applied.

3-3.02. Epoxy. When used, epoxy shall be applied in accordance with the coating manufacturer's recommendations, including temperature limitations and protection from sunlight until top-coated.

When concrete is to be coated, coatings shall not be applied to concrete surfaces in direct sunlight or when the temperature of the concrete is rising. Preferably the coating shall be applied when the temperature of the concrete is dropping.

When applying high build epoxy coatings with a roller or brush and where a dry film thickness of at least 4-6 mils per coat is required, two or more coats shall be applied to achieve the recommended dry film thickness equal to a spray applied coating.

3-3.03. Epoxy Enamel. Epoxy enamel shall be applied in accordance with the coating manufacturer's recommendations, including temperature limitations and protection from sunlight until topcoated.

3-3.04. Coal Tar Epoxy. When used, the application of coal tar epoxy, including time limits for recoating, shall conform to the recommendations of the coating manufacturer.

When concrete is to be coated, coatings shall not be applied to concrete surfaces in direct sunlight or when the temperature of the concrete is rising. Preferably the coating shall be applied when the temperature of the concrete is dropping.

3-3.05. Film Thickness. The total coating film thickness including intermediate coats and finish coat, shall be not less than the following:

<u>Type of Coating</u>	<u>Minimum Dry Film Thickness</u>
Medium consistency coal tar	20 mils.
Coal tar epoxy (two coats)	20 mils.
Epoxy	
Floors (two coats)	10 mils.
Surfaces with first coat of epoxy and final coat of aliphatic polyurethane	7 mils (5 mils DFT for epoxy plus 2 mils DFT for aliphatic polyurethane).
Surfaces with first and second coat of epoxy and final coat of aliphatic polyurethane	12 mils (10 mils DFT for epoxy plus 2 mils DFT for aliphatic polyurethane).
Other surfaces (two coats)	10 mils.
Immersion service (three coats)	15 mils.
Epoxy enamel	
Surfaces with first coat of epoxy enamel and final coat of aliphatic polyurethane	7 mils
Other surfaces (two coats)	10 mils
Other (one coat)	5 mils.
Other (two coats)	10 mils.

3-3.06. Weather Conditions. Coatings shall not be applied, except under shelter, during wet, damp, or foggy weather, or when windblown dust, dirt, debris, or insects will collect on freshly applied coating.

Coatings shall not be applied at temperatures lower than the minimum temperature recommended by the coating manufacturer, or to metal surfaces such as tanks or pipe containing cold water, regardless of the air temperature, when metal conditions are likely to cause condensation. When necessary for proper application, a temporary enclosure shall be erected and kept heated until the coating has fully cured.

Coatings shall not be applied at temperatures higher than the maximum temperature recommended by the coating manufacturer. Where coatings are applied during periods of elevated ambient temperatures, Contractor and the coatings manufacturer shall be jointly responsible to ensure that proper application is performed including adherence to all re-coat window requirements. Precautions shall be taken to reduce the temperature of the surface application, especially for metal, at elevated temperatures above 100°F including shading application area from direct sunlight, applying coating in the evening or at night, and ventilating the area to reduce the humidity and temperature,

Vinyl ester coating materials, when required, shall be maintained during transportation, storage, mixing, and application at the temperature required by the coating manufacturer, 35°F to 90°F .

3-4. REPAIRING FACTORY FINISHED SURFACES. Factory finished surfaces damaged prior to acceptance by Owner shall be spot primed and recoated with materials equivalent to the original coatings. If, in the opinion of Engineer, spot repair of the damaged area is not satisfactory, the entire surface or item shall be recoated.

3-5. PROTECTION OF SURFACES. Throughout the work Contractor shall use drop cloths, masking tape, and other suitable measures to protect adjacent surfaces. Contractor shall be responsible for correcting and repairing any damage resulting from its or its subcontractors' operations. Coatings spilled or spattered on adjacent surfaces which are not being coated at the time shall be immediately removed. Exposed concrete or masonry not specified to be coated which is damaged by coatings shall be either removed and rebuilt or, where authorized by Owner, coated with two coats of masonry coating.

3-6. FIELD QUALITY CONTROL. The following inspection and testing shall be performed: surface profile, visual inspection, and wet and dry film thickness testing. All inspection and testing shall be witnessed by Engineer.

3-6.01. Surface Profile Testing. The surface profile for ferrous metal surfaces shall be measured for compliance with the specified minimum profile. The surface profile for concrete shall comply with SSPC 13/NACE 6 Table 1 for severe service.

3-6.02. Visual Inspection. The surface of the protective coatings shall be visually inspected.

3-6.03. Film Thickness. Coating film thickness shall be verified by measuring the film thickness of each coat as it is applied and the dry film thickness of the entire system. Wet film thickness shall be measured with a gauge that will measure the wet film thickness within an accuracy of ± 0.5 mil. Dry film thickness shall be measured in accordance with SSPC-PA 2.

3-6.04. Spark Testing. Not required.

3-6.05. Adhesion Testing. Not required.

3-7. FIELD PRIMING SCHEDULE. In general, steel and cast iron surfaces of equipment are specified to be shop primed. Any such surfaces which have not been shop primed shall be field primed. Damaged or failed shop coatings which have been determined unsuitable by Engineer shall be removed and the surfaces shall be field coated, including prime coat (if any). Galvanized, aluminum, stainless steel, and insulated surfaces shall be field primed. Primers used for field priming, unless otherwise required for repair of shop primers, shall be:

<u>Surface To Be Primed</u>	<u>Material</u>
Equipment, surfaces to be coated with	
Aliphatic polyurethane	Universal primer.
Epoxy	Same as finish coats.
Coal tar coating	Same as finish coats.
Steel and cast iron, surfaces to be coated with	
Epoxy	Same as finish coats or inorganic zinc.

<u>Surface To Be Primed</u>	<u>Material</u>
Coal tar coating	Same as finish coats.
Aluminum	Epoxy.
Galvanized	Epoxy.
Copper	Epoxy.
Stainless steel	Epoxy.
Plastic surfaces, including PVC and FRP	Same as finish coats.
Insulated piping	As recommended by manufacturer of finish coats.
Concrete, surfaces to be coated with epoxy	
For damp-proofing	Epoxy.
For all other surfaces	Epoxy concrete filler and surfacer.
Concrete block exposed in exterior locations	Epoxy concrete block filler.
Concrete block to be coated with epoxy	Epoxy concrete block filler.

Unless otherwise recommended by the coating manufacturer or specified herein, priming will not be required on concrete, or concrete block, nor on metal surfaces specified to be coated with coal tar epoxy, and heat-resistant coatings. Concrete surfaces to be coated with epoxy shall be filled with epoxy concrete filler and surfacer so that a continuous film is obtained, except where concrete is damp-proofed with epoxy.

3-8. FINISH COATING SYSTEMS. The following schedule lists coatings systems and coating surface designations. See Article 1-3 for a definition of the surface designations.

No.	Finish Coating Systems	Coating Surface Designation						
		A	C	E	F	G	H	P
1.	Epoxy – One coat	x			x	x		
2.	Epoxy – Two coats	x	x	x	x	x		x
3.	Epoxy / NSF – Two coats		x	x				
4.	Epoxy – Three coats	x	x	x				
5.	Epoxy / NSF – Three coats	x	x	x				
6.	Epoxy – First coat Aliphatic polyurethane – Finish coat	x	x	x	x	x		x
7.	Epoxy – First and second coat Aliphatic polyurethane – Finish coat	x	x	x	x	x		
8.	Universal primer – First coat Aliphatic polyurethane – Finish coat	x		x				
9.	Medium consistency coal tar – Two coats	x	x	x				

No.	Finish Coating Systems	Coating Designation						
		A	C	E	F	G	H	P
10.	Coal tar epoxy – Two coats	x	x	x				
11.	Vinyl ester – Two coats	x	x	x				
12.	Heat resistant – Two coats						x	
13.	High heat resistant – Two coats						x	
14.	Zinc primer – First coat Epoxy – Intermediate coat Aliphatic polyurethane – Final coat	x		x				
15.	Flake-filled epoxy	x		x				

3-8.01. Surfaces Not To Be Coated. Unless otherwise specified, the following surfaces shall be left uncoated:

Exposed aluminum, except ductwork.

Polished or finished stainless steel. Unfinished stainless steel, except flashings and counter flashings, shall be coated.

Nickel or chromium.

Galvanized surfaces, except piping, conduit, ductwork, and other items specifically noted.

Rubber and plastics, except as specified.

Exterior concrete.

Surfaces specified to be factory finished.

3-8.02. Shop Finishing. Items to be shop finished include the following. Shop finishing shall be in accordance with the coating manufacturer's recommendations.

- a. Surfaces where blast cleaning cannot be or is not recommended to be performed in the field.
- b. Other items as otherwise specified.

3-8.03. Field Coating. Items to be field coated include the following. Field coating shall be in accordance with the field priming schedule, the coating schedule, and the manufacturer's recommendations.

- a. Surfaces not indicated to be shop finished and surfaces where blast cleaning can be performed in the field.
- c. All interior ferrous metal surfaces.
- d. Other items as otherwise specified.

3-9. METAL SURFACES COATING SCHEDULE.

Surface To Be Coated

Finish Coating System

<u>Surface To Be Coated</u>	<u>Finish Coating System</u>
Non-galvanized and galvanized structural and miscellaneous steel exposed to view or to the elements in exterior locations.	A6
Non-galvanized and galvanized structural and miscellaneous steel exposed to view inside buildings.	A2
Steel handrails, steel floor plates, doors, door frames.	A8
Unless otherwise specified, pumps, motors, speed reducers, and other machines and equipment exposed to view.	E8
Heating and air conditioning units, convector covers, electrical equipment cabinets, and similar Items and equipment (unless factory finished) exposed to view.	E8
Cast Iron and steel piping inside buildings, including piping to be insulated, valves, fittings, flanges, bolts, supports, and accessories, and galvanized surfaces after proper priming.	A2
Cast Iron and steel piping above grade exposed to the elements and to view outdoors, including piping to be insulated, valves, fittings, flanges, bolts, supports, and accessories, and galvanized surfaces after proper priming.	A6
Copper pipe and tubing, including fittings and valves.	F1
All metal surfaces, unless otherwise specified, which will be submerged or buried, all or in part, including valves, and scum baffles, and cast iron slide gates, but excluding piping laid in the ground.	E4 or A10
Aluminum in contact with concrete.	F1
Aluminum and galvanized ductwork and conduit indoors.	F1 or G1
Aluminum and galvanized ductwork and conduit exposed to elements outdoors.	F6 or G6
Aluminum materials exposed to the elements outdoors.	F6

3-10. CONCRETE AND MASONRY SURFACES COATING SCHEDULE.

<u>Surface To Be Coated</u>	<u>Finish Coating System</u>
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All concrete and concrete block (Except floors Indoor –C2 and surfaces scheduled to receive other Outdoor –C7 coatings) which are exposed to view.

3-11. MISCELLANEOUS SURFACES COATING SCHEDULE.

Plastic Surfaces, including PVC and FRP.	Outdoor – P6 Indoor – P2
Piping Insulation	Outdoor – P6 Indoor – P2

3-12. PIPING IDENTIFICATION SCHEDULE. Exposed piping and piping in accessible chases shall be identified with lettering or tags designating the service of each piping system, marked with flow directional arrows, and color coded.

Piping scheduled to be color coded shall be completely coated with the indicated colors, except surfaces specified to remain uncoated shall include sufficiently long segments of the specified color to accommodate the lettering and arrows. All other piping shall be coated to match adjacent surfaces, unless otherwise directed by Engineer.

3-12.01. Location. Lettering and flow direction arrows shall be provided on pipe near the equipment served, adjacent to valves, on both sides of wall and floor penetrations, at each branch or tee, and at least every 50 feet in straight runs of pipe. If, in the opinion of Engineer, this requirement will result in an excessive number of labels or arrows, the number required shall be reduced as directed.

3-12.02. Metal Tags. Where the outside diameter of pipe or pipe covering is 5/8 inch or smaller, aluminum or stainless steel tags shall be provided instead of lettering. Tags shall be stamped as specified and shall be fastened to the pipe with suitable chains. Pipe identified with tags shall be color coded as specified.

3-12.03. Lettering. Lettering shall be painted or stenciled on piping or shall be applied as snap-on markers. Snap-on markers shall be plastic sleeves, Brady "Bradysnap-On B-915", Seton "Setmark", or equal. Letter size shall be as follows:

<u>Outside Diameter of Pipe or Covering</u>	<u>Minimum Height of Letters</u>
5/8 inch and smaller	Metal tags -1/4 inch
3/4 to 4 inches	3/4 inch
5 inches and larger	2 inches

3-12.04. Color Coding and Lettering. All piping for the following services shall be color coded. Bands shall be 6 inches wide spaced along the pipe at 5 foot intervals. For services not listed, the color coding and lettering shall be as directed by the Engineer.

Piping Identification		
Service	Color of Pipe	Color of Letters
Drain	Dark gray	White
Potable Water (hot or cold)	Dark blue	White ¹
Raw Water	Olive green	White
Reclaimed Water	Purple	Black ²
Sewage	Dark gray	Black

Notes:

1. Lettering shall be on a light green background.
2. Lettering shall read, "CAUTION: RECLAIMED WATER, DO NOT DRINK".

Electrical conduit shall be coated to match adjacent ceiling or wall surfaces as directed by Engineer. Vent lines shall be coated to match surfaces they adjoin.

In addition, special coating of the following items will be required:

<u>Item</u>	<u>Color</u>
Valve handwheels and levers	Red

Numerals at least 2 inches high shall be painted on or adjacent to all accessible valves, pumps, flowmeters, and other items of equipment which are identified on the Drawings or in the Specifications by number.

End of Section

SURFACE DESCRIPTION	SYSTEM NO. -

SURFACE PREPARATION DESCRIPTION
<input type="checkbox"/> Solvent SSPC-SP1 <input type="checkbox"/> Ferrous Metal Nonimmersion SSPC-SP6 <input type="checkbox"/> Ferrous Metal Immersion <ul style="list-style-type: none"> <input type="checkbox"/> SSPC-SP10 <input type="checkbox"/> SSPC-SP-5 <input type="checkbox"/> Other

COATING	DFT mils [µm]	MANUFACTURER AND PRODUCT
First Coat (Primer)		
Second Coat		
Third Coat		
Total System		Not less than minimum thickness specified.

Notes: (Attached if needed.)

Project:		
Coatings Manufacturer:		Initials _____
Painting Applicator:		Initials _____
BLACK & VEATCH	COATING SYSTEM DATA SHEET	Fig 1-09940

SHOP PRIMED SURFACE DESCRIPTION	SYSTEM NO. -	-F

SURFACE PREPARATION DESCRIPTION
<input type="checkbox"/> Solvent SSPC-SP1 <input type="checkbox"/> Other:

COATING	DFT mils [μm]	MANUFACTURER AND PRODUCT
Shop (Primer)		(Identify Product/Type)
Touchup		
Intermediate Coat		
Finish Coat		
Total System		Not less than minimum thickness specified.

Notes: (Attached if needed.)

Project:		
Coatings Manufacturer:		Initials _____
Painting Applicator:		Initials _____
BLACK & VEATCH	COATING SYSTEM DATA SHEET	Fig 2-09940

LOUVERS AND VENTS

PART 1 - GENERAL

1-1. SCOPE. This section covers the furnishing and installation of stationary type weather louvers. Combination louver/dampers, control dampers, fire dampers, adjustable louvers, penthouses, and smoke vents are covered in other sections.

1-2. GENERAL. Louvers shall be furnished and installed as specified herein and in accordance with the details, louver schedule, or arrangements indicated on the Drawings.

Louvers shall be of the sizes required for opening sizes indicated on the Drawings. Actual opening sizes for louvers or vents scheduled for insertion within existing construction shall be field verified. Actual louver sizes shall allow for shim and caulk space.

1-3. SUBMITTALS. Complete specifications and detailed drawings covering arrangement, dimensions, hardware, accessories, and details of construction and installation of the louvers shall be submitted in accordance with the Submittals Procedures section.

1-3.01. Florida Product Approvals. As required by Florida law, building envelope components and systems shall have either a state or local product approval for demonstrating resistance to the structural wind loads required in the current code edition as a condition for site specific permit verification. The Contractor shall be responsible for obtaining and providing approvals demonstrating compliance with this requirement as it relates to products covered under this section.

1-4. COLOR SELECTION. Colors of louvers will be selected from the manufacturer's full line of colors by Engineer. Procedures for selecting colors shall be as indicated in the Submittals Procedures section.

1-5. DELIVERY, STORAGE, AND HANDLING. Shipping shall be in accordance with the Product Delivery Requirements section. Handling and storage shall be in accordance with the Product Storage and Handling Requirements section.

Materials shall be handled, transported, and delivered in a manner which will prevent bends, dents, scratches, or damages of any kind. Damaged materials shall be promptly replaced. Materials shall be stored off the ground and protected from the weather.

PART 2 - PRODUCTS

2-1. PERFORMANCE AND DESIGN CRITERIA.

2-1.01. Governing Standard. Except as modified or supplemented herein, all stationary louvers shall be Miami-Dade Certified to meet the performance criteria for louvers impacted by wind borne debris as specified and outlined by AMCA Standard 540.

2-1.02. Finishes. Louvers shall have a Kynar paint finish.

Kynar paint finishes shall meet the AAMA specification 605.2 with 1.2 mils total dry film thickness.

2-1.03. Construction. Louvers shall be of aluminum construction and shall be the product of one manufacturer. Louvers shall be furnished complete with all hardware and appurtenances necessary for a satisfactory installation.

Stationary type weather louvers shall be architectural style continuous blades with concealed mullions.

2-1.04. Performance Requirements.

2-1.04.01. Stationary Type. The velocity at which the beginning point of water penetration occurs for stationary type weather louvers shall be at least 1055 fpm. The minimum free area for a 48 inches x 48 inches louver shall be 49 percent. The maximum static pressure loss at 600 fpm shall be 0.08 inches wc.

2-2. ACCEPTABLE PRODUCTS.

2-2.01. Stationary Type Weather Louvers. Subject to the requirements specified herein, stationary type weather louvers shall be equivalent to the following:

Ruskin "ELF-375DXD"

Arrow United Industries "EA-22"

American Warming and Ventilating "LE-22"

2-2.02. Accessories. Stationary type louvers shall have aluminum removable insect screens mounted to the exterior of the louver frame as detailed on the Drawings. The screen shall be charcoal colored 20/20 fiberglass mesh. The insect screen frame shall include a groove for a spline and shall be of the same construction as the louver frame and have the same finish.

2-3. MATERIALS.

Aluminum Extrusions ASTM B221, Alloy 6063-T5, minimum
0.125 inch thick.

PART 3 - EXECUTION

3-1. GENERAL. Products shall be installed in accordance with this section, the manufacturer's instructions, and as indicated on the Drawings.

Complete specifications and detailed drawings covering arrangement, dimensions, hardware, accessories, and details of construction and installation of the louvers and vents will be made available to the louver and vent installer.

3-2. INSTALLATION. The louvers shall be installed with anchors suitable for the adjacent material and shall be caulked as specified in the caulking section. Insect screens shall be installed on the exterior frame of the louvers.

Where aluminum work is to be attached to steel supporting members or other dissimilar metal, the aluminum shall be kept from direct contact with such metals by a heavy coat of epoxy enamel. Aluminum surfaces which will be in contact with concrete or masonry when installed shall be given a heavy coat of epoxy enamel. All paint shall be dry and hard when the coated parts are installed.

End of Section

IDENTIFYING DEVICES

PART 1 - GENERAL

1-1. SCOPE. This section covers furnishing and installation of non-illuminated wall mounted exterior signs, an interior signage system, plaques, miscellaneous signs, hazardous chemical warning signs, and identification nameplates for valves and equipment.

Sign locations, wording, and letter styles and sizes shall be as indicated on the drawings or as specified herein. Exit signs are scheduled on the electrical drawings. Piping identification is covered in the painting section.

1-2. SUBMITTALS. A complete listing of all signs and nameplates covered by this section shall be submitted for review in accordance with the submittals section. Listing shall contain the exact wording proposed for each sign, the size of the sign, the size of the lettering, and the proposed mounting method. All signage shall meet Americans with Disabilities Act requirements where appropriate.

Colors for all signs will be selected from the manufacturer's standard line of colors.

PART 2 – PRODUCTS

2-1. NON-ILLUMINATED POST-MOUNTED EXTERIOR SIGNS.

2-1.01. System. Post-mounted permanent project signs shall be provided at the entrance to each facility. The face panel and post shall be the “Modulex Pacific” series manufactured by ASI Sign Systems. The face panel shall be 1/8-inch cold-rolled aluminum with concealed mounting clips.

2-1.02. Sign Panel. The sign panels shall be 3 feet in height by 4 feet in width. Sign panels shall be ASI 3-inch thick panels consisting of 1/8-inch thick fiberglass material with integral returns fully encapsulating a welded aluminum core. All edges and corners shall have a 1/8-inch radius. Panels shall be attached to posts with mechanical fasteners as recommended by the sign manufacturer.

2-1.03. Typography. Graphics for each sign shall be as indicated in Figures 10400-F1 and 10400-F2.

2-1.04. Posts. Posts shall be 3-inch half round extruded aluminum sections of the length required with full round sections from underside of panel to foundation. Posts shall have aluminum fillers at top and bottom of sign panel to complete the assembly. Posts shall have necessary hardware for mounting of sign panel. Posts shall be provided with an aluminum baseplate drilled for anchor bolts as recommended by the sign manufacturer.

2-1.05. Loads. The completed signs shall be designed to withstand 100-mph windloads.

2-1.06. Colors. Finish for the sign posts and panels shall match and shall be selected from manufacturer's standard colors. Lettering shall be opaque white. Arrows and color samples shall be submitted to the Engineer for selection. The sign for the reclaimed facility shall be reclaimed purple, Pantone 522-C. The sign for the well field shall be potable water blue, Pantone Process Blue C.

2-2. ROOM IDENTIFICATION SIGNAGE SYSTEM. Not used.

2-3. BRONZE PLAQUE. Not used.

2-4. MISCELLANEOUS SIGNS. Not used.

2-5. HAZARDOUS CHEMICAL WARNING SIGNS. Not used.

PART 3 - EXECUTION

3-1. NON-ILLUMINATED POST-MOUNTED SIGNS.

3-1.01. Installation. Signs shall be mounted on concrete bases with anchor bolts. Signs shall be set true, level, and plumb as recommended by the manufacturer, with lettering surface oriented as directed by the Engineer. Unless otherwise indicated, signs shall be perpendicular or parallel to the adjacent curb. Exact location of each sign shall be as directed by the Engineer.

3-2. ROOM IDENTIFICATION SIGNAGE SYSTEM. Not used.

End of Section



Orange County Utilities Southern Regional Wellfield

13419 LANDSTAR BOULEVARD

**FOR EMERGENCIES CALL: 407-836-2777
OR WATER SCADA 407-254-9509**



**Orange County Utilities
Meadow Woods
Reclaimed Water
Storage and Re-Pump Facility**

402 RHODE ISLAND WOODS CIRCLE

FOR EMERGENCIES CALL: 407-836-2777

MISCELLANEOUS SPECIALTIES

PART 1 - GENERAL

1-1. SCOPE. This section covers the miscellaneous items of work not covered in other sections.

1-2. GENERAL. Miscellaneous specialties shall be furnished and installed as specified herein and in accordance with the details, arrangements, and dimensions indicated on the drawings. Where not specifically indicated or specified, fasteners, gaskets, and other accessories shall be provided as required and as recommended by the manufacturer of the specific item.

1-3. SUBMITTALS. Complete specifications, detailed drawings, and setting or erection drawings covering miscellaneous specialties shall be submitted in accordance with the submittals section.

PART 2 - PRODUCTS

2-1. PRODUCTS.

2-1.01. FIRE EXTINGUISHERS. Portable fire extinguishers of the all-purpose, nitrogen-pressured, dry chemical type shall be provided as scheduled herein. The fire extinguishers shall be UL approved for Class A, B, and C fires and shall have a 10 pound capacity, such as Badger "10MB-8H", Buckeye "10 LB - ABC", or Kidde "Pro 460". Finish of shell shall be red with all metal handle and valve.

Wall-mounted fire extinguishers shall be mounted on suitable wall brackets at the specific locations noted in the schedule below.

The following fire extinguishers shall be provided:

<u>Location</u>	<u>Quantity</u>	<u>Mounting</u>
Pump Houses, near exit door	2 (1 each)	Surface

PART 3 - EXECUTION

3-1. INSTALLATION. All products herein shall be installed as recommended by the manufacturer and as indicated on the drawings. All moving parts shall be properly lubricated and adjusted as required for proper operation.

End of Section

EQUIPMENT INSTALLATION

PART 1 - GENERAL

1-1. SCOPE. This section covers installation of new equipment units that have been purchased by Contractor as part of this Work, or purchased by others under equipment specifications.

Startup requirements shall be as indicated in the Startup Requirements section.

1-2. GENERAL. Equipment installed under this section shall be erected and placed in proper operating condition in full conformity with drawings, specifications, engineering data, instructions, and recommendations of the equipment manufacturer, unless exceptions are noted by Engineer.

When pumping units are being installed, hydraulic considerations and definition of terms shall be as set forth in the Hydraulic Institute Standards.

Any equipment identified as being provided by others will be furnished complete for installation by Contractor. Technical specifications under which the equipment will be purchased are available.

Any existing equipment which is removed shall be handled as indicated in the Project Requirements section.

1-2.01. Coordination. When manufacturer's field services are provided by the equipment manufacturer, Contractor shall coordinate the services with the equipment manufacturer. Contractor shall give Engineer written notice at least 30 days prior to the need for manufacturer's field services furnished by others.

Submittals for equipment furnished by others under each procurement contract will be furnished to Contractor upon completion of review by Engineer. Contractor shall review equipment submittals and coordinate with the requirements of the Work and the Contract Documents. Contractor accepts sole responsibility for determining and verifying all quantities, dimensions, and field construction criteria.

Flanged connections to equipment including the bolts, nuts, and gaskets are covered in the appropriate pipe specification section.

1-3. DELIVERY, STORAGE, AND HANDLING.

1-3.01. Storage. Upon delivery, all equipment and materials shall immediately be stored and protected by Contractor in accordance with the Handling and Storage section until installed in the Work. Equipment shall be protected by Contractor against damage and exposure from the elements. At no time shall the equipment be stored on or come into contact with the ground, grass, or any other type of vegetation. Contractor shall keep the equipment dry at all times.

In addition to the requirements in Section 02675, the well pump column, bowl assembly and submerged components shall be disinfected with a solution of sodium hypochlorite during installation.

3-1.01.1. Submersible Pumps. Control cables shall be supported to avoid tension and damage. Mounting of cable supports in wetwells will be coordinated by the pump supplier. Liquid level sensors shall operate freely and shall be adjusted to the levels indicated in the respective pump schedules, or in the electrical schematics or P&ID's. Each system of sensors will be furnished by others, and shall be installed complete with all required mounting brackets, weights, galvanized steel mounting pipes and accessories, control panel transformers, auxiliary relays, cables, and junction boxes.

3-1.02. Cleaning. The exposed finish shall be inspected after completing system installation, including pipe connections, fittings, valves, and specialties. Burrs, dirt, and construction debris shall be removed and damaged finishes, including chips, scratches, and abrasions shall be repaired.

3-1.03. Protection. The equipment shall be protected after installation, but prior to final acceptance by Owner. Protection provisions shall be as recommended by the manufacturer and shall include provisions to prevent rust, mechanical damage, and foreign objects entering the equipment.

3-2. STARTUP AND TESTING. Startup requirements, and tests associated with startup shall be as indicated in the Startup Requirements section. Other field tests shall be as indicated in the specific equipment sections. Startup and tests required shall occur in the order listed in the following paragraphs. Tests shall not begin until any installation supervision and installation checks by the equipment manufacturer have been completed, except where noted below.

3-2.01. Preliminary Field Tests. Preliminary field tests shall be conducted on all equipment by Contractor as indicated in the Startup Requirements section. When an installation check is specified in the equipment sections, the equipment manufacturer's representative will participate in these tests to the extent described in the Startup Requirements section and in the equipment sections.

3-2.02. Field System Operation Tests. Field system operation tests shall be conducted on all equipment by Contractor as indicated in the Startup Requirements section. When an installation check is specified in the equipment sections, the equipment manufacturer's service personnel will participate in these tests to the extent described in the Startup Requirements section and in the equipment sections.

3-2.03. Field Demonstration Tests. Field demonstration tests will be conducted by the equipment manufacturer on equipment as indicated and as specified in the equipment sections.

3-2.04. Field Performance Tests & Distribution Tests. Field performance tests or distribution tests will be conducted by the equipment manufacturer on equipment as indicated and as specified in the equipment sections.

3-2.05. Field Baseline Performance Tests. Field baseline performance tests shall be conducted by Contractor on the equipment indicated in the equipment sections, and the tests shall be performed as indicated. When indicated in the equipment sections, the equipment manufacturer will participate in these tests. This test shall not be considered an acceptance test, but rather a test to determine initial performance curves and efficiency just prior to the equipment entering service.

End of Section

VERTICAL DIFFUSION VANE PUMPS – WELL SERVICE

PART 1 - GENERAL

1-1. SCOPE. This section covers the furnishing of vertical diffusion vane pumping units as indicated herein:

Pump designation.	Well Pumps
Number of pumps.	2
Pump tag numbers.	WL_P7 and WL_P8
Pump location.	Well Houses

Each pumping unit shall be complete with a pump, electric motor, pedestal, sub-base, anchor bolts, and all other appurtenances specified or required for proper operation.

The following sections are applicable to pumps to be installed:

<u>Section</u>	<u>Title</u>
11060	Equipment Installation
13563	Pressure and Level Transmitters

1-2. GENERAL. Equipment furnished under this section shall be fabricated and assembled in full conformity with drawings, specifications, engineering data, instructions, and recommendations of the equipment manufacturer, unless exceptions are noted by Engineer.

1-2.01. General Equipment Stipulations. The General Equipment Stipulations shall apply to all equipment furnished under this section. If requirements in this specification differ from those in the General Equipment Stipulations, the requirements specified herein shall take precedence.

1-2.02. Governing Standard. Except as modified or supplemented herein, all vertical diffusion vane pumps shall conform to the applicable requirements of ANSI/AWWA E101-88 and the Hydraulic Institute Standards.

1-2.03. Tagging. Each item of equipment and each part shipped separately shall be tagged and identified with indelible markings for the intended service. Tag number shall be clearly marked on all shipping labels and on the outside of all containers.

1-2.04. Power Supply. Unless otherwise indicated, power supply to the equipment shall be 480 volts, 60 Hz, 3 phase.

1-3. SUBMITTALS.

1-3.01. Drawings and Data. Complete fabrication and assembly drawings, together with detailed specifications and data covering materials, parts, devices, and accessories forming a part

of the equipment furnished, shall be submitted in accordance with the Submittals section. The data and specifications for each pumping unit shall include, but shall not be limited to, the following:

Pumps

- Name of manufacturer.
- Type and model.
- Design rotative speed.
- Diameter of discharge outlet.
- Diameter of line shafting.
- Type of lineshaft bearings.
- Diameter and wall thickness of pump column.
- Number of stages.
- Type of bowl bearings.
- Complete performance curves showing capacity versus head, NPSH required, pump and wire-to-water efficiency, and bhp [brake kW] plotted to scales consistent with performance requirements.
- OD of pump bowls.
- Weight including bowls, column, and pedestal

Complete Pumping Unit

- Max overall dimensions.
- Total weight including motor and base plate.
- Data on shop painting.

Motors

As specified in the General Purpose Induction Motors section.

1-3.02. Operation and Maintenance Data and Manuals. Adequate operation and maintenance information shall be supplied as required in the Submittals section. Operation and maintenance manuals shall be submitted in accordance with the Submittals section. The operation and maintenance manuals shall be in addition to any instructions or parts lists packed with or attached to the equipment when delivered.

1-4. QUALITY ASSURANCE.

1-4.01. Balance. All rotating parts shall be accurately machined and shall be in as nearly perfect rotational balance as practicable. Excessive vibration shall be sufficient cause for rejection of the equipment. The mass of the unit and its distribution shall be such that resonance at normal operating speeds is avoided. In any case, the unfiltered vibration velocity, as measured at any point on the machine including the motor, shall not exceed the maximum vibration limit of the governing standard unless otherwise required.

At any operating speed, the ratio of rotative speed to the critical speed of a unit or its components shall be less than 0.8 or more than 1.3.

1-4.02. Efficiency Evaluation. If the efficiency, as determined by the shop test, is below the specified minimum efficiency, Owner may, at his option, reject the unit.

1-5. DELIVERY, STORAGE, AND HANDLING. Shipping shall be in accordance with the Shipping section. Handling and storage shall be in accordance with the Handling and Storage section.

1-6. SPARE PARTS AND ACCESSORIES. Spare parts shall be suitably packaged, with labels indicating the contents of each package. Spare parts shall be delivered to Owner as directed. The following spare parts shall be furnished with each pump.

<u>Spare Part</u>	<u>Quantity</u>
Lantern ring	1
Bowl wearing rings	1
Impeller wearing rings	1
Sets of bowl bearings	1
Sets of lineshaft bearings	1

PART 2 - PRODUCTS

2-1. ACCEPTABLE MANUFACTURERS. Well Service Pumps WL_P7 and WL_P8 shall be manufactured by Fairbanks Morse, Flowserve, Goulds or Peerless without exception. The products of other manufacturers will not be acceptable. All of the well service pumps shall be a product of the same manufacturer.

2-2. SERVICE CONDITIONS. Each pumping unit will be installed in a well casing with an inside diameter of approximately 15.25 inches. The pumps specified in this section shall be used to supply raw water from deep wells to be treated for public drinking water.

The pumping units shall be suitable for the following service conditions:

Seismic zone.	N/A
Type of environmental exposure.	Indoor
Ambient air temperature range.	20 to 110 °F
Liquid temperature range.	70 to 80 °F
Pumps start and stop against a closed valve.	No
Site elevation.	87 ft
Units subject to freezing temperatures.	No
Crane facilities available.	No

Parts shall be interchangeable between units of similar size and capacity to extent practical.

All equipment furnished shall be designed to meet all specified conditions and to operate satisfactorily at this elevation.

Each pumping unit shall be designed to facilitate installation and removal using the facilities provided for that purpose as indicated on the drawings.

All equipment furnished shall be designed to meet all specified conditions and to operate satisfactorily at the site elevation indicated.

2-3. PERFORMANCE AND DESIGN REQUIREMENTS. Pumping units shall be designed for the following performance and design requirements, at maximum speed unless otherwise noted:

Pump tag numbers.	WL_7 and WL_8
Rated head.	184 ft
Capacity at rated head.	1750 gpm
Minimum shutoff head.	240 ft
Maximum shutoff head.	290 ft
Maximum nominal pump speed.	1800 rpm
Maximum power required at pump input shaft at any point in the operating range.	125 bhp
Maximum power at shutoff head.	125 bhp
Efficiency.	74 %
Type of efficiency indicated.	Wire to water
Efficiency calculated at.	Rated head
Pump designed for reverse rotation.	No
Minimum nominal size of pump column.	10 in
Nominal size of pump discharge.	10 in
Length of Pump Column	100 ft
Maximum length of any component or subassembly.	10 ft

Overall (wire-to-water) efficiency for constant speed pumps shall include losses in the pump and motor.

Minimum shop test pressure on bowl assembly shall be 1.5 times the shutoff head plus maximum suction pressure where applicable.

The pump setting shall be as indicated on drawings.

For design and rating purposes, the water to be pumped shall be assumed to have a temperature of 70°F [21°C].

Pump performance shall be stable and free from damaging cavitation, vibration, and noise in the operating head range. The performance of pumps with an enclosed impeller shall be based on a radial running clearance between the bowl wearing ring and the impeller of not less than 6 mils [152 µm], or 0.5 mil per inch [10 µm per 20 mm] of wearing ring diameter, whichever is greater.

2-4. MATERIALS.

Suction Strainer	Stainless steel
Labyrinth Sand Collar	Bronze, ASTM B584.
Pump Bowls	Cast iron, ASTM A48, Class 30.
Impellers	Silicon Bronze, ASTM B584 – 873.
Bowl Wearing Rings	Martensitic stainless steel, Brinell 300+.
Impeller Wearing Rings	Martensitic stainless steel, Brinell 200-250.
Bowl Assembly Shaft	Martensitic stainless steel, AISI Type 410 or 416.
Bowl Bearings	Bronze, ASTM B505-932, water lubricated, except suction case (bowl) bearing shall be permanently packed with water-resistant grease.
Lineshaft, stainless steel	Martensitic stainless steel shaft, AISI Type 410 or 416, with Martensitic stainless steel couplings of dissimilar alloy.
Lineshaft Sleeves	Martensitic stainless steel, Brinell 400+.
Open Lineshaft Bearings	Goodrich "Cutless Rubber", water lubricated.
Lineshaft Bearing Retainer	Bronze, ASTM B584; ductile iron.
Threaded Pump Column	ASTM A53, Grade A standard weight steel pipe, with threaded couplings.
Stuffing Box Housing	Cast iron, ASTM A48, Class 30.
Stuffing Box Bearing	Bronze, ASTM B505-932, water, internal lubricated.
Stuffing Box Hardware	Corrosion-resistant metal.
Lantern Rings	Bronze, ASTM B584 or glass-filled Teflon for 2-1/2 inch [63 mm] OD and smaller shafts; bronze only for shafts larger than 2-1/2 inches [63 mm] OD.
Stuffing Box Packing	Braided, graphite impregnated carbon.
Water Slinger	Rubber or bronze.
Pedestal and Subbase	Cast iron or fabricated steel.

Lineshaft Coupling Thread
Lubricant

Jet-Lube "Nikal", John Crane "Thred Gard
Nickel", Never-Seez "Pure Nickel Special", or
Permatex "Nickel Anti-Seize".

Epoxy Coating

Ameron "Amerlock 400 High-Solids Epoxy
Coating", Carboline "Carboguard 891", or
Tnemec "Series N140 Pota-Pox Plus".

2-5. PUMP CONSTRUCTION. Each pump shall be the turbine type suitable for well installation.

2-5.01. Suction Bowl Inlet. Well pumps shall be provided with a suction pipe strainer that has a net opening of at least 2-1/2 times the inlet area of the pump.

2-5.02. Impellers and Bowls. Impellers shall be accurately machined, dynamically balanced, and securely locked on the pump shaft. Impellers shall be enclosed.

Balance rings which depend upon close running clearances to reduce the load on the drive unit thrust bearing will not be acceptable unless otherwise indicated.

Pump bowls and impellers shall be equipped with wearing rings designed to maintain pump efficiency. Wearing rings shall be securely locked in place so that they will not move or loosen during any condition of operation or handling, including reverse rotation of the pump.

A sand collar shall be provided to protect the pump bowl tail bearing from intrusion of abrasives.

2-5.03. Shafting. All pump shafting shall conform to the applicable sections of the governing standard. Shaft diameter shall be not less than the minimum permitted for the applicable driver nameplate power rating. Shafting shall be open.

2-5.04. Lineshaft Sleeves. Shaft sleeves shall be provided on lineshafting where the shaft passes through each bearing. Shaft sleeves shall be replaceable in the field and shall make a watertight fit with the shaft.

2-5.05. Shaft Couplings. Shaft couplings shall transmit the maximum combination of torque and thrust and shall maintain alignment between adjacent shaft sections. Couplings shall be threaded type.

During assembly, anti-seize thread lubricant shall be applied to male threads of all threaded connections.

2-5.06. Bearing Retainers. Open lineshaft pumps shall have bearings mounted in streamlined spiders supported by the column assembly. Rubber bearings shall be positively held in place by shoulders, retainer rings, or other mechanical means.

2-5.07. Lineshaft Enclosing Tube. Not used.

2-5.08. Pump Column. Pump column sections shall be so designed and constructed that accurate alignment will be obtained when the column is assembled. The type of couplings shall be threaded.

2.5.09. Lineshaft Stuffing Box. A low pressure stuffing box shall be provided at the top of the pump pedestal for sealing the lineshaft entry point.

Low pressure lineshaft stuffing box housings shall contain a bronze bearing, a grease line (for open lineshaft units) or a water line (for enclosed lineshaft units) to the bearing terminating in a lantern ring or an annular port, at least four rings of packing, and a split gland. The gland halves shall be interlocked at assembly and held in position at all operating pressures by at least two bolts or studs.

2-5.10. Pre-Lubrication System. The discharge head stuffing box shall be provided with a pre-lubrication system for lubricating the line-shafting prior to startup. Pre-lubrication piping shall be connected to the pump discharge piping and shall be complete with shutoff valves solenoids and all appurtenances as required. The pre-lubrication system shall supply water to the shafting such that water is directed down the shafting.

2-5.11. Pedestal. Each pump pedestal shall be designed to support the drive unit and the entire pump assembly. Suitable openings shall be provided for access to the stuffing box and other accessories. A registered connection or dowels shall be provided between the motor and the pedestal. The shaft area between the motor and the pedestal shall be provided with removable safety screens. The tolerance of the registered fit shall be less than the stuffing box bearing tolerance so that when installed the shaft will not touch the stuffing box bearing. A suitable stuffing box leakage collector with a 1/2 inch [12.7 mm] tapped drain opening shall be provided. Each pocket shall have a drain connection.

2-5.12. Pump Discharge Outlets. Pump discharge outlets shall have flanged ends. The pump discharge outlet shall be integral with the pedestal. The pump discharge outlet shall be above the floor.

The diameter and drilling of the flange shall conform to ANSI/ASME B16.1, Class 125.

2-5.13. Subbase. A rigid subbase with rounded corners shall be provided to support each pedestal. Abutting surfaces between the subbase and the pedestal shall be machined to provide uniform bearing.

Each subbase shall have a center opening large enough to permit withdrawal of the entire pump assembly.

2-5.14. Pump Barrel. Not used.

2-5.15. Shop Painting. All iron and steel parts which will be in contact with pumped liquid or submerged after installation, including the inside of the pump column and all exterior surfaces below the subbase plate or mounting flange, shall be shop cleaned by blasting in accordance with the coating manufacturer's recommendations and painted with an epoxy coating system. The coating shall have a dry film thickness of at least 10 mils [250 µm] and shall consist of a prime

(first) coat and one or more finish coats. At least 1 quart [1 L] of the finish material shall be furnished with each pump for field touchup.

All other iron and steel surfaces, except stainless steel and machined surfaces, shall be protected with suitable protective coatings applied in the shop. Surfaces of the equipment that will be inaccessible after assembly shall be protected for the life of the equipment. Coatings shall be suitable for the environment where the equipment is installed. Exposed surfaces shall be finished, thoroughly cleaned, and filled as necessary to provide a smooth, uniform base for painting. Electric motors, speed reducers, starters, and other self-contained or enclosed components shall be shop primed or finished with an oil-resistant enamel or universal type primer suitable for top coating in the field with a universal primer and aliphatic polyurethane system.

Surfaces to be coated after installation shall be prepared for painting as recommended by the paint manufacturer for the intended service, and then shop painted with one or more coats of the specified primer.

2-6. ACCESSORIES.

2-6.01. Solenoid Oiler. Not used.

2-6.02. Anti-Reverse Device. Each pumping unit shall be provided with a suitable backstop, anti-reverse device.

2-6.03. Level Transmitter. The level transmitter shall be as specified in Section 13563 Pressure and Level Transmitters.

2-6.04. Air Release Connection. Not used.

2-7. DRIVE UNITS.

2-7.01. Electric Motors. Electric motors shall be designed as specified in the General Purpose Induction Motors section.

Motor shaft shall be hollow type.

For hollow shaft motors, an adjusting nut shall be provided at the top of the motor for raising or lowering the shafting to properly center the impellers in the bowls. When required, a coupling shall be provided in the shafting below the motor to permit removal of the motor without lifting it over the shaft. A ball valve and plug shall be provided on the lubrication drain.

If the motor is not shop tested with the pump, certified motor efficiency data shall be furnished to the pump supplier based on tests conducted on the motor or on an identical motor.

2-7.02. Stabilizer. Not used.

2-7.03. Adjustable Frequency Drives. Not used.

2-8. SHOP TESTS. Each pump shall be tested at the factory for capacity, power requirements, and efficiency at specified rated head, evaluated head, shutoff head, operating head extremes, and at as many other points as necessary for accurate performance curve plotting. All tests and test reports shall be made in conformity with the requirements and recommendations of the Hydraulic Institute Standards.

Each pumping unit shall be shop tested with a motor, of the specified type and size, be installed in the work. Wire-to-water efficiency shall be based on certified efficiency data of the motor. Certified efficiency data shall be included in the report.

A certified test report shall be prepared. Five certified copies of a report covering each test shall be prepared by the pump manufacturer and delivered to Engineer not less than 10 days prior to the shipment of the equipment from the factory. The report shall include data and test information as stipulated in the Hydraulic Institute Standards, copies of the test log originals, test reading to curve conversion equations, and certified performance curves. The curves shall include head, pump input power, pump efficiency, and wire-to-water efficiency (when specified), rpm, and shop test NPSH available, plotted against capacity. The curves shall be easily read and plotted to scales consistent with performance requirements, with all test points clearly shown.

PART 3 - EXECUTION

3-1. INSTALLATION. Each pump will be installed in accordance with Equipment Installation section.

3-2. FIELD QUALITY CONTROL.

3-2.01. Installation Check. An experienced, competent, and authorized representative of the manufacturer shall visit the site of the Work and inspect, check, adjust if necessary, and approve the equipment installation in the presence of the County Inspector and a representative of OCU Water Production. The representative shall be present when the equipment is placed in operation in accordance with Startup Requirements section, and shall revisit the job site as often as necessary until all trouble is corrected and the equipment installation and operation are satisfactory in the opinion of Engineer.

The manufacturer's representative shall furnish a written report certifying that the equipment has been properly installed and lubricated; is in accurate alignment; is free from any undue stress imposed by connecting piping or anchor bolts; and has been operated under full load conditions and that it operated satisfactorily.

All costs for these services shall be included in the contract price.

3-2.02. Installation Supervision. The equipment manufacturer shall furnish a qualified field installation supervisor during the equipment installation.

All costs for these services shall be included in the contract price.

Manufacturers' installation supervisor shall observe, instruct, guide, and direct the installing contractor's erection or installation procedures. The equipment manufacturer will be provided with written notification 10 days prior to the need for such services.

3-3. TRAINING. Two four (4) hour training sessions shall be provided.

End of Section

MODIFICATIONS TO PRESTRESSED CONCRETE RESERVOIR

PART 1 - GENERAL

1-1. SCOPE. This section covers the modifications necessary to remove the aerator from Ground Storage Tank (GST) No. 1. Painting requirements for both GST's are also specified herein.

The reservoir modifications shall be designed and constructed by Crom Corporation or Precon Corporation, without exception.

1-2. GENERAL.

1-2.01. Governing Standards. Except as modified or supplemented herein, reservoir design and construction of the prestressed composite core wall, dome roof, and foundation shall be in accordance with the appropriate and applicable recommendations of ACI 372R, "Design and Construction of Circular Wire and Strand Wrapped Prestressed Concrete Structures"; ACI 350R, "Environmental Engineering Concrete Structures"; and ACI 318, "Building Code Requirements for Reinforced Concrete".

All applicable sections of ACI 318, including supplements, shall be followed except when modified and supplemented herein. Except as otherwise specified, allowable stresses shall be in accordance with ACI 318.

1-3. SUBMITTALS. Complete data, detailed drawings, and complete specifications for all materials shall be submitted in accordance with the submittals section. Drawings and data shall show full information as to the design, design criteria, and construction, including amount, type, and placement of all reinforcement, details of all construction joints, and all accessories.

Drawings shall be sealed by a Professional Engineer registered in the State of Florida.

1-4. QUALITY ASSURANCE.

1-4.01. Contractor Qualifications. The reservoir modifications shall be designed and constructed by a reservoir contractor who shall be a specialist in the design and construction of circular, prestressed concrete reservoirs of the continuous wire or strand-wound type; shall have furnished at least five circular, prestressed concrete reservoirs of the general type and size specified herein within the last ten years which have been in successful operation for at least 5 years; and shall have a record of experience and quality of work in the design and construction of circular prestressed concrete reservoirs that is satisfactory to the Engineer.

The design of the modifications to the prestressed concrete reservoir under this contract shall be the responsibility of the reservoir contractor. All shop drawings and design modifications for the reservoir shall be prepared by a professional engineer registered in the State of Florida who has designed at least five circular prestressed concrete reservoirs within the last ten years, of the general type and size specified herein and which have been in successful operation for at least five years.

1-4.02. Qualifications. Workers, including the reservoir contractor's superintendent and foreman, shall be fully qualified to perform the work. The reservoir contractor's superintendent and foreman shall have had experience on at least two reservoirs of comparable size and construction within the last ten years.

PART 2 - PRODUCTS

2-1. GENERAL DESCRIPTION. The removal of the aerator and all associated reservoir modifications shall be constructed complete with all materials and accessories as required and as specified herein. The aerator complete with trays, enclosure, and all accessories shall be removed from the dome. The concrete curb at the base of the aerator shall be removed and the surface of the finished dome restored. The inlet pipe shall be cut off at 6 inches above the floor slab and removed from the tank. All penetrations in the dome for the inlet pipe, aerator down spouts, aerator drain, etc shall be sealed in a manner providing a structurally sound surface capable of supporting personnel and code required live loads.

A general description of the existing reservoir is provided below:

Minimum capacity, measured below the high water level, gallons	1,000,000
Year Constructed	1985
Diameter, approximate, feet	85
Depth, at wall line, floor to Overflow weir, feet	23.58
Elevations, feet	
Reservoir finished floor	87.50
Overflow weir level	111.08
Inlet pipe diameter, inches	16
Aerator capacity, approximate, gpm	4,000

2-2. MATERIALS.

2-2.01. Cast-in-Place Concrete. All work in connection with cast-in-place concrete, including reinforcing steel, forms, finishing, curing, and other appurtenant work, shall conform to the applicable requirements of the cast-in-place concrete section, except as modified herein.

2-3. COATINGS.

2-3.01. Painting. Interior concrete surfaces of the dome do not require painting.

2-3.02. Exterior Coating. All exposed exterior concrete surfaces of the reservoir dome within the footprint of the aerator shall be given a base coat of Thoro Consumer Products ThoroSeal® with Acryl® 60 in accordance with manufacturers recommendations, followed by two (2) coats of Tnemec Series 156 Waterborne Acrylate paint (4-6 mil DFT) in accordance with manufacturers recommendations.

For both GST No. 1 and GST No. 2, a 2ft high color coded band shall be painted around the top of the reservoir wall to indicate that the tank is being used for reclaimed water service. The color used shall match the color at other County facilities, Pantone 522-C. Painting shall be as specified in the protective coatings section.

PART 3 - EXECUTION

3-1. CLEANING. The reservoir shall be kept clean at all times, and under no circumstances shall body excrement be permitted to come in contact with any interior surfaces of the structure. After the reservoir has been completed, the Contractor shall carefully clean out the interior of the reservoir, remove all rubbish, trash, loose material, and other items of a temporary nature, and then thoroughly scrub and hose down all interior floor, ceiling, and wall surfaces and shall keep such surfaces clean until final acceptance by the Owner. All water remaining in the reservoir after the scrubbing and hosing operations have been completed shall be removed by and at the expense of the Contractor.

End of Section

INSTRUMENTATION AND CONTROL SYSTEM

PART 1 – GENERAL

1-1. SCOPE. This section covers the furnishing and installation of instrumentation and control systems designated as the Meadow Woods Reclaimed Water Pump Station and the Meadow Woods SRWSF Wells 7 and 8 Control Systems.

The system shall be furnished as specified, complete with all software, human machine interface (HMI) hardware, input/output hardware, instrumentation, and all devices, accessories, appurtenances, testing, and training necessary for proper operation.

1-1.01. Associated Sections. This section also includes the equipment and services specified in the following sections.

Section 13530	PROGRAMMABLE LOGIC CONTROLLERS
Section 13550	SOFTWARE CONTROL BLOCK DESCRIPTIONS
Section 13561	PANEL MOUNTED INSTRUMENTS
Section 13562	FLOW INSTRUMENTS
Section 13563	PRESSURE AND LEVEL INSTRUMENTS
Section 13565	MISCELLANEOUS INSTRUMENTS
Section 13570	PANELS, CONSOLES, AND APPURTENANCES
Section 13580	UNINTERRUPTIBLE POWER SUPPLY
Section 13590	ETHERNET NETWORKS
Section 13591	NETWORK CABLING

1-2. GENERAL. Equipment furnished and installed under this section shall be fabricated, assembled, erected, and placed in proper operating condition in full conformity with the drawings, specifications, engineering data, instructions, and recommendations of the equipment manufacturer, unless exceptions are noted by Engineer.

1-2.01. General Equipment Stipulations. The General Equipment Stipulations shall apply to all equipment and materials furnished under this section. If requirements in this specification differ from those in the General Equipment Stipulations, the requirements specified herein shall take precedence.

1-2.02. Drawings. The drawings indicate locations and arrangements of equipment and may include installation details and block and one-line diagrams showing connections and interfaces with other equipment. The input/output (I/O) lists are attached as an appendix to the Programmable Logic Controllers section.

Principal components of the instrumentation systems shall be as indicated on the P&ID drawings

and instrument device schedule attached to this section.

1-2.03. Codes, Permits and Agency Approvals. All work performed and all materials used shall be in accordance with the National Electrical Code, and with applicable local regulations and ordinances. Where mandated by codes, panels, assemblies, materials, and equipment shall be listed by Underwriters' Laboratories. Contractor shall, as part of their work, arrange for and obtain all necessary permits, inspections, and approvals by the authorities having local jurisdiction of such work. This shall include any third-party inspections and testing of panels and equipment.

1-2.04. Supplier's Qualifications. Equipment and software furnished under this section and under other related sections listed in the Scope paragraph above shall be designed, coordinated, and supplied by a single manufacturer or supplier, hereinafter referred to as the System Supplier. The System Supplier shall be regularly engaged in the business of supplying computer-based monitoring, control, and data acquisition systems. The Contractor shall utilize the services of the System Supplier to coordinate all control system related items, to check-out and calibrate instruments, and to perform all testing, training, and startup activities specified to be provided.

All instrumentation, PLCs, PLC programming, Operator Interface Terminals (OIT), OIT programming, HMI programming, networks, and fiber optic work shall be provided and configured by one of the following integrators:

- Curry Controls Company, 4245 S. Pipkin Road, Lakeland Florida 33811,
- Revere Controls, 2240 Rocky Ridge Road Birmingham, AL 35216,
- Electro Design Engineering, Inc., 711 60th Street Court East, Bradenton, FL 34208,

1-2.05. Coordination. Systems supplied under this section shall be designed and coordinated by System Supplier for proper operation with related equipment and materials furnished by other suppliers under other sections of these specifications, under other contracts, and, where applicable, with related existing equipment. All equipment shall be designed and installed in full conformity with the drawings, specifications, engineering data, instructions, and recommendations of the manufacturer, and the manufacturer of the related equipment.

1-2.06. Related Equipment and Materials. Related equipment and materials may include, but will not be limited to, instrumentation, motor controllers, valve actuators, chemical feeders, analytical measuring devices, conduit, cable, and piping as described in other sections or furnished under other contracts.

1-2.07. Device Tag Numbering System. All devices shall be provided with permanent identification tags. The tag numbers shall agree with System Supplier's equipment drawings and shall be as close as practical to the tag numbers used on the project drawings and device schedules. All field-mounted transmitters and devices shall have stamped stainless steel identification tags. Panel, subpanel, and rack-mounted devices shall have laminated phenolic identification tags securely fastened to the device. Hand-lettered or tape labels will not be acceptable.

1-3. GENERAL REQUIREMENTS. The drawings and specifications indicate the extent and general arrangement of the systems. If any departures from the drawings or specifications are deemed necessary by System Supplier, details of such departures and the reasons shall be

submitted to Engineer for review with or before the first stage submittal. No departures shall be made without prior written acceptance.

The specifications describe the minimum requirements for hardware and software. Where System Supplier's standard configuration includes additional items of equipment or software features not specifically described herein, such equipment or features shall be furnished as a part of the system and shall be warranted as specified herein.

1-3.01. Governing Standards. Equipment furnished under this section shall be designed, constructed, and tested in accordance with IEEE 519, ANSI C37.90, FCC Part 15 - Class A, and NEMA ICS-1-109.60.

1-3.02. Dimensional Restrictions. Layout dimensions will vary between manufacturers and the layout area indicated on the drawings is based on typical values. The System Supplier shall review the contract drawings, the manufacturer's layout drawings and installation requirements, and make any modifications requisite for proper installation subject to acceptance by Engineer. At least three feet of clear access space shall be provided in front of all instrumentation and control system components.

1-3.03. Workmanship and Materials. System Supplier shall guarantee for two years all equipment against faulty or inadequate design, improper assembly or erection, defective workmanship or materials, and leakage, breakage, or other failure. Materials shall be suitable for service conditions.

All equipment shall be designed, fabricated, and assembled in accordance with recognized and acceptable engineering and shop practice. Individual parts shall be manufactured to standard sizes and thicknesses so that repair parts, furnished at any time, can be installed in the field. Like parts of duplicate units shall be interchangeable. Equipment shall not have been in service at any time prior to delivery, except for testing.

1-3.04. Corrosive Fluids. All parts, which are exposed to corrosive conditions, shall be made from corrosion resistant materials. System Supplier shall submit certification that the instrument manufacturer approves the selection of materials of primary elements that are in contact with the specified process fluid to be inert to the effects of the process fluid.

1-3.05. Appurtenances. Signal converters, signal boosters, amplifiers, special power supplies, special cable, special grounding, and isolation devices shall be furnished as needed for proper performance of the equipment. In no case shall signal or communications wiring share conduit with power wiring.

1-3.06. Programming Devices. A programming or system-configuring device shall be provided for systems that contain any equipment that requires such a device for routine calibration, maintenance, and troubleshooting. The programming device shall be complete, newly purchased for this project, and shall be in like-new condition when turned over to Owner at completion of startup.

1-4. SUBMITTALS. Complete dimensional, assembly, and installation drawings, wiring and schematic diagrams; and details, specifications, and data covering the materials used and the parts, devices and accessories forming a part of the system furnished, shall be submitted in

accordance with the submittals section. Submittal data shall be grouped and submitted in three separate stages. The submittal for each stage shall be substantially complete. Individual drawings and data sheets submitted at random intervals will not be accepted for review. Equipment tag numbers or identifications used on the drawings shall be referenced where applicable.

1-4.01. First Stage Submittal. The first stage submittal shall include the following items.

- a. A detailed list of any exceptions, functional differences, or discrepancies between the system proposed by System Supplier and this specification.
- b. Product catalog cut sheets on all hardware and software items, clearly marked to show the model number, optional features, and intended service of each device.
- c. A brief, concise description of the proposed system, including major hardware and software components and personnel training.
- d. A block diagram or schematic drawing showing the principal items of equipment furnished, including model numbers, and their interrelationships.
- e. Drawings showing floor space or desktop area requirements for all equipment items, including allowances for door swings and maintenance access.
- f. Environmental and power requirements, including heat release information for each equipment item.
- g. Standard field termination drawings for all process input/output equipment, showing typical terminations for each type of point available in the system.
- h. A copy of the proposed software licenses for all software associated with the system.
- i. Outline for training classes.
- j. Additional Requirements identified in other Instrumentation and Control System sections.

1-4.02. Second Stage Submittal. Before any equipment is released for shipment to the site and before factory testing is scheduled, the following data shall be submitted.

At System Supplier's option, the first and second stage submittals may be combined.

- a. Detailed functional descriptions of all software modules specified and furnished as part of System Supplier's standard system. The descriptions shall be identified with the applicable specification paragraph.
- b. Complete panel fabrication drawings and details of panel wiring, piping, and painting. Panel and subpanel drawings shall be to scale and shall include overall dimensions, metal thickness, door swing, mounting details, weight, and front of panel arrangement to show general appearance, with spacing and mounting height of instruments and control devices.
- c. Wiring and installation drawings for all interconnecting wiring between components of the system and between related equipment and the equipment furnished under this section. Wiring diagrams shall show complete circuits and indicate all connections. If panel terminal designations, interdevice connections, device features and options,

or other features are modified during the fabrication or factory testing, revised drawings shall be submitted before shipment of the equipment to the site.

- d. Review of drawings submitted prior to the final determination of related equipment shall not relieve System Supplier from supplying systems in full compliance with the specific requirements of the related equipment.
- e. Preliminary input/output listings showing point names, numbers, and addresses. Input/output identification numbers from the contract documents shall be cross-referenced in this submittal. See the Section 1-4.03.04 below for the required information to be submitted as part of the second stage submittal.
- f. Proposed lesson plans or outlines for all training courses specified herein, including schedule, instructors' qualifications and experience, and recommended prerequisites.
- g. Standard system engineering and user manuals describing the use of the system and application programming techniques for creating reports, graphics, database, historical records, and adding new process I/O nodes to the system.
- h. A list of programming devices to be provided by the System Supplier for review by the Owner. If a device is not needed by the Owner, a credit will be made available for use by the Owner.
- i. Additional Requirements identified in other Instrumentation and Control System sections.

1-4.03. Third Stage Submittal. Complete system documentation, in the form of Operation and Maintenance Manuals, shall be submitted before the commencement of field acceptance testing. Operation and Maintenance Manuals shall include complete instruction books for each item of equipment furnished. Where instruction booklets cover more than one specific model or range of device, product data sheets shall be included which indicate the device model number and other special features. This submittal shall include a written narrative outlining process control strategies and operations of equipment. It shall describe how the process works and how the process is controlled in the PLC program.

A complete set of "as-built" wiring, fabrication, and interconnection drawings shall be included with the manuals. If field-wiring modifications are made after these drawings are submitted, the affected drawings shall be revised and resubmitted.

1-4.03.01 Loop Diagrams. Detailed loop diagrams shall be provided for all control loops. Typical diagrams may not be used. At a minimum, loop diagrams shall include content required by ANSI/ISA S5.4 Instrument Loop Diagrams. Contractor may use their own format for presentation. In addition to the minimum standards set by ANSI/ISA 5.4, the following information must also be included on the loop diagrams.

- Specific location of each device, such as area, panel location, rack number, etc.
- Instrumentation, equipment, and component descriptions, manufacturers, and model numbers.
- Signal ranges and calibration information, including set point values for switches and alarm and shutdown devices.

- PLC related items such as Input/Output (I/O) type and address, PLC rack number, PLC slot number, PLC point number, PLC number, and PLC equipment manufacturer and part numbers.
- HMI and control or monitoring designations.

The loop diagrams must depict the complete wiring of each control loop. References to Shop Drawings or manufacturers' Shop Drawings for continuation of wiring will not be acceptable except where such reference is to contact inputs or relay outputs. Divide each loop diagram into areas for operator interface, PLC, panel, and field.

1-4.03.02 Ladder Diagrams. For discrete control and power circuits, provide electrical ladder diagrams. Include devices related to discrete functions that require electrical connections. Show unique rung numbers on the diagram, and depict and identify all terminal connections. Show each circuit individually and show names corresponding to other Contractor drawings or documentation for circuits entering and leaving an enclosure or panel. Include the following as a minimum:

- Terminals: Location (enclosure number, terminal junction box number, or motor control center number), terminal strip number, and terminal block number.
- Discrete Components:
 - Tag number, terminal numbers and location.
 - Switching Action, set point value and units, and process variable description.
- I/O Points: PLC cabinet unit number, I/O tag number, I/O address, terminal numbers, and terminal strip numbers.
- Relay Coils:
 - Tag Number and its function.
 - Contact location by ladder number and sheet number.
- Relay Contacts: Coil tag number, function, and coil location (ladder rung and sheet number).
- Ground wires, surge protectors and connections.

1-4.03.03 Interconnection Wiring Diagrams. Interconnection wiring diagrams for control panels and PLC enclosures shall be provided. The interconnection wiring diagrams are to show the control or PLC panel internal wiring and the associated interconnections with field elements and equipment. "Typical" diagrams or "typical" wire lists may not be used; each circuit shall be shown individually. The diagrams must depict the complete interconnection wiring. References to Shop Drawings or manufacturers' Shop Drawings for continuation of wiring will not be acceptable except where such reference is to contact inputs or relay outputs.

As a minimum, the interconnection wiring diagrams will show the following:

- Panel instrumentation and control components’ tag number, description, terminals, scale range, and calibration information (such as set points).
- Internal terminal strip number and terminal number assignments.
- Internal wire number assignments.
- General location of devices such as field or panel.
- All point-to-point interconnections with identifying numbers of electrical cable or wire.
- Field element tag number, description, terminals, location (e.g., “FIELD,” enclosure, MCC number), and signal range and calibration information (such as set points).
- Circuit name or field wire numbers for wires entering or leaving a panel.
- PLC related items such as Input/Output (I/O) type and address, PLC rack number, PLC slot number, PLC point number, PLC number, and PLC components part numbers.
- Overall panel power wiring showing primary source of panel power, voltages, branch circuits, and power connections to panel and field devices.
- Energy sources of devices (field, panel, or otherwise) such as electrical power. Identify voltage and other applicable requirements. For electrical sources, identify circuit or disconnect numbers.

1-4.03.04 PLC I/O List. A PLC I/O list shall be provided by the System Supplier. The PLC I/O list shall be provided on hard copy and as an electronic file using the latest version of Microsoft Excel®. The initial I/O list is available from the Engineer as an Excel® spreadsheet and will be provided to the System Supplier if requested. The list shall include documentation and listing of each analog and discrete input or output point to the PLC.

The System Supplier shall be responsible to designate all of the PLC I/O list parameters.

The PLC I/O list shall include as a minimum the following data fields.

FIELD NAME	FIELD DESCRIPTION
TAG	The tag number for the data point (as shown on the drawings).
DESCRIPT	A brief description of the function and location of the point.
SGNLTYPE	Input or output signal type. Signal types include:
	AI = Analog Input
	AO = Analog Output
	DI = Discrete Input
	DO = Discrete Output

FIELD NAME	FIELD DESCRIPTION
IOADDR	The particular input or output address in the PLC.
RACKNO	The rack number or address that the I/O point is located. This field will be left blank when IOADDR is PLC.
SLOTNO	The slot number in the rack that the I/O point is located. This field will be left blank when IOADDR is PLC.
POINTNO	The point number in the slot that the I/O point is located. This field will be left blank when IOADDR is PLC.
PLCNUM	The PLC number (or station number) that owns the I/O address.
PLCADDR	Internal PLC address for I/O mapping and communication between PLC and PMCS.
LORANGE	For analog point: The lowest value of the data point in engineering units. This typically corresponds to a 4-mADC signal. For discrete point: This field will be left blank.
HIRANGE	For analog point: The highest value of the data point in engineering units. This typically corresponds to a 20-mADC signal. For discrete point: This field will be left blank.
LOALARM	The value in engineering units of the point at which a low value alarm is initiated. For discrete points, this field will be left blank.
LOLOALARM	The value in engineering units of the point at which a low value alarm is initiated. For discrete points, this field will be left blank.
HIALARM	The value in engineering units of the point at which a high value alarm is initiated. For discrete points, this field will be left blank.-0
HIHIALARM	The value in engineering units of the point at which a high value alarm is initiated. For discrete points, this field will be left blank.
EU	The engineering units in which the ranges and alarms are specified. For discrete points, this field will be blank.
STATUS	For discrete points: A word to describe what the status of the point is when the data point is set high (true). STATUS words include:

FIELD NAME	FIELD DESCRIPTION
ON	
OFF	
STRT	(Start)
STOP	
OPEN	(Opened)
CLSD	(Closed)
FWD	(Forward)
REV	(Reverse)
AUTO	(Automatic)
MAN	(Manual)
CASC	(Cascade)
REM	(Remote)
LOC	(Local)
HI	(High)
HIHI	(High-High)
LO	(Low)
LOLO	(Low-Low)
FAIL	(Fail)
TRBL	(Trouble)
ALM	(Alarm)

For analog points, this field will be left blank.

Additional requirements are identified in other Instrumentation and Control System sections.

1-5. PREPARATION FOR SHIPMENT. All electronic equipment and instruments shall be suitably packaged to facilitate handling and to protect against damage during transit and storage. All equipment shall be boxed, crated, or otherwise completely enclosed and protected during shipment, handling, and storage. All equipment shall be protected from exposure to the elements, shall be kept dry at all times, and shall not be exposed to adverse ambient conditions.

Painted surfaces shall be protected against impact, abrasion, discoloration, and other damage. Painted surfaces that are damaged prior to acceptance of equipment shall be repainted, prior to final acceptance, to the satisfaction of Engineer.

Each shipment shall include an appropriate shipping list that indicates the contents of the package, including the specific instrument tags. The shipping list shall be accessible without exposing the instruments to the atmosphere. The shipping list shall also contain any cautionary notes regarding storage of the instruments, including requirements to protect the instrument from static discharge, desensitizing chemicals (solvents, paints, etc.), or ambient atmospheric conditions.

Individual instruments shall be appropriately tagged or labeled to positively identify the device. All identification shall be visible without the need to unpack the instrument from its protective packaging.

Instrument shipment and storage requirements shall be coordinated with Engineer or Owner prior to shipment. System Supplier shall provide adequate storage and be ready to accept the shipment before shipping any equipment to the site. Additional shipping and storage requirements shall be as detailed in the individual instrument specifications.

Components which are shipped loose due to transportation limitations shall be assembled and disassembled by the manufacturer prior to shipment to assure that all components fit together and are adequately supported.

1-6. DELIVERY, STORAGE, AND SHIPPING. Shipping shall be in accordance with the shipping section. Handling and storage shall be in accordance with the handling and storage section.

1-7. SPARE PARTS. The System Supplier shall provide the manufacturer recommended spare parts for equipment provided by the System Supplier.

1-7.01. Packaging. All spare parts shall be delivered to Owner before final acceptance of the system. Packaging of spare parts shall provide protection against dust and moisture and shall be suitable for storage. Circuit boards and other electronic parts shall be enclosed in anti-static material. All packages shall be clearly marked with the manufacturer's name, part number or other identification, date of manufacture, and approximate shelf life.

1-7.02. Replacement. System Supplier may utilize spare parts and supplies during system installation, de-bugging, startup, or training, but shall restore all such materials and supplies to the specified quantities before final acceptance of the systems. Prior to utilization of any spares, the System Supplier shall provide notification in writing to the Owner which part is being utilized in order for the Owner to track this usage. The Contractor shall inventory all spare parts provided by the System Supplier prior to final acceptance.

PART 2 - PRODUCTS

2-1. GENERAL REQUIREMENTS. All equipment furnished under each section referenced in SCOPE is a part of this section and shall be selected by System Supplier for its superior quality and intended performance. Equipment and materials used shall be subject to review.

2-1.01. Standard Products. The systems furnished shall be standard products. Where two or more units of the same type of equipment are supplied, they shall be the products of the same manufacturer; however, all components of the systems furnished hereunder need not be the products of one manufacturer unless specified herein.

To the extent possible, instruments used for similar types of functions and services shall be of the same brand and model line. Similar components of different instruments shall be the products of the same manufacturer to facilitate maintenance and stocking of repair parts. Whenever possible, identical units shall be furnished.

2-2. PERFORMANCE AND DESIGN REQUIREMENTS. The design of the systems furnished hereunder shall utilize concepts, techniques and features that provide maximum reliability and ease of maintenance and repair. The systems shall include board-level devices such as light emitting diodes or other indicators to facilitate quick diagnosis and repair. Diagnostic software shall be furnished to facilitate system-level troubleshooting.

Where redundant hardware is provided, the system shall be capable of performing all specified functions, without reconfiguring hardware or software, with only one device of each category in service.

2-2.01. Factory Assembly. Equipment shall be shipped completely factory assembled, except where its physical size, arrangement, configuration, or shipping and handling limitations make the shipment of completely assembled units impracticable.

2-3. POWER SUPPLY AND INSTRUMENT SIGNAL. Power supply to all control system equipment will be 120 volts, 60 Hz, single phase. System Supplier shall be responsible for distribution of power among enclosures, consoles, peripherals, and other components of the system from the power supply receptacles and junction boxes indicated on the drawings. Power distribution hardware shall include cables and branch circuit overcurrent protection installed in accordance with the electrical section.

Unless otherwise indicated, power supply to the instrumentation will be UPS regulated 120 volts ac. Unless otherwise indicated, all transmitted electronic analog instrument signals shall be 4-20 mA dc and shall be linear with the measured variable.

2-3.01. Facility Distribution System. Equipment not indicated to be powered from an uninterruptible power source shall be suitable for being supplied from the facility distribution system and shall be capable of withstanding voltage variations of ± 10 percent and harmonics up to the limits of IEEE 519 without affecting operation. System Supplier shall provide voltage conditioning or filtering equipment if necessary to meet the requirements specified.

2-3.02. Power Supplies. Power supplies for voltages other than those listed above shall be an integral part of the equipment furnished. Internal power supplies shall be regulated, current limiting, and self-protected.

2-3.03. Surge Withstand. All equipment shall meet all surge withstand capability tests as defined in ANSI C37.90 without damage to the equipment.

2-3.04. Uninterruptible Power Supply. An uninterruptible power supply (UPS) shall be furnished hereunder to power the equipment indicated on the drawings and will be furnished under section 13570. System Supplier shall be responsible for coordinating the size of the UPS units with the equipment furnished hereunder, and shall advise Engineer if a unit of higher capacity is necessary.

In general, all PLCs, 24V dc power supplies, two-wire analog instruments, four wire analog instruments, Ethernet and serial devices, and communications equipment shall be powered by an

uninterruptible power supply that is provided and wired by the Contractor. Each UPS shall provide at least 20 minutes of backup power at full load.

Each UPS shall be of the on-line, double-conversion type with true sine wave output. UPS shall provide power conditioning to the load.

UPS will be in either an air conditioned or a ventilated building.

It is not intended that auxiliary control panel components such as space heaters, receptacles, and fans be connected to UPS power.

Reclaimed Pump Station and Well house PLC panels, and other remote location PLCs shall use individual UPS units located within panels. See Section 13570 2-11. Each UPS shall be provided with a bypass switch such that the UPS can be taken out for maintenance without disturbing the devices it protects. The design shall provide for power conditioning when the UPS is bypassed.

Each supplied UPS shall be provided with new spare batteries at final acceptance, if onsite three months or more.

Each UPS shall provide auxiliary contact outputs connected to the PLC to monitor UPS Fail, and UPS Low Battery. The PLC panel shall provide alarms for UPS bypassed and Power Fail.

2-4. SERVICE CONDITIONS AND ENVIRONMENTAL REQUIREMENTS. The equipment provided for the instrumentation and control system shall be suitable for the service conditions specified in the attached equipment sections.

All equipment shall be designed and selected to operate without degradation in performance throughout the environmental extremes specified. Equipment shall be designed to prevent the generation of electromagnetic and radio frequency interference and shall be in compliance with FCC Rules and Regulations, Part 15, for Class A computing devices.

2-4.01. Ambient Temperature and Elevation. All system equipment located in air conditioned rooms shall be suitable for operation in ambient temperatures from 10°C to 35°C and a relative humidity of 10 to 80 percent, noncondensing. All equipment located in non air conditioned indoor areas shall be suitable for an ambient temperature range of 0°C to 50°C and a relative humidity of 10 to 95 percent, noncondensing. All equipment located outdoors shall be suitable for operation in an ambient temperature range 0°C to 60°C and a relative humidity of 5 to 100 percent. Heaters and air conditioning/cooling equipment shall be provided where essential to maintain equipment within its manufacturer-recommended operating ranges.

All equipment and instruments shall be designed to operate at the site elevation of 93 ft.

2-4.02. Deleterious Effects. All system equipment will be installed in areas without anti-static floor construction and without any provisions for control of particulates or corrosive gases other than ordinary office-type HVAC filtering. System Supplier shall furnish any additional air cleaning equipment, anti-static chair pads, or other protective measures necessary for proper operation of the system.

All input/output hardware shall meet or exceed, without false operation, all requirements of NEMA ICS-1-109.60, Electrical Noise Tests.

2-4.03. Noise Level. The equivalent "A" weighted sound level for any system equipment located in the control room, except printers, shall not exceed 35 dBA. The sound level for printers shall not exceed 65 dBA. Sound reduction enclosures shall be provided where necessary to comply with these limits.

2-4.04. Lightning Protection. In addition to other environmental protection specified herein, the entire system shall be provided with lightning protection. Lightning protection measures shall include the following.

2-4.04.01. Grounding. All major components of the system shall have a low resistance ground connection. Grounding system provisions indicated on the drawings shall be modified as recommended by System Supplier.

2-4.04.02. Surge Suppressors. Surge and lightning suppressors shall be non-faulting, non-interrupting, and shall protect against line-to-line and line-to-ground surges. Devices shall be solid-state metal oxide varistor (MOV) or silicon junction type, with a response time of less than 50 nanoseconds. Surge protective devices shall be applied for the following:

- a. All power connections to RTUs, PLCs, DCUs, instruments and control room equipment. Surge arresters shall be MTL "MA Series" Transtector "ACP-100 Series", Power Integrity Corporation "ZTA Series", Phoenix Contact "Mains PlugTrab", or MCG Surge Protection "400 Series".
- b. All connections to coaxial-based networked equipment (including CCTV, CATV, Ethernet, Arcnet, and satellite) where any part of the circuit is outside of the building envelope. Surge arresters shall be Telematic "VP08", Transtector "TCP Series", Phoenix Contact "CoaxTrab Series", or Northern Technologies "TCS-CP3 Series".
- c. All analog signal circuits shall be protected at both the transmitter and the control system end of the circuit. Surge protection devices shall not impede or interfere with the use of smart transmitter calibration/communication. Protection devices located near the transmitter shall be MTL "SD Series", Telematic "TP48." Protection devices in control panels shall be Transtector "TSP Series", Telematic "SD Series", Phoenix Contact "PipeTrab Series", or Citel "BP1-24."
- d. All metallic pair (twisted and untwisted) conductor local area network and data highway termination points, where any part of the data highway cable is routed outside of the building envelope. Single-port protective devices shall be Phoenix Contact "PlugTrab Series" or Telematic "NP Series."
- e. All serial, PLC data highway, and remote I/O network termination points where any part of the circuit is routed outside of the building envelope. Surge protection devices shall be Transtector "DLP Series" (RS-232); Transtector "FSP4000MC Series" (RS-422); Phoenix Contact "PlugTrab Series"; or Citel "E280 Series".
- f. All radio antenna leads. Surge protection devices shall be as specified in Multiple Address Radio Equipment section.
- g. All telephone lines at points of connection to the system. Protection devices for dial-up circuits shall be Transtector "TSJ Series", Telebyte "Model 22PX", Citel "BP1-

T”, or equal. Protection devices for full period circuits shall be Transtector “LMP Series”, Northern Technologies “DLP-S Series”, Phoenix Contact “TeleTrab Series”, or Circuit Components, Inc. “SPR-TM Series.”

2-5. SOFTWARE DOCUMENTATION. System Supplier shall furnish complete documentation on all software supplied with the systems specified herein. PLC Software, Operating systems, compilers, assemblers, and utility and diagnostic programs that are standard commercial products of third parties need not be included in the magnetic media backup. Software documentation shall consist of the following principal items.

- a. One backup set of any integrated circuit or solid-state memory-based plug-in firmware used with any hardware to make connections.
- b. Two complete back-up copies of system and application software in executable format on magnetic media compatible with the system furnished.
- c. Three sets of user reference manuals for all standard system and application software.
- d. One set of user reference manuals for all operating system software.
- e. Three sets of printed as-built reference documentation for any special software provided specifically for this contract.
- f. For each licensed software product, all documentation provided by the product manufacturer shall be provided. This includes all reference manuals and any other documents that were provided by the manufacturer. There should be one set of this documentation for each and every piece of equipment provided. Multiple pieces of similar equipment or software require multiple copies of this documentation.
- g. For each PLC a commented printout of each PLC program shall be provided. This printout can be supplied in a PDF format.

2-6. SOFTWARE LICENSE. All software programs supplied as a standard part of System Supplier’s products for this project shall be licensed to Owner for use on the system specified herein. Such license shall not restrict Owner from using the software on the system provided hereunder or its replacement. Owner shall have the right to make copies of the software for use on the system provided. Specific requirements of System Supplier’s software license are subject to review and approval by Owner and Engineer.

2-7. INSTALLATION TEST EQUIPMENT. All necessary testing equipment for calibration and checking of system components shall be provided by System Supplier. System Supplier shall also furnish calibration and maintenance records for all testing and calibration equipment used on the site if requested by Engineer.

2-8. PROGRAMMING DEVICES. The following programming devices shall be provided for the instruments specified in other sections:

<u>Instruments Requiring Programming Devices</u>	<u>Quantity of Programming Devices</u>
Panel mounted instruments	1
Flow instruments	1

Pressure and level instruments	1
Miscellaneous instruments	1

2-9. PROGRAMMING SOFTWARE. The following programming software shall be provided for the instruments specified in other sections:

<u>Instruments Requiring Programming Software</u>	<u>Number of Copies of Programming Software</u>
Panel mounted instruments	1
Flow instruments	1
Pressure and level instruments	1
Miscellaneous instruments	1

PART 3 – EXECUTION

3-1. INSTALLATION REQUIREMENTS. The installation of equipment furnished hereunder shall be by the Contractor or their assigned subcontractors.

3-1.01. Field Wiring. Field wiring materials and installation shall be in accordance with the electrical section.

3-1.02. Instrument Installation. Instruments shall be mounted so that they can be easily read and serviced and so that all appurtenant devices can be easily operated. Instruments mounted outdoors shall be installed so as to be facing away from exposure to direct sunlight and shall be equipped with sun shields. Installation details for some instruments are indicated on the drawings.

3-1.03. Salvage of Existing Equipment. Existing equipment and materials removed or replaced under this contract shall be delivered to Owner at a location designated by Owner, or shall be properly disposed of at Owner’s discretion. Care shall be taken to avoid damage to equipment delivered to Owner.

Any mounting brackets, enclosures, stilling wells, piping, conduits, wiring, or openings that remain after removal of equipment and support hardware shall be removed or repaired in a manner acceptable to Owner and Engineer. Transmitters or switches containing mercury shall be removed and disposed of by personnel trained in the handling of hazardous materials and using approved procedures.

3-2. SYSTEM SOFTWARE CONFIGURATION. The system software consists of existing GE Proficy i-FIX installations at the Southern Regional Water Supply Facility (SRWSF), East Regional Water Supply Facility (ERWSF) and the Southern Water Reclamation Facility (SWRF). The System software shall be configured by the System Supplier. Configuration services shall consist of the expansion of the system databases, operator interface graphics and tabular display screen formats, and programming of control units to provide a fully functioning system. The System Supplier shall fully configure the system using data provided herein or supplied by the Engineer and/or the Owner after award of the contract.

3-2.01. Control System Databases. The two iFix installations have separate databases that follow different tagname conventions. These control system databases shall be expanded and configured by the System Supplier. The System Supplier shall enter information obtainable from the Contract Documents into the databases and shall follow the tag naming conventions established at each facility. The tagging convention for the Water Supply Facilities follows the conventions established by the Water Division Electrical and I&C Water System Improvements Document 1/19/2007. The tagging convention for the Water Reclamation Facility shall be obtained from the Owner by the System Supplier prior to beginning work.. The System Supplier shall determine the need for any "pseudo" database points and shall ascertain and enter all information needed to define these points. The System Supplier is responsible for entering all information associated with each point. This includes but is not limited to, descriptions, engineering units, associated displays, areas, security, etc. All fields associated with each database point must be completely filled out accurately.

3-2.02. Graphic Screen Displays. The System Supplier shall be responsible for developing and configuring the custom graphic displays at each facility. Each piece of major process equipment that is monitored by the control system shall be displayed on one or more graphic screens. Graphic screens shall be representations of the equipment and piping. All iFix graphics shall be consistent across all iFix machines. The screens must accurately show all devices and equipment that are part of the control loops. These items must be done in accordance to the Configuration Standards and Conventions as described later in this section. Alarm and/or event displays shall also be provided and proven functional prior to acceptance of the system. A means of capturing and printing of all graphic screens shall also be included. The software program provided must be capable of printing the screen in a black and white (using gray scale) or color format. This program must be accessible from all terminals provided under this contract. The black and white printing shall be done in a manner in which the use of the black background is not represented in the printout. This is done to keep the utilization of ink cartridge and toner cartridge to a minimum.

The following new screens shall be provided, as a minimum:

- SWRF-Main Overview of the Meadow Woods Reclaimed Pump Station

The following existing screens, if existing, shall be updated:

- SRWSF – Well Matrix
- SRWSF – Network Status Screen
- SRWSF – PLC Overview Screen
- SRWSF – Site Lighting and Vehicle Gate
- SRWSF – Event Summary
- SWRF – Network Status Screen
- SWRF – PLC Overview Screen
- SWRF – Site Lighting and Vehicle Gate
- SWRF – Event Summary
- ERWSF – SRWSF Well Matrix
- Other displays as determined during the Configuration Review Meeting

3-2.03. Trend Displays: The existing trending displays shall utilize a single trending graphic screen and a list of “trend pen” files. Trend pen sets shall be stored as separate “csv” or text files. When a trend pen set is selected, the saved tags are populated into the trend graphic and system trending initiated. Each operator shall be able to select, configure, and save custom trend pen sets.

3-2.04. Report Formats. Report formats shall be developed and programmed by the System Supplier using tag names defined in the database creation. Reports shall be provided as summarized below. All reports will be provided with a header on each page to indicate the contents of each column of information. Each page shall be numbered and indicate the name of the report, the date the report was printed, and the time of the printout. The printout shall also include the time span of the information shown on the report.

- South Water Reclamation Facility – Meadow Woods Daily Operating Report. A daily report, listing the major plant variables (up to 10 variables) shall be provided. The report shall include hourly values and minimum/maximum/average values where appropriate.
- South Water Reclamation Facility – Meadow Woods Monthly Operating Report. A monthly operating report, which averages the values from the above daily reports, shall be provided. The report shall include monthly minimum/maximum/average values where appropriate.
- East and South Regional Water Supply Facilities – Well 7 and 8 data to be added to existing daily and hourly reports.
- East and South Regional Water Supply Facilities – The Meadow Woods reports shall be removed from the databases at the East and Southern Regional Water Supply Facilities.

3-2.05. Configuration Standards and Conventions. A “Software Configuration Standards and Conventions” document shall be prepared and submitted by the System Supplier for each facility that conforms to the standards that are in place at the SRWSF and SWRF. The document shall be submitted for review and approval before software configuration commences. The document shall describe and define such items as proposed graphic display process line colors/representations; color standards for “on”, “off”, “opened”, “closed”, and “alarm” conditions; alarm handling conventions; how items will be selected for control; methods for navigation between displays; address usage/naming conventions; and security setup. Before submitting the initial draft document, the System Supplier shall meet with the Engineer and/or Owner to review any of the Owner’s existing standards and conventions. All copies of this submittal shall be provided in color to insure the accuracy of each item. No black and white copies will be accepted. The colors used in the printed submittal shall accurately depict the colors and shapes proposed for use on the final system.

In addition to submitting the document for review, an updated version of the document shall be submitted as part of the O&M Manuals. The document shall be revised to document any additional standards that are established throughout the configuration process.

3-2.06. Configuration Review Meetings. Proposed graphic screens and report formats shall be reviewed with the Owner and Engineer throughout the configuration process. An initial review meeting will be held before any configuration activities begin to discuss graphics standards and general screen navigation setup requirements. The System Supplier’s programming personnel shall attend the initial review meeting. This meeting shall be held at the Owner’s facilities.

3-2.07. Software Functional Requirements. General functional requirements for system configuration are indicated on the drawings and described in the specifications. The information presented herein and indicated on the drawings illustrates the general functional intent of the system, and may not be sufficient to fully configure the system. The System Supplier shall be responsible for determining what additional information may be required to complete the configuration tasks, and for obtaining this information from the Engineer or the Owner.

3-3. SYSTEMS CHECK. The System Supplier shall provide the services of a field manager and a trained and experienced field supervisor to assist the installation contractor during installation, and to calibrate, test, and advise others of the procedures for installation, adjustment, and operation.

3-3.01. Field Manager. System Supplier shall appoint a field services manager who shall be responsible for the coordination of all system check-out and startup activities, and who shall be immediately available to Engineer and Owner by phone or on site for the duration of this project.

3-3.02. Field Inspection at Delivery. The field supervisor shall inspect major equipment items within five working days of delivery, to assure that the equipment was not damaged during shipment and shall supervise or assist with unpacking, initial placement, and initial wiring of the system.

3-3.03. Field Calibration of Instruments. After each instrument has been installed, a technical representative of System Supplier shall calibrate each instrument and shall provide a written calibration report for each instrument, indicating the results and final settings. The adjustments of calibrated instruments shall be sealed or marked, insofar as possible, to discourage tampering. Instrument calibration shall be done before checkout of the system operation. A typical instrument calibration report is attached to the end of this section.

3-3.04. Training for Installation Personnel. The field supervisor shall train the installation personnel in reading and understanding submittal drawings, and in the correct installation and wiring procedures for the equipment. Two days shall be included for this training.

3-3.05. Field Inspection Prior to Start Up. After installation and wiring connections are complete, the field supervisor, with additional System Supplier's personnel shall verify that each external connection to the system is correctly wired and field process components and devices are functioning as intended. A minimum of 5 working days shall be included for this task, but System Supplier shall be responsible for completing the following scope of work.

3-3.05.01. Analog Signals. Analog input signals shall be simulated at the transmitting source, and verified to be received at the proper register address in the control system. Analog outputs shall be generated at the control system, and verified to be received with the correct polarity, at the respective receiving device.

3-3.05.02. Discrete Signals. Discrete input and output signals shall be simulated and verified that they are received at the respective receiving device, and at the proper voltage.

3-3.05.03. Devices by Other Suppliers. If interrelated devices furnished by other suppliers, under other contracts, or by Owner, such as valve actuators, motor controls, chemical feeders,

and instruments, do not perform properly at the time of system checkout, the field supervisor shall use suitable test equipment to introduce simulated signals to and/or measure signals from these devices to locate the sources of trouble or malfunction.

3-3.05.04. System Check Out Report. The System Supplier shall submit a written report on the results of such tests to Engineer. Additional documentation shall be furnished as requested by Engineer to establish responsibility for corrective measures. System Supplier shall verify, in writing, to Engineer or Owner that System Supplier has successfully completed the external connection check before beginning system startup or field acceptance testing.

3-3.06. Start Up Assistance. After the field supervisor has completed the system check and submitted his report, System Supplier shall supply a factory-trained engineer and programmer to provide on-site start up assistance. During the startup period, these personnel shall thoroughly check all equipment, correct any deficiencies, and verify the proper operation of all components. 5 working days shall be included for this task.

3-4. TESTING. The system shall be acceptance tested at the factory and on site.

System Supplier shall prepare a testing procedure to be approved by Owner and Engineer that shall demonstrate that each system conforms to the specifications. The testing procedure shall be submitted at least 30 days in advance of testing. The testing shall be conducted by System Supplier and witnessed by Owner and/or Engineer.

System Supplier shall notify Engineer and Owner in writing at least 14 days before the proposed testing date. System Supplier shall reimburse Owner and Engineer for all expenses incurred in connection with attending factory testing. If the factory acceptance test is concluded unsuccessfully, the test shall be repeated. System Supplier shall reimburse Owner and Engineer for all expenses incurred in connection with attending repeated factory or site testing necessitated by system failure or inadequate preparation.

3-4.01. Factory Acceptance Testing. After system assembly and debugging at System Supplier's facility, the system shall be tested before the system is shipped to the site. The System Supplier shall be responsible for all costs associated with the travel and expenses of County personnel monitoring the factory test. The factory test shall be conducted on the complete system, including all field I/O devices, communications and network equipment, and peripherals.

The entire system, including all peripherals and associated software, shall be factory tested under simulated operating conditions. Both normal operating sequences and fault conditions shall be simulated. The results shall be noted on the CRT displays and the logging printer for hard copy. The testing procedures for hardware and software are described below.

All basic functions shall be demonstrated, including I/O processing, communications, alarm handling, HMI display functions, alarm logging, report generation, and historical data storage, as well as the specific functions listed herein. The system shall operate continuously for at least a 72 hours without faults. This operational test may run concurrently with the demonstration of hardware and software functions. The test procedure shall also include at a least four-hour period for discretionary tests to be conducted by Engineer or Owner.

For systems with software configuration by Engineer/Owner, a preliminary version of such configured software may be used as part of the factory acceptance test.

3-4.01.01. Hardware Test. Processors, processor modules, and peripheral devices associated with the system shall be assembled together as they will be installed in the field and shall be tested. The test shall demonstrate proper operation of each hardware device and communications among devices, and shall include verification of selected analog and discrete inputs and outputs.

3-4.01.02. Software Test. All system software modules specified herein shall be demonstrated. Software tests shall include running all diagnostics, debugging routines, and system test routines. The operating system, advanced process control language compiler, and all associated drivers shall be fully tested and operable for the system test. Software "patches" or changes to bypass failed or flawed modules during the test will not be acceptable.

3-4.01.03. PLC Program Emulation. When PLC program emulation testing software is required in Programmable Logic Controller Section, its functionality shall be demonstrated as part of the factory acceptance test.

3-4.02. Site Acceptance Testing. After installation and checkout by System Supplier's personnel, the system shall be subjected to an acceptance test.

Site acceptance testing shall be scheduled after receipt of the System Check Out Report and System Supplier shall verify that all field signal changes are reflected in the proper address locations in the system database.

The site acceptance testing shall follow the same procedure as the factory testing and shall operate without loss of basic functions. The number of working days of continuous operation for the test shall be 30. The operational demonstration shall confirm that the status, alarm, and process variable signals are valid and are being updated appropriately, and that the discrete and analog output signals from the control system are being correctly transmitted and implemented. Any errors or abnormal occurrences shall be recorded by System Supplier's field representative. System Supplier's field representative need not be continuously present during the site acceptance testing, but shall be available to respond to the site within one hour of notification. The representative shall inspect the system for faults at least once every 24 hours and shall log or record any noted problems. The log shall include a description of the problem, its apparent cause, and any corrective action taken.

3-4.02.01. Failure of Redundant Equipment. Failure of redundant equipment shall not be considered downtime provided that automatic failover occurs as specified and, in the opinion of Engineer, the failure was not caused by deficiency in design or installation. In the event of repeated failure of any hardware component or software module, the acceptance test shall be terminated and re-started.

3-4.02.02. Completion of Test. Successful completion of the site acceptance test, including the operational demonstration, is prerequisite to Substantial Completion as specified in the Supplementary Conditions.

3-5. TRAINING. System Supplier shall conduct training courses for personnel selected by Owner. Eight categories of training, instrument, control system maintenance, operator (pre-

installation), operator (post-installation), programmer (HMI software), programmer (PLC software), networking, and supplemental shall be provided. Training shall be conducted by experienced instructors who are familiar with the specific system supplied.

3-5.01. General Training Requirements. In general, System Supplier's standard training courses may be used to meet the training objectives specified. Where standard courses do not meet these objectives, additional coursework shall be developed. Clock hour requirements for each level of training are shall be as listed. A "clock hour" is defined as one hour of instruction or supervised training exercise. Training hour requirements are the number of hours of training to be provided for each student. Additional training time shall be provided if considered necessary to meet the training objectives.

3-5.01.01. Training Costs. All costs associated with the training program; excluding travel, lodging, and per diem expenses for Owner's and Engineer's personnel to attend off-site training programs; shall be the responsibility of System Supplier and shall be included in the contract price.

3-5.01.02. Lessons. Training lesson plans and other information for the second stage submittal as defined herein shall be submitted at least 30 days prior to the start of training.

3-5.01.03. Video Recording. Not used.

3-5.02. Instrument Training. Training on the calibration, maintenance, troubleshooting, and repair for the instrument devices provided under this project shall be provided. Training shall also be provided for any hand-held or computer-based calibration devices and their associated software. Four (4) hours of training for 8 students from both the Water and Reclaimed Water staff shall be provided at the Owner's facility.

3-5.03. Control System Maintenance Training. System maintenance training shall be provided to enable Owner's personnel to perform routine and preventive maintenance, troubleshoot, and repair all hardware furnished with the system, except equipment provided by the HMI computer manufacturer. Maintenance and repair instruction shall assume that Owner's personnel will repair equipment by replacing circuit boards and modules, and shall not include instruction on circuit board level repair.

3-5.03.01. Classes. All maintenance training shall be conducted at Owner's facilities. Each session shall consist 4 hours of training for 8 of the Owner's personnel from both the Water and Reclaimed Water staff.

3-5.03.02. Content of Classes. The training shall cover at least the following topics:

- a. Preventive, scheduled maintenance for all equipment.
- b. Function and normal operation of circuit boards and modules.
- c. Diagnosis of hardware failures to the faulted board or module.
- d. Removal and replacement of removable circuit boards and modules.
- e. Emergency maintenance and restoration procedures.

The maintenance training program shall be developed for personnel who have experience in electronics maintenance and repair and a general knowledge of computer systems, but not necessarily any familiarity with the specific hardware furnished.

3-5.04. Operator Training. Owner's personnel will utilize the system for day-to-day monitoring and/or control of the facilities. The training program shall provide operators with sufficient knowledge to move from screen to screen within the system, understand the contents of group and detailed point displays, react to and acknowledge alarms, adjust control setpoints and alarm limits, configure and print shift reports, print preconfigured reports on demand, control equipment connected to the system, and react to and resolve minor system errors.

3-5.04.01. Classes. Operator training shall include sessions as specified below.

3-5.04.01.01. Pre-installation Session. 4 hours training for 15 students from both the Water and Reclaimed Water staff shall be provided at the Owner's facility.

3-5.04.01.02. Post-installation Session. The post-installation training shall include three separate, but identical, sessions for three shifts of personnel and shall be conducted at Owner's facilities. Each class shall consist of 4 hours of instruction using the lesson plan submitted and approved for use. The post-installation sessions may have to be conducted outside normal working hours to accommodate the working schedule of Owner's personnel. The post-installation training sessions shall be conducted for 15 of the Owner's operating personnel from both the Water and Reclaimed Water staff.

3-5.04.02. Content of Classes. Each session shall cover at least the following topics.

- a. Power-up, "bootstrapping", and shutdown of all hardware devices.
- b. Logging on and off the system and the use of passwords.
- c. Access and interpretation of standard displays and diagnostics.
- d. Use and care of operator workstations, servers, video displays, printers, and other control room hardware, including replenishment of supplies and replacement of ribbons and ink cartridges.
- e. Moving from screen to screen within the graphic display environment.
- f. Interpretation of preconfigured group and detailed point or database displays.
- g. Response to and acknowledgment of alarms.
- h. Adjustment of control set points and alarm limits.
- i. Configuration and printing of shift and other reports by schedule or on demand.
- j. Control of field equipment and devices connected to the system.
- k. Manual entries to database points.
- l. Generation of current (real-time) and historical custom and predefined reports and trend displays.
- m. Appropriate responses to software and hardware errors.
- n. Enabling and disabling individual inputs and outputs.

The operator-training program shall be developed for personnel with no prior experience with the hardware and software provided as part of the project.

3-5.05. Programmer Training (HMI Software). Not used.

3-5.06. Programmer Training (PLC Software). Not used.

3-5.07. Network Training. System Supplier shall provide training on network equipment provided. Network training shall be conducted in one session at Owner's facilities using the hardware and software installed for this project.

- a. Course shall provide an overall description of the network and how it operates.
- b. A one hour course (for each make/model of switch, router, and firewall) on configuration shall be provided for up to five people. This instruction shall be aimed at a network administrator's level of understanding, and shall be provided by the individual that configured the devices. The course shall review the configuration settings. Course training material shall be vendor provided equipment manuals.
- c. A one hour course on the use of the management software shall be provided for up to five people. This instruction shall be aimed at a network administrator's level of understanding, and shall be provided by the individual that configured the software. Course training material shall be vendor provided software manuals.
- d. Training shall be provided on the use of any Network Test Equipment provided. Course training material shall be vendor provided equipment manuals.

The training shall provide instruction for up to 5 Owner-selected students.

3-5.08. Supplemental Training. System Supplier shall provide additional training to Owner's personnel on topics of Owner's choosing. Supplemental training shall be conducted in one session at Owner's facilities using the hardware and software installed for this project. The training shall consist of 4 hours of instruction for 15 students from both the Water and Reclaimed Water staff.

INSTRUMENT NAME & SERVICE:		
BRAND & MODEL NO.:		
TAG OR LOOP NO.:		
INPUT/OUTPUT RANGE:		
INPUT	ACTUAL OUTPUT	DESIRED OUTPUT
PROPORTIONAL BAND:		
RESET:		
POSITION OF SWITCHES, JUMPERS, ETC.		
COMMENTS:		
DATE OF CALIBRATION: CALIBRATED BY:		
Black & Veatch	INSTRUMENT CALIBRATION REPORT	□□□Figure 1-13500

End of Section

Instrument Device Schedule - Legend/Description Sheet

Item. This is an arbitrary sequential number which is for reference only.
Structure. Reclaimed Pump Station (RPS), Well 7 (W7) and Well 8 (W8)
Tag. This is the ISA (or similar) alpha tag representing the function of the instrument.
Loop. This is the numeric (or alphanumeric) loop designation for the instrument.
Service Description. This is the description of the instrument service (i.e. Filter No. 1 Loss-of-Head).
Device Type & Size. This is the instrument device type and should match the description as listed in the specification. Where appropriate, the size of the device (such as diameter of flowmeters) will be listed.
Remarks. This column may include a cross reference to another specification section where applicable or to a note which provides additional information. Notes are appended to the end of the device schedule listings.
Output Type. This generally will be 4-20 mA or "Dry Contact". It could also be a serial output for smart devices (such as HART or FLD-BUS) but only if the serial output is the primary I/O interface.
Output Range. This is the calibrated range for analog devices or the trip point(s) for discrete devices.
Power. This will typically be either 2-wire for loop powered devices or 4-wire for 120 volt powered devices.
P&I Drawing. This is the drawing number of the P&ID where the device is shown.
Spec. This is the section in the specifications where the device is specified.

Item	Structure	Tag	Loop Number	User Description	Device Type	Output Type	Output Range	Power Type	P&I Drawing	Remarks	Specification
	W7	FE	07	WELL NO. 7 FLOW	PROPELLER FLOW METER				I-4		13562
	W7	FTT	07	WELL NO. 7 FLOW	PROPELLER FLOW TRANSMITTER	4-20 mA	0-2000 GPM	4-WIRE	I-4		13562
	W7	HS	07 A	WELL HOUSE NO. 7 OUTSIDE LIGHTS HAND-OFF-AUTO CONTROL	3-POSITION SELECTOR SWITCH	CONTACT			I-4	On outside lighting contactor	16480
	W7	LT	07	WELL NO. 7 DRAW DOWN LEVEL	SUBMERSIBLE PRESSURE TRANSMITTER	4-20 mA	0-45 FT.	2-WIRE	I-4	Ensure adequate cable length from static water level to PLC panel termination.	13563
	W7	PI	07	WELL NO. 7 DISCHARGE PRESSURE INDICATION	PRESSURE GAUGE		0-150 PSI		I-4		15130
	W7	PTT	07	WELL NO. 7 DISCHARGE PRESSURE INDICATION	PRESSURE TRANSMITTER	4-20 mA	0-150 PSI	2-WIRE	I-4		13563
	W7	PSL	07	WELL NO. 7 LOW DISCHARGE PRESSURE	PRESSURE SWITCH	CONTACT			I-4	Coordinate Trip Point With Pump Manufacturer	13563
	W7	FS	07	WELL NO. 7 PRE-LUBE FLOW SWITCH	TARGET TYPE	CONTACT			I-4		
	W7	ZS	07 A	WELL HOUSE NO. 7 BUILDING INTRUSION	PROXIMITY DOOR SWITCH	CONTACT			I-4		13565
	W7	ZS	07 B	WELL HOUSE NO. 7 PLC PANEL INTRUSION	PROXIMITY DOOR SWITCH	CONTACT			I-4		13565
	W8	FE	08	WELL NO. 8 FLOW	PROPELLER FLOW METER				I-4		13562
	W8	FTT	08	WELL NO. 8 FLOW	PROPELLER FLOW TRANSMITTER	4-20 mA	0-2000 GPM	4-WIRE	I-4		13562
	W8	HS	08 A	WELL HOUSE NO. 8 OUTSIDE LIGHTS HAND-OFF-AUTO CONTROL	3-POSITION SELECTOR SWITCH	CONTACT			I-4	On outside lighting contactor	16480
	W8	LT	08	WELL NO. 8 DRAW DOWN LEVEL	SUBMERSIBLE PRESSURE TRANSMITTER	4-20 mA	0-45 FT.	2-WIRE	I-4	Ensure adequate cable length from static water level to PLC panel termination.	13563
	W8	PI	08	WELL NO. 8 DISCHARGE PRESSURE INDICATION	PRESSURE GAUGE		0-150 PSI		I-4		15130
	W8	PTT	08	WELL NO. 8 DISCHARGE PRESSURE INDICATION	PRESSURE TRANSMITTER	4-20 mA	0-150 PSI	2-WIRE	I-4		13563
	W8	PSL	08	WELL NO. 8 LOW DISCHARGE PRESSURE	PRESSURE SWITCH	CONTACT			I-4	Coordinate Trip Point With Pump Manufacturer	13563
	W8	ZS	08 A	WELL HOUSE NO. 8 BUILDING INTRUSION	PROXIMITY DOOR SWITCH	CONTACT			I-4		13565
	W8	ZS	08 B	WELL HOUSE NO. 8 PLC PANEL INTRUSION	PROXIMITY DOOR SWITCH	CONTACT			I-4		13565
	W8	ZS	08 C	WELL HOUSE NO. 8 EYEWASH ALARM	FLOW SWITCH	CONTACT			I-4		15400
	RPS	LIT	01	GROUND STORAGE TANK 1 LEVEL TRANSMITTER	ULTRASONIC	4-20 mA	0-X FT	4-WIRE	I-6	Existing instrument, new power and analog wire	13563
	RPS	LE	01	GROUND STORAGE TANK 1 LEVEL TRANSDUCER	ULTRASONIC	N/A			I-6	Existing instrument, new power and analog wire	13563
	RPS	LIT	02	GROUND STORAGE TANK 2 LEVEL TRANSMITTER	ULTRASONIC	4-20 mA	0-X FT	4-WIRE	I-6	Existing instrument, new power and analog wire	13563
	RPS	LE	02	GROUND STORAGE TANK 2 LEVEL TRANSDUCER	ULTRASONIC	N/A			I-6	Existing instrument, new power and analog wire	13563
	RPS	FTT	01	PUMP STATION FLOW TRANSMITTER	MAGNETIC FLOW TRANSMITTER	4-20 mA	0-X GPM	4-WIRE	I-6		13562
	RPS	FE	01	PUMP STATION FLOW ELEMENT	MAGNETIC FLOW METER				I-6		13562
	RPS	LSHH	01	GROUND STORAGE TANK 1 HIGH HIGH LEVEL	BALL FLOAT	CONTACT			I-6		13563
	RPS	LSHH	02	GROUND STORAGE TANK 2 HIGH HIGH LEVEL	BALL FLOAT	CONTACT			I-6		13563
	RPS	ZS	09 A	RECLAIMED PUMP STATION BUILDING INTRUSION	PROXIMITY DOOR SWITCH	CONTACT			I-4		13565
	RPS	ZS	09 B	RECLAIMED PUMP STATION BUILDING INTRUSION	PROXIMITY DOOR SWITCH	CONTACT			I-4		13565
	RPS	ZS	09 C	RECLAIMED PUMP STATION PLC PANEL INTRUSION	PROXIMITY DOOR SWITCH	CONTACT			I-4		13565
	RPS	PTT	01	PUMP STATION DISCHARGE PRESSURE INDICATION	PRESSURE TRANSMITTER	4-20 mA	0-150 PSI	2-WIRE	I-6		13563
	RPS	PIT	02	PUMP STATION SYSTEM PRESSURE INDICATION	PRESSURE TRANSMITTER	4-20 mA	0-150 PSI	2-WIRE	I-6		13563

PROGRAMMABLE LOGIC CONTROLLERS

PART 1 - GENERAL

1-1. SCOPE. This section covers programmable logic controllers (PLCs), including associated input/output hardware to control process equipment and serve as the interface to field devices.

1-1.01. Control System. The Instrumentation and Control System section shall apply to all equipment furnished under this section. Additional PLC software requirements are indicated in Software Control Block Descriptions section.

1-2. GENERAL. Equipment furnished and installed under this section shall be fabricated, assembled, erected, and placed in proper operating condition in full conformity with the drawings, specifications, engineering data, instructions, and recommendations of the equipment manufacturer, unless exceptions are noted by Engineer.

1-2.01. General Equipment Stipulations. The General Equipment Stipulations shall apply to all equipment and materials furnished under this section. If requirements in this specification differ from those in the General Equipment Stipulations, the requirements specified herein shall take precedence.

1-2.02. Drawings. Supplementing this section, the drawings indicate the number and sizes of PLCs, locations of PLCs, and provide diagrams and schematics regarding connection and interaction with other equipment. All hardware, including power supplies, special cables, and other appurtenant equipment, shall be provided to meet the functional requirements described herein and indicated on the drawings. The System Supplier shall provide PLC-7, PLC-8 and RWS-PLC.

1-2.03. I/O List. An input/output (I/O) field device signal listing is included as an appendix attached to this section.

1-3. SUBMITTALS. Submittals shall be as specified in the Instrumentation and Control System section.

1-4. DELIVERY, STORAGE, AND SHIPPING. Delivery, storage and shipping shall be as specified in the Instrumentation and Control System Section.

1-5. SPARE PARTS. Spare parts for the Reclaimed Pump Station shall be furnished as follows:

<u>Spare Part</u>	<u>Quantity</u>
Processor modules	2 of each type used
Power supply modules	2 of each type used
I/O modules	2 of each type used
Communications modules	2 of each type used

Spare parts for the Well 7 and 8 shall consist of 2 spare analog input modules.

PART 2 - PRODUCTS

2-1. GENERAL. All equipment furnished under this section shall be expressly selected by System Supplier for its superior quality for the intended purpose and shall comply with the following requirements.

2-1.01. Interchangeability. All programmable logic controller systems shall be products of the same manufacturer and of the same series or product line. Processors, local and remote input/output hardware, communications modules, and specialty modules such as coprocessors and ASCII modules shall be interchangeable among all I/O panels and systems. PLC modules and hardware by other manufacturers will be acceptable only if the PLC manufacturer does not offer suitable modules and hardware for the same functions.

2-1.02. Initial, Spare, and Future Memory (RAM). System Supplier shall provide adequate memory for the amount of I/O, control algorithms, and communications in the initial system.

Each programmable logic controller shall include provisions for future expansion and shall have 100 percent spare memory capacity and 100 percent spare data capacity installed. The spare memory capacity shall be documented by submitting to Engineer, during factory testing, a statement indicating the amounts of memory of all types being utilized and the total amount available in each system. The statement shall include an estimate of the total program and data memory necessary, including spare memory, based on the I/O hardware for the system, and previous programming experience.

2-1.03. Spare I/O. Each PLC input/output enclosure shall be provided with at least 20 percent spare inputs and outputs of each type. Spare I/O shall be installed, wired, and interfaced properly to the terminal strip. The spare I/O shall be in addition to any I/O installed and reserved for future process signals as may be indicated on the I/O list. In addition, each PLC input/output enclosure shall be capable of accommodating 20 percent of additional input/output capacity of each type as originally assembled, without the need for additional expansion racks, communication adapters, cables, or PLC power supplies.

2-1.04. Expandability. Each PLC processor and associated I/O shall have a future expandability of at least 50 percent of the provided system.

2-1.05. Acceptable Manufacturers. The Well PLCs shall be Modicon non-Unity Quantum with latest software and firmware versions, without exception. The Well PLCs shall be programmed with ProWorx32. The RWPS-PLC shall be a Siemens S7-317 platform without exception.

2-1.06. Signal Power Supplies. Regulated dc power supplies shall be provided in each PLC enclosure for analog inputs. Power supplies shall be suitable for an input voltage variation of ± 10 percent, and the supply output shall be fused or protected against short-circuiting. Output voltage regulation shall be as required by the instrumentation equipment supplied under another section.

The loop power supply shall be separate from the power supply circuit for the processor and

racks.

The power source for all digital inputs from field devices shall be separately fused for each digital input module. Unless otherwise noted, all field devices will be provided with dry contacts that close to provide an input to the PLC.

2-1.07. Appurtenances. The PLC processor and I/O hardware shall be provided as complete systems, as shown on the block diagram drawings. The PLCs shall include all necessary hardware and software for a complete working system. All special rack or panel mounted power supplies, special interconnecting and programming cables, special grounding hardware, or isolation devices shall be furnished for proper operation of the equipment. Signal converters, signal boosters, amplifiers, special power supplies, special cable, special grounding, intrinsically safe relays and current repeaters, surge suppression devices, and isolation devices shall be furnished and installed for proper operation of the equipment.

2-1.08. PLC Arrangement. The PLCs shall be distributed and arranged as indicated on the drawings. Input/output hardware shall be arranged such that rack /module assignments be accomplished in an order to minimize or eliminate single points of failure due to equipment being concentrated on one I/O card.

2-1.09. Service Conditions. PLCs will be installed in air conditioned rooms and non air conditioned rooms.

2-2. LARGE PLC PROCESSOR (Wells 7 and 8). The programmable logic controller processor shall be an industrial-type rack-mounted unit that utilizes battery-backed CMOS type or nonvolatile type memory. Battery backed memory shall include integral batteries with sufficient capacity for at least 6 months' memory retention without power to the processing unit. Standby and shelf life of the batteries shall be at least 5 years.

2-2.01. Diagnostics. The processor shall utilize self-monitoring diagnostic techniques and shall contain easily visible LED diagnostic indicators for "run" and "halt" conditions as well as memory and input/output error conditions. Diagnostic codes shall also be available through the programming device to facilitate troubleshooting.

2-2.02. Programming Port. The processor shall include a programming port that is available for programming and monitoring on-line after the system is fully functional, and after all communications, human machine interface (HMI), and network connections have been made. Removal or disruption of network communications, remote I/O communications, and HMIs to allow for on-line programming and monitoring will not be acceptable. A key switch shall be provided on the processor for selection of the operating mode and as a security measure.

2-2.03. Communications. The processor shall be programmed to operate autonomously, regardless of communications status with other units. Each programmable controller shall be furnished complete with communication modules for local and remote input/output hardware communications, communications with other programmable controllers, and communication with host computers as shown on the block diagram.

2-2.04. Environment. The processor shall be suitable for operation in the environments specified in another section.

2-2.05. Programming. The processor shall be programmable using the IEC 1131 international programming standards and ladder logic programming. IEC 1131 programming shall include the following:

- Functional Block Diagram
- Sequential Function Chart.
- Instruction List.
- Structured Text.
- Ladder Diagram.

Ladder logic programming shall include a minimum of the following capabilities:

- Contacts, coils, branching.
- Data comparisons.
- On-delay and off-delay timers.
- Counters with comparators.
- Floating point Math and Logical instructions.
- PID loop control.
- Jumps and Subroutine functions.
- Master control relay.
- Transitional or one-shot outputs.
- Standard and user-defined data tables for digital and analog value storage.
- Remote I/O capability.
- Fault-mode subroutine.

2-2.06. Programming Capabilities. The processor shall include the following capabilities for programming, debugging of programs, and troubleshooting.

- Off-line programming.
- On-line programming.
- On-line status of coils and registers.
- Input/output forcing.

2-2.07. Hardware Configuration. Processors shall be configured for standard rack mounting. Each programmable logic controller processor shall include integral communications ports for the programming device, remote input/output, HMI device, or remote communications interfaces.

2-2.08. Input/Output Hardware. Programmable logic controller systems shall support the following types of input/output modules.

120 volt ac digital input and output.

4-20 mA dc analog input and output.

All digital input/output hardware shall include isolation against surges of at least 1500 volts. All output hardware connected to inductive loads shall be supplied with surge suppression devices and recommended by the PLC manufacturer to prevent damage to output hardware. Combination input/output modules will be acceptable if they meet the following requirements.

2-2.08.01. Wiring Terminals. All input/output modules shall utilize easily removable plug-in or hinged field wiring terminals to allow removal of modules without disconnecting individual wires.

2-2.08.02. I/O Circuit Power Supply. Outputs for motor driven equipment will typically be powered from the driven equipment. Digital outputs for miscellaneous equipment shall be powered either from the controlled equipment or the PLC enclosure as indicated on the drawings or as coordinated with the controlled equipment supplier. Outputs that control process equipment specified under other sections or provided under other contracts shall be fully isolated or shall operate either interposing relays or relay-type digital output modules in the PLC cabinet.

2-2.08.03. Digital Input Modules. Digital input modules shall sense voltages between 100 and 130 volts ac and shall have LED indicators for each point to display the status of the field contact. Each input module shall be suitable for being connected to a separate voltage source and return. Digital input modules shall provide complete electrical isolation between individual inputs. Digital input modules shall have multiple inputs. Schneider Automation part number 140 DAI 540 00 shall be used without exception.

2-2.08-04. Digital Output Modules. Not Used.

2-2.08.05. Relay Digital Output Modules. Where indicated on the PLC input/output listing, digital output modules shall have dry contact relay type outputs suitable to control voltages from 24 to 110 volts dc and 24 to 230 volts ac and shall be rated at least 2 amperes. Outputs have LED indicators to display output status. Digital outputs for motor driven equipment shall be powered by the driven equipment. Outputs shall withstand a surge of at least 80 amperes for 15 milliseconds. Relay digital output modules shall have multiple outputs. Schneider Automation part number 140 DRA 840 00 shall be used without exception.

2-2.08.06. Analog Input Modules. Analog input modules shall accept linear 4-20 mA dc signals from field transmitters. Analog to digital conversion accuracy shall be at least 12-bit (0-4095 count) resolution. Analog input modules shall have multiple inputs. Each input shall be fully isolated from the other inputs. Schneider Automation part number 140 ACI 030 00 shall be used without exception.

2-2.08.07. Analog Output Modules. Analog output modules shall transmit linear 4-20 mA dc signals to field devices. Loop power for all analog outputs shall be provided by regulated power supplies in each input/output enclosure and shall be capable of driving a 0 to 600 ohm load. Digital to analog conversion accuracy shall be at least 12-bit (0-4095 count) resolution. Analog

output modules shall have multiple outputs. Schneider Automation part number 140 ACO 020 00 shall be used without exception.

2-2.08.08. Panel Terminations. All PLC input/output signals for field connections shall be terminated through panel enclosure terminal strips. Direct connection of field wiring to the I/O module terminals is not acceptable.

2-2.08.09. Interposing Relays. Interposing relays shall be incorporated on all output circuits as shown on the PLC input/output listing, where required by the application of isolate foreign power sources, where the continuous output rating of the PLC relay digital or output module is not sufficient to power the connected device or equipment, or where otherwise required by the System Supplier's equipment. Interposing relays shall be provided for any digital output module output signal that leaves the PLC enclosure. Interposing relays shall be mounted in the PLC enclosure containing the output module that activates the relays. All Interposing relays shall be lighted to indicate an energized condition.

2-3. MINI PLC PROCESSOR (RWPS-PLC). The programmable logic controller processor shall be an industrial type that utilizes battery-backed CMOS type or nonvolatile type memory. Battery-backed memory shall include integral batteries with sufficient capacity for at least 6 months' memory retention without power to the processing unit. Standby and shelf life of the batteries shall be at least 5 years.

2-3.01. Diagnostics. The processor shall utilize self-monitoring diagnostic techniques. Easily visible LEDs shall indicate "run" and "halt" status as well as memory and input/output error conditions. Diagnostic codes shall also be available through the programming device to facilitate troubleshooting.

2-3.02. Programming Port. The processor shall include a programming port that is available for programming and monitoring on-line after the system is fully functional. Removal or disruption of network communications, remote I/O communications, or HMIs to permit programming and monitoring will not be acceptable.

2-3.03. Communications. The processor shall be programmed to operate autonomously, regardless of communications status with other units.

2-3.04. Environment. The processor shall be suitable for operation in the environments specified in another section. A key switch shall be provided on the processor to select the operating mode and as a security measure.

2-3.05. Programming. The processor shall be programmable using conventional relay ladder logic, or as required, and shall include the following functions and features.

Contacts, coils, branching.

Data comparisons.

On-delay and off-delay timers.

Counters with comparators.

Floating Point Math and Logical instructions.

Master control relay.

Transitional or one-shot outputs.

Standard and user-defined data tables for digital and analog value storage.

2-3.06. Capabilities. The processor shall include the following capabilities for programming, debug of programs, and troubleshooting.

Off-line programming.

On-line status of coils and registers.

Input/output forcing.

2-3.07. Configuration. Processors shall be configured for standard rack mounting and shall be of plug-in printed circuit board construction. Each programmable logic controller shall include integral communications ports for the programming device, remote input/output, HMI device, or remote communications interfaces as required.

Programmable logic controller systems shall support the following types of input/output.

120 volt ac digital input and output.

24 volt dc digital input and output.

4-20 mA dc analog input and output.

2-3.08. Input/Output Hardware. Input/output hardware shall be supplied in standard modules of 4, 8, 16, or 32 points each for assembly in local and remote input/output enclosures.

Programmable logic controllers having fixed, non-removable input/output hardware are not acceptable.

All digital input/output hardware shall include isolation against surges of at least 1500 volts. All output hardware connected to inductive loads shall be supplied with surge suppression devices as required and recommended by the PLC manufacturer to prevent damage to output hardware. Combination input/output modules will be acceptable if they meet all of the requirements in the following subparagraphs.

2-3.08.01. Wiring Terminals. All input/output modules shall utilize easily removable plug-in or hinged field wiring terminals to allow removal of modules without disconnecting individual wires.

2-3.08.02. I/O Circuit Power Supply. Outputs for motor driven equipment will typically be powered from the driven equipment. Digital outputs for miscellaneous equipment shall be powered either from the controlled equipment or the PLC enclosure as indicated on the drawings or as coordinated with the controlled equipment supplier. Outputs that control process equipment specified under other sections or provided under other contracts shall be fully isolated or shall operate relay-type digital output modules or interposing relays in the PLC cabinet.

2-3.08.03. Digital Input Modules. Digital input modules shall sense voltages between 100 and 130 volts ac and shall have LED indicators for each point to display the status of the field

contact. Each input module shall be suitable for being connected to a separate voltage source and return. Return voltage may be common to the entire input module.

2-3.08.04. Digital Output Modules. Digital output modules shall control voltages from 100 and 130volts ac and shall be rated at least 1 ampere. Outputs shall be individually fused and shall have LED indicators to display output status. Each digital output shall be provided with an interposing relay. Outputs shall withstand a surge of at least 80 amperes for one cycle and shall have an off-state leakage current not to exceed 2.0 mA.

2-3.08.05. Relay Digital Output Modules. Not used.

2-3.08.06. Analog Input Modules. Analog input modules shall accept linear 4-20 mA dc signals from field transmitters. Input circuitry shall be floating differential type designed to prevent loop grounding. Analog to digital conversion accuracy shall be at least 12 bit (0-4095 count) resolution. Where analog input signals are grounded outside of the PLC enclosure, isolation shall be provided for the associated analog input point either on the analog input module or through an I/I signal isolator provided in the PLC enclosure.

2-3.08.07. Analog Output Modules. Analog output modules shall transmit linear 4-20 mA dc signals to field devices. Loop power for all analog outputs shall be provided by regulated power supplies in each input/output enclosure and shall be capable of driving a 0 to 600 ohm load. Digital to analog conversion accuracy shall be at least 12 bit (0-4095 count) resolution.

2-3.08.08. Panel Terminations. All PLC input/output signals for field connections shall be terminated through panel enclosure terminal strips. Direct connection of field wiring to the I/O module terminals is not acceptable.

2-4. COMMUNICATIONS. Each programmable controller system shall be furnished complete with communication hardware modules for local input/output hardware, .

Communication hardware shall be compatible with the cable, data highway, fiber optic, or radio communication media. Ethernet components and cable are specified in other specification sections.

2-4.01. Addressability. Each programmable logic controller shall be individually addressable so that only the selected controller responds when queried. IP addressing shall be used. Designation of a controller's network address may be either a software or hardware function.

2-4.02. Communications Hardware. System Supplier shall provide all necessary communications hardware. Hardware shall be included for, but not be limited to, remote I/O, data highway, host computer, fiber optics, Ethernet and radio.

2-4.02.01. PLC to PLC Communications Hardware. Each Well PLC shall communicate to other PLCs over a data highway communications network utilizing Modbus/TCP. The RWPS PLC shall communicate using Profinet. System Supplier shall include all rack mounted, enclosure mounted, or desktop mounted communications modules required for a complete working system. System Supplier shall utilize the PLC rack mounted Schneider Model 140-NOE-771-11 Quantum Series Modbus/TCP Ethernet modules without exception for the Well PLCs and shall have the latest firmware and security updates installed prior to the Factory Test.

2-4.02.02. PLC to Remote Communications Hardware. Not used.

2-4.02.03. PLC to Host Communications Hardware. Each PLC shall communicate to the host computer over a data highway communications network. System Supplier shall include all rack mounted, enclosure mounted, or desktop mounted communications modules required for a complete working system. The computer system hardware is covered in another section. CONTRACTOR shall utilize the PLC rack mounted Schneider Model 140-NOE-771-11 Quantum Series Modbus/TCP Ethernet modules without exception for the Well PLCs and shall have the latest firmware and security updates installed prior to the Factory Test.

2-4.03. Communications Media. System Supplier shall provide all necessary cabling for the PLC communications network. Communications cables shall meet the requirements of the manufacturers of the PLCs and communications modules. PLC communications media shall be as specified under the Network Systems section.

2-5. MEDIA CONVERTERS. Not Used.

2-6. TELEPHONE NETWORKS. Not used.

2-7. SERIAL NETWORKS. Not Used.

2-8. PROGRAMMING DEVICE HARDWARE. The programming device shall be a portable notebook computer. System Supplier shall provide two interconnecting cables, each 5 meters long, to connect the computer to the programmable logic controller. The cables shall be shielded data cable and shall be terminated on both ends with the appropriate connectors. Connectors shall be labeled to identify the connected equipment.

2-8.01. Special Devices. System Supplier shall provide two sets of any special devices (such as null modems, adapter cards, interface converters, etc.) required to establish an operational programming line between the programmable logic controllers and programming device.

2-9. PROGRAMMING SOFTWARE. System Supplier shall furnish one licensed copy of the Siemens type PLC programming software for the Owner. The RWPS-PLC software shall be suitable for running on a laptop computer running Windows 7 operating system software. A full legal set of programming software documentation shall accompany each copy of the software. Each copy of the programming software shall include all necessary device drivers and add-on software packages.

2-9.01. Standard Product. The programming software shall be personal computer based and a standard product of the PLC manufacturer. The software shall be ProWorx 32 without exception for the Well PLCs and Siemens Step 7 for the RWPS-PLC.

2-9.02. PLC Simulation. The programming software shall include a PLC simulation feature that allows the program logic of a single PLC to be tested and debugged entirely in the programming device without the PLC.

2-9.03. Programming Software Features. The programming software shall allow off-line development of all PLC-related programming, including user annotation of the program, and

creation and printing of application programs and I/O cross-reference lists. Special programming tasks originally provided by System Supplier shall also be included.

On-line features shall include IEC-1311 standards program modification, ladder-logic modification, program language modification, monitoring of real-time ladder-logic execution, monitoring of program execution, monitoring and manipulation of timer and counter preset and present values, monitoring and forcing of physical I/O, and monitoring and manipulation of analog (register) and bit (binary) data table values. PLC and I/O hardware diagnostic and status information shall be accessible using the software in on-line mode.

2-10. SYSTEM ENCLOSURES. Programmable logic controllers and input/output hardware shall be housed in shop-assembled panels as indicated on the drawings and as described in the Panels, Consoles, and Appurtenances section.

2-11. OPERATOR INTERFACE TERMINALS (RWPS-PLC). Operator interface terminals (OIT) shall be microprocessor-based flat panel type. The unit shall have data entry capabilities and shall include a password security function. The unit shall be connected to the PLC and shall display status, alarm, and diagnostic information. The unit shall provide a nominal diagonal display area dimension of 12", with a minimum resolution of 800x600, 18 bit color, and a luminance of 300 cd/m². The OIT shall be furnished with a minimum of 8 MB of flash memory and 8 MB of system memory. The operator interface unit shall be provided with an Ethernet port for communications, and one serial RS-232 or RS-485 port for programming. The OIT shall be rated NEMA 4X, suitable for panel face.

Terminals shall be powered from 120 V ac, 60 Hz, single phase. Terminals shall be suitable for ambient temperatures of +32 to +130°F and a relative humidity of 5 to 95 percent.

One licensed copy of the OIT software used to create the screens shall be turned over to the Owner upon successful startup and commissioning of the system.

The operator interface unit shall be an SIMATIC HMI KTP1000 Basic color touch panel or equal.

OIT shall provide graphic screens that shall be used by the operators to access all functions and setpoints necessary for comprehensive control. The Manufacturer shall be responsible for developing and configuring the custom graphic displays. Each piece of major process equipment that is monitored and controlled by the control system shall be displayed on the graphic screens. Graphic screens shall be representations of the equipment and piping. The screens must accurately show all devices and equipment that is part of the control loops. The manufacturer shall use the configuration standards and conventions to be established by direct coordination with the Owner that shall describe and define such items as proposed graphic display process line colors/representations; color standards for "on", "off", "opened", "closed", and "alarm" conditions; alarm handling conventions; how items will be selected for control; methods for navigation between displays; address usage/naming conventions; and security setup. Proposed displays shall be submitted to the Engineer and Owner for approval.

PART 3 - EXECUTION

3-1. INSTALLATION REQUIREMENTS. PLCs installation requirements are specified in Instrumentation and Control System section except as described herein.

Field check, testing, and training shall be as specified in the Instrumentation and Control System section.

3-2. CONFIGURATION.

3-2.01. PLC Programming and Configuration. Configuration services are specified in the Instrumentation and Control System section.

3-2.02. Communications Configuration. The communications shall be fully configured and installed by System Supplier. Communications shall be configured as shown on the drawings.

End of Section

PROGRAMMABLE LOGIC CONTROLLERS

PART 1 - GENERAL

1-1. SCOPE. This section covers programmable logic controllers (PLCs), including associated input/output hardware to control process equipment and serve as the interface to field devices.

1-1.01. Control System. The Instrumentation and Control System section shall apply to all equipment furnished under this section. Additional PLC software requirements are indicated in Software Control Block Descriptions section.

1-2. GENERAL. Equipment furnished and installed under this section shall be fabricated, assembled, erected, and placed in proper operating condition in full conformity with the drawings, specifications, engineering data, instructions, and recommendations of the equipment manufacturer, unless exceptions are noted by Engineer.

1-2.01. General Equipment Stipulations. The General Equipment Stipulations shall apply to all equipment and materials furnished under this section. If requirements in this specification differ from those in the General Equipment Stipulations, the requirements specified herein shall take precedence.

1-2.02. Drawings. Supplementing this section, the drawings indicate the number and sizes of PLCs, locations of PLCs, and provide diagrams and schematics regarding connection and interaction with other equipment. All hardware, including power supplies, special cables, and other appurtenant equipment, shall be provided to meet the functional requirements described herein and indicated on the drawings. The System Supplier shall provide PLC-7, PLC-8 and RWS-PLC.

1-2.03. I/O List. An input/output (I/O) field device signal listing is included as an appendix attached to this section.

1-3. SUBMITTALS. Submittals shall be as specified in the Instrumentation and Control System section.

1-4. DELIVERY, STORAGE, AND SHIPPING. Delivery, storage and shipping shall be as specified in the Instrumentation and Control System Section.

1-5. SPARE PARTS. Spare parts for the Reclaimed Pump Station shall be furnished as follows:

<u>Spare Part</u>	<u>Quantity</u>
Processor modules	2 of each type used
Power supply modules	2 of each type used
I/O modules	2 of each type used
Communications modules	2 of each type used

Spare parts for the Well 7 and 8 shall consist of 2 spare analog input modules.

PART 2 - PRODUCTS

2-1. GENERAL. All equipment furnished under this section shall be expressly selected by System Supplier for its superior quality for the intended purpose and shall comply with the following requirements.

2-1.01. Interchangeability. All programmable logic controller systems shall be products of the same manufacturer and of the same series or product line. Processors, local and remote input/output hardware, communications modules, and specialty modules such as coprocessors and ASCII modules shall be interchangeable among all I/O panels and systems. PLC modules and hardware by other manufacturers will be acceptable only if the PLC manufacturer does not offer suitable modules and hardware for the same functions.

2-1.02. Initial, Spare, and Future Memory (RAM). System Supplier shall provide adequate memory for the amount of I/O, control algorithms, and communications in the initial system.

Each programmable logic controller shall include provisions for future expansion and shall have 100 percent spare memory capacity and 100 percent spare data capacity installed. The spare memory capacity shall be documented by submitting to Engineer, during factory testing, a statement indicating the amounts of memory of all types being utilized and the total amount available in each system. The statement shall include an estimate of the total program and data memory necessary, including spare memory, based on the I/O hardware for the system, and previous programming experience.

2-1.03. Spare I/O. Each PLC input/output enclosure shall be provided with at least 20 percent spare inputs and outputs of each type. Spare I/O shall be installed, wired, and interfaced properly to the terminal strip. The spare I/O shall be in addition to any I/O installed and reserved for future process signals as may be indicated on the I/O list. In addition, each PLC input/output enclosure shall be capable of accommodating 20 percent of additional input/output capacity of each type as originally assembled, without the need for additional expansion racks, communication adapters, cables, or PLC power supplies.

2-1.04. Expandability. Each PLC processor and associated I/O shall have a future expandability of at least 50 percent of the provided system.

2-1.05. Acceptable Manufacturers. The Well PLCs shall be Modicon non-Unity Quantum with latest software and firmware versions, without exception. The Well PLCs shall be programmed with ProWorx32. The RWPS-PLC shall be a Siemens S7-317 platform without exception.

2-1.06. Signal Power Supplies. Regulated dc power supplies shall be provided in each PLC enclosure for analog inputs. Power supplies shall be suitable for an input voltage variation of ± 10 percent, and the supply output shall be fused or protected against short-circuiting. Output voltage regulation shall be as required by the instrumentation equipment supplied under another section.

The loop power supply shall be separate from the power supply circuit for the processor and

racks.

The power source for all digital inputs from field devices shall be separately fused for each digital input module. Unless otherwise noted, all field devices will be provided with dry contacts that close to provide an input to the PLC.

2-1.07. Appurtenances. The PLC processor and I/O hardware shall be provided as complete systems, as shown on the block diagram drawings. The PLCs shall include all necessary hardware and software for a complete working system. All special rack or panel mounted power supplies, special interconnecting and programming cables, special grounding hardware, or isolation devices shall be furnished for proper operation of the equipment. Signal converters, signal boosters, amplifiers, special power supplies, special cable, special grounding, intrinsically safe relays and current repeaters, surge suppression devices, and isolation devices shall be furnished and installed for proper operation of the equipment.

2-1.08. PLC Arrangement. The PLCs shall be distributed and arranged as indicated on the drawings. Input/output hardware shall be arranged such that rack /module assignments be accomplished in an order to minimize or eliminate single points of failure due to equipment being concentrated on one I/O card.

2-1.09. Service Conditions. PLCs will be installed in air conditioned rooms and non air conditioned rooms.

2-2. LARGE PLC PROCESSOR (Wells 7 and 8). The programmable logic controller processor shall be an industrial-type rack-mounted unit that utilizes battery-backed CMOS type or nonvolatile type memory. Battery backed memory shall include integral batteries with sufficient capacity for at least 6 months' memory retention without power to the processing unit. Standby and shelf life of the batteries shall be at least 5 years.

2-2.01. Diagnostics. The processor shall utilize self-monitoring diagnostic techniques and shall contain easily visible LED diagnostic indicators for "run" and "halt" conditions as well as memory and input/output error conditions. Diagnostic codes shall also be available through the programming device to facilitate troubleshooting.

2-2.02. Programming Port. The processor shall include a programming port that is available for programming and monitoring on-line after the system is fully functional, and after all communications, human machine interface (HMI), and network connections have been made. Removal or disruption of network communications, remote I/O communications, and HMIs to allow for on-line programming and monitoring will not be acceptable. A key switch shall be provided on the processor for selection of the operating mode and as a security measure.

2-2.03. Communications. The processor shall be programmed to operate autonomously, regardless of communications status with other units. Each programmable controller shall be furnished complete with communication modules for local and remote input/output hardware communications, communications with other programmable controllers, and communication with host computers as shown on the block diagram.

2-2.04. Environment. The processor shall be suitable for operation in the environments specified in another section.

2-2.05. Programming. The processor shall be programmable using the IEC 1131 international programming standards and ladder logic programming. IEC 1131 programming shall include the following:

- Functional Block Diagram
- Sequential Function Chart.
- Instruction List.
- Structured Text.
- Ladder Diagram.

Ladder logic programming shall include a minimum of the following capabilities:

- Contacts, coils, branching.
- Data comparisons.
- On-delay and off-delay timers.
- Counters with comparators.
- Floating point Math and Logical instructions.
- PID loop control.
- Jumps and Subroutine functions.
- Master control relay.
- Transitional or one-shot outputs.
- Standard and user-defined data tables for digital and analog value storage.
- Remote I/O capability.
- Fault-mode subroutine.

2-2.06. Programming Capabilities. The processor shall include the following capabilities for programming, debugging of programs, and troubleshooting.

- Off-line programming.
- On-line programming.
- On-line status of coils and registers.
- Input/output forcing.

2-2.07. Hardware Configuration. Processors shall be configured for standard rack mounting. Each programmable logic controller processor shall include integral communications ports for the programming device, remote input/output, HMI device, or remote communications interfaces.

2-2.08. Input/Output Hardware. Programmable logic controller systems shall support the following types of input/output modules.

120 volt ac digital input and output.

4-20 mA dc analog input and output.

All digital input/output hardware shall include isolation against surges of at least 1500 volts. All output hardware connected to inductive loads shall be supplied with surge suppression devices and recommended by the PLC manufacturer to prevent damage to output hardware. Combination input/output modules will be acceptable if they meet the following requirements.

2-2.08.01. Wiring Terminals. All input/output modules shall utilize easily removable plug-in or hinged field wiring terminals to allow removal of modules without disconnecting individual wires.

2-2.08.02. I/O Circuit Power Supply. Outputs for motor driven equipment will typically be powered from the driven equipment. Digital outputs for miscellaneous equipment shall be powered either from the controlled equipment or the PLC enclosure as indicated on the drawings or as coordinated with the controlled equipment supplier. Outputs that control process equipment specified under other sections or provided under other contracts shall be fully isolated or shall operate either interposing relays or relay-type digital output modules in the PLC cabinet.

2-2.08.03. Digital Input Modules. Digital input modules shall sense voltages between 100 and 130 volts ac and shall have LED indicators for each point to display the status of the field contact. Each input module shall be suitable for being connected to a separate voltage source and return. Digital input modules shall provide complete electrical isolation between individual inputs. Digital input modules shall have multiple inputs. Schneider Automation part number 140 DAI 540 00 shall be used without exception.

2-2.08.04. Digital Output Modules. Not Used.

2-2.08.05. Relay Digital Output Modules. Where indicated on the PLC input/output listing, digital output modules shall have dry contact relay type outputs suitable to control voltages from 24 to 110 volts dc and 24 to 230 volts ac and shall be rated at least 2 amperes. Outputs have LED indicators to display output status. Digital outputs for motor driven equipment shall be powered by the driven equipment. Outputs shall withstand a surge of at least 80 amperes for 15 milliseconds. Relay digital output modules shall have multiple outputs. Schneider Automation part number 140 DRA 840 00 shall be used without exception.

2-2.08.06. Analog Input Modules. Analog input modules shall accept linear 4-20 mA dc signals from field transmitters. Analog to digital conversion accuracy shall be at least 12-bit (0-4095 count) resolution. Analog input modules shall have multiple inputs. Each input shall be fully isolated from the other inputs. Schneider Automation part number 140 ACI 030 00 shall be used without exception.

2-2.08.07. Analog Output Modules. Analog output modules shall transmit linear 4-20 mA dc signals to field devices. Loop power for all analog outputs shall be provided by regulated power supplies in each input/output enclosure and shall be capable of driving a 0 to 600 ohm load. Digital to analog conversion accuracy shall be at least 12-bit (0-4095 count) resolution. Analog

output modules shall have multiple outputs. Schneider Automation part number 140 ACO 020 00 shall be used without exception.

2-2.08.08. Panel Terminations. All PLC input/output signals for field connections shall be terminated through panel enclosure terminal strips. Direct connection of field wiring to the I/O module terminals is not acceptable.

2-2.08.09. Interposing Relays. Interposing relays shall be incorporated on all output circuits as shown on the PLC input/output listing, where required by the application of isolate foreign power sources, where the continuous output rating of the PLC relay digital or output module is not sufficient to power the connected device or equipment, or where otherwise required by the System Supplier's equipment. Interposing relays shall be provided for any digital output module output signal that leaves the PLC enclosure. Interposing relays shall be mounted in the PLC enclosure containing the output module that activates the relays. All Interposing relays shall be lighted to indicate an energized condition.

2-3. MINI PLC PROCESSOR (RWPS-PLC). The programmable logic controller processor shall be an industrial type that utilizes battery-backed CMOS type or nonvolatile type memory. Battery-backed memory shall include integral batteries with sufficient capacity for at least 6 months' memory retention without power to the processing unit. Standby and shelf life of the batteries shall be at least 5 years.

2-3.01. Diagnostics. The processor shall utilize self-monitoring diagnostic techniques. Easily visible LEDs shall indicate "run" and "halt" status as well as memory and input/output error conditions. Diagnostic codes shall also be available through the programming device to facilitate troubleshooting.

2-3.02. Programming Port. The processor shall include a programming port that is available for programming and monitoring on-line after the system is fully functional. Removal or disruption of network communications, remote I/O communications, or HMIs to permit programming and monitoring will not be acceptable.

2-3.03. Communications. The processor shall be programmed to operate autonomously, regardless of communications status with other units.

2-3.04. Environment. The processor shall be suitable for operation in the environments specified in another section. A key switch shall be provided on the processor to select the operating mode and as a security measure.

2-3.05. Programming. The processor shall be programmable using conventional relay ladder logic, or as required, and shall include the following functions and features.

Contacts, coils, branching.

Data comparisons.

On-delay and off-delay timers.

Counters with comparators.

Floating Point Math and Logical instructions.

Master control relay.

Transitional or one-shot outputs.

Standard and user-defined data tables for digital and analog value storage.

2-3.06. Capabilities. The processor shall include the following capabilities for programming, debug of programs, and troubleshooting.

Off-line programming.

On-line status of coils and registers.

Input/output forcing.

2-3.07. Configuration. Processors shall be configured for standard rack mounting and shall be of plug-in printed circuit board construction. Each programmable logic controller shall include integral communications ports for the programming device, remote input/output, HMI device, or remote communications interfaces as required.

Programmable logic controller systems shall support the following types of input/output.

120 volt ac digital input and output.

24 volt dc digital input and output.

4-20 mA dc analog input and output.

2-3.08. Input/Output Hardware. Input/output hardware shall be supplied in standard modules of 4, 8, 16, or 32 points each for assembly in local and remote input/output enclosures.

Programmable logic controllers having fixed, non-removable input/output hardware are not acceptable.

All digital input/output hardware shall include isolation against surges of at least 1500 volts. All output hardware connected to inductive loads shall be supplied with surge suppression devices as required and recommended by the PLC manufacturer to prevent damage to output hardware. Combination input/output modules will be acceptable if they meet all of the requirements in the following subparagraphs.

2-3.08.01. Wiring Terminals. All input/output modules shall utilize easily removable plug-in or hinged field wiring terminals to allow removal of modules without disconnecting individual wires.

2-3.08.02. I/O Circuit Power Supply. Outputs for motor driven equipment will typically be powered from the driven equipment. Digital outputs for miscellaneous equipment shall be powered either from the controlled equipment or the PLC enclosure as indicated on the drawings or as coordinated with the controlled equipment supplier. Outputs that control process equipment specified under other sections or provided under other contracts shall be fully isolated or shall operate relay-type digital output modules or interposing relays in the PLC cabinet.

2-3.08.03. Digital Input Modules. Digital input modules shall sense voltages between 100 and 130 volts ac and shall have LED indicators for each point to display the status of the field

contact. Each input module shall be suitable for being connected to a separate voltage source and return. Return voltage may be common to the entire input module.

2-3.08.04. Digital Output Modules. Digital output modules shall control voltages from 100 and 130volts ac and shall be rated at least 1 ampere. Outputs shall be individually fused and shall have LED indicators to display output status. Each digital output shall be provided with an interposing relay. Outputs shall withstand a surge of at least 80 amperes for one cycle and shall have an off-state leakage current not to exceed 2.0 mA.

2-3.08.05. Relay Digital Output Modules. Not used.

2-3.08.06. Analog Input Modules. Analog input modules shall accept linear 4-20 mA dc signals from field transmitters. Input circuitry shall be floating differential type designed to prevent loop grounding. Analog to digital conversion accuracy shall be at least 12 bit (0-4095 count) resolution. Where analog input signals are grounded outside of the PLC enclosure, isolation shall be provided for the associated analog input point either on the analog input module or through an I/I signal isolator provided in the PLC enclosure.

2-3.08.07. Analog Output Modules. Analog output modules shall transmit linear 4-20 mA dc signals to field devices. Loop power for all analog outputs shall be provided by regulated power supplies in each input/output enclosure and shall be capable of driving a 0 to 600 ohm load. Digital to analog conversion accuracy shall be at least 12 bit (0-4095 count) resolution.

2-3.08.08. Panel Terminations. All PLC input/output signals for field connections shall be terminated through panel enclosure terminal strips. Direct connection of field wiring to the I/O module terminals is not acceptable.

2-4. COMMUNICATIONS. Each programmable controller system shall be furnished complete with communication hardware modules for local input/output hardware, .

Communication hardware shall be compatible with the cable, data highway, fiber optic, or radio communication media. Ethernet components and cable are specified in other specification sections.

2-4.01. Addressability. Each programmable logic controller shall be individually addressable so that only the selected controller responds when queried. IP addressing shall be used. Designation of a controller's network address may be either a software or hardware function.

2-4.02. Communications Hardware. System Supplier shall provide all necessary communications hardware. Hardware shall be included for, but not be limited to, remote I/O, data highway, host computer, fiber optics, Ethernet and radio.

2-4.02.01. PLC to PLC Communications Hardware. Each Well PLC shall communicate to other PLCs over a data highway communications network utilizing Modbus/TCP. The RWPS PLC shall communicate using Profinet. System Supplier shall include all rack mounted, enclosure mounted, or desktop mounted communications modules required for a complete working system. System Supplier shall utilize the PLC rack mounted Schneider Model 140-NOE-771-11 Quantum Series Modbus/TCP Ethernet modules without exception for the Well PLCs and shall have the latest firmware and security updates installed prior to the Factory Test.

2-4.02.02. PLC to Remote Communications Hardware. Not used.

2-4.02.03. PLC to Host Communications Hardware. Each PLC shall communicate to the host computer over a data highway communications network. System Supplier shall include all rack mounted, enclosure mounted, or desktop mounted communications modules required for a complete working system. The computer system hardware is covered in another section. CONTRACTOR shall utilize the PLC rack mounted Schneider Model 140-NOE-771-11 Quantum Series Modbus/TCP Ethernet modules without exception for the Well PLCs and shall have the latest firmware and security updates installed prior to the Factory Test.

2-4.03. Communications Media. System Supplier shall provide all necessary cabling for the PLC communications network. Communications cables shall meet the requirements of the manufacturers of the PLCs and communications modules. PLC communications media shall be as specified under the Network Systems section.

2-5. MEDIA CONVERTERS. Not Used.

2-6. TELEPHONE NETWORKS. Not used.

2-7. SERIAL NETWORKS. Not Used.

2-8. PROGRAMMING DEVICE HARDWARE. The programming device shall be a portable notebook computer. System Supplier shall provide two interconnecting cables, each 5 meters long, to connect the computer to the programmable logic controller. The cables shall be shielded data cable and shall be terminated on both ends with the appropriate connectors. Connectors shall be labeled to identify the connected equipment.

2-8.01. Special Devices. System Supplier shall provide two sets of any special devices (such as null modems, adapter cards, interface converters, etc.) required to establish an operational programming line between the programmable logic controllers and programming device.

2-9. PROGRAMMING SOFTWARE. System Supplier shall furnish one licensed copy of the Siemens type PLC programming software for the Owner. The RWPS-PLC software shall be suitable for running on a laptop computer running Windows 7 operating system software. A full legal set of programming software documentation shall accompany each copy of the software. Each copy of the programming software shall include all necessary device drivers and add-on software packages.

2-9.01. Standard Product. The programming software shall be personal computer based and a standard product of the PLC manufacturer. The software shall be ProWorx 32 without exception for the Well PLCs and Siemens Step 7 for the RWPS-PLC.

2-9.02. PLC Simulation. The programming software shall include a PLC simulation feature that allows the program logic of a single PLC to be tested and debugged entirely in the programming device without the PLC.

2-9.03. Programming Software Features. The programming software shall allow off-line development of all PLC-related programming, including user annotation of the program, and

creation and printing of application programs and I/O cross-reference lists. Special programming tasks originally provided by System Supplier shall also be included.

On-line features shall include IEC-1311 standards program modification, ladder-logic modification, program language modification, monitoring of real-time ladder-logic execution, monitoring of program execution, monitoring and manipulation of timer and counter preset and present values, monitoring and forcing of physical I/O, and monitoring and manipulation of analog (register) and bit (binary) data table values. PLC and I/O hardware diagnostic and status information shall be accessible using the software in on-line mode.

2-10. SYSTEM ENCLOSURES. Programmable logic controllers and input/output hardware shall be housed in shop-assembled panels as indicated on the drawings and as described in the Panels, Consoles, and Appurtenances section.

2-11. OPERATOR INTERFACE TERMINALS (RWPS-PLC). Operator interface terminals (OIT) shall be microprocessor-based flat panel type. The unit shall have data entry capabilities and shall include a password security function. The unit shall be connected to the PLC and shall display status, alarm, and diagnostic information. The unit shall provide a nominal diagonal display area dimension of 12", with a minimum resolution of 800x600, 18 bit color, and a luminance of 300 cd/m². The OIT shall be furnished with a minimum of 8 MB of flash memory and 8 MB of system memory. The operator interface unit shall be provided with an Ethernet port for communications, and one serial RS-232 or RS-485 port for programming. The OIT shall be rated NEMA 4X, suitable for panel face.

Terminals shall be powered from 120 V ac, 60 Hz, single phase. Terminals shall be suitable for ambient temperatures of +32 to +130°F and a relative humidity of 5 to 95 percent.

One licensed copy of the OIT software used to create the screens shall be turned over to the Owner upon successful startup and commissioning of the system.

The operator interface unit shall be an SIMATIC HMI KTP1000 Basic color touch panel or equal.

OIT shall provide graphic screens that shall be used by the operators to access all functions and setpoints necessary for comprehensive control. The Manufacturer shall be responsible for developing and configuring the custom graphic displays. Each piece of major process equipment that is monitored and controlled by the control system shall be displayed on the graphic screens. Graphic screens shall be representations of the equipment and piping. The screens must accurately show all devices and equipment that is part of the control loops. The manufacturer shall use the configuration standards and conventions to be established by direct coordination with the Owner that shall describe and define such items as proposed graphic display process line colors/representations; color standards for "on", "off", "opened", "closed", and "alarm" conditions; alarm handling conventions; how items will be selected for control; methods for navigation between displays; address usage/naming conventions; and security setup. Proposed displays shall be submitted to the Engineer and Owner for approval.

PART 3 - EXECUTION

3-1. INSTALLATION REQUIREMENTS. PLCs installation requirements are specified in Instrumentation and Control System section except as described herein.

Field check, testing, and training shall be as specified in the Instrumentation and Control System section.

3-2. CONFIGURATION.

3-2.01. PLC Programming and Configuration. Configuration services are specified in the Instrumentation and Control System section.

3-2.02. Communications Configuration. The communications shall be fully configured and installed by System Supplier. Communications shall be configured as shown on the drawings.

End of Section

Input/Output List - Legend/Description Sheet

Item. This is an arbitrary sequential number which is for reference only.
Panel ID. This is the panel identification for the I/O cabinet, PLC cabinet, or controller where the I/O signal terminates.
Type: This is the type of I/O signal, as follows:
 AI = Analog Input
 AO = Analog Output
 DI = Discrete Input
 DO = Discrete Output
 PI = Pulse Input (totalizer or accumulator type input)
Number. This is a sequential number for a given type within a specific controller (PLC, RTU, or DCU).
Service Description. This is the description or the function (i.e. Filter No. 1 Loss-of-Head).
Field Device. This is the tag number of equipment identifier associated with the I/O point.
Analog Data (Signal Type). This will typically be 4-20mA, but could also be 1-5Vdc, serial, HART, FLD-BUS, or similar to indicate the signal type of the associated input or output.
Analog Data (Calibrated Range). This will be the scaled value of the input in engineering units.
Analog Data (Power). This will typically be '2-wire' for devices which are loop powered from the PLC enclosure, or '4-wire' for devices which are powered from external power supplies, unless noted otherwise.
Discrete Data (Closed State). This will indicate the state of the input or output when it is considered to be closed or energized (normal, alarm, running, failed, etc.).
Discrete Data (Power Source). This will indicate the location of the power source for the wetting voltage on the contacts, as follows:
 Field = External field power source. (May require interposing relays or isolated I/O module type.)
 Local = Power originates from within the PLC or I/O enclosure.
Discrete Data (Interp Relay). This will be either 'Yes' or 'No' to indicate whether the input or output requires an interposing relay. Relays are typically required to isolate external voltage sources. See specifications for additional details.

Comments/Notes. This column may include a cross reference to another specification section where applicable, or to a note which provides additional information. Notes are appended to the end of the I/O listing.

Item	Panel ID	Type	Service Description	Tag	Field Device	Analog Data			Discrete Data				Comments/ Notes
						Signal Type	Calibrated Range	Power	Signal Type	Closed State	P S o o w u r e r e e	Interp Relay	
1	PLC-7	AI	DISCHARGE PRESSURE	MEAD_WL_P7_TRNS_PRS	PIT-07	4-20 ma	0-100 psig	4-WIRE	CONTACT	N/A	N/A	NO	
2	PLC-7	AI	DRAW DOWN LEVEL	MEAD_WL_P7_TRNS_LVL	LT-07	4-20 ma	0-45'	2-WIRE	N/A	N/A	N/A	N/A	
3	PLC-7	AI	FLOW	MEAD_WL_P7_TRNS_FLOW	FIT-07	4-20 ma	0-3500 GPM	2-WIRE	N/A	N/A	N/A	N/A	
4	PLC-7	AI	POWER	MEAD_WL_P7_TRNS_PWR	RVS-7 JT-07	4-20 ma	BY SUPPLIER	4-WIRE	N/A	N/A	N/A	N/A	
5	PLC-7	DI	BUILDING INTRUSION	MEAD_WL_P7_INT_AL	ZS-07B	N/A	N/A	N/A	CONTACT	ALARM	LOCAL	NO	
6	PLC-7	DI	COMMON ALARM	MEAD_WL_P7_AL	RVS-7	N/A	N/A	N/A	CONTACT	ALARM	LOCAL	NO	
7	PLC-7	DI	PLC PANEL INTRUSION	MEAD_WL_P7_INT_AL2	PLC_PNL_ZS-07B	N/A	N/A	N/A	CONTACT	PLC PANEL INTRUSION	LOCAL	NO	
8	PLC-7	DI	POWER FAILURE	MEAD_WL_P7_PWR_AL1	PLC_PNL_ES-07A	N/A	N/A	N/A	CONTACT	POWER FAIL	LOCAL	NO	
9	PLC-7	DI	PRESSURE SWITCH LOW	MEAD_WL_P7_PRS_LOW	PSL-07	N/A	N/A	N/A	CONTACT	LOW PRESSURE	LOCAL	NO	
10	PLC-7	DI	FLOW SWITCH CLOSED	MEAD_WL_P7_FS_AL	FS-07	N/A	N/A	N/A	CONTACT	CONTACT MADE	LOCAL	NO	
11	PLC-7	DI	PUMP IN AUTO	MEAD_WL_P7_AUT_ST_HW	RVS-7 HS-07B	N/A	N/A	N/A	CONTACT	IN-AUTO	LOCAL	NO	
12	PLC-7	DI	RUNNING	MEAD_WL_P7_RUN	RVS-7 YL-07A	N/A	N/A	N/A	CONTACT	RUNNING	LOCAL	NO	
13	PLC-7	DI	UPS BYPASSED	MEAD_WL_P7_PWR_AL2	BYP_SW_ES-07B	N/A	N/A	N/A	CONTACT	UPS BYPASSED	LOCAL	NO	
14	PLC-7	DI	UPS FAILURE	MEAD_WL_P7_UPS_AL3	UPS_ES-07C	N/A	N/A	N/A	CONTACT	UPS FAIL	LOCAL	NO	
15	PLC-7	DI	UPS LOW BATTERY	MEAD_WL_P7_UPS_AL4	UPS_ES-07D	N/A	N/A	N/A	CONTACT	UPS LOW BATTERY	LOCAL	NO	
16	PLC-7	DO	RUN COMMAND	MEAD_WL_P7_STRT_CMD	RVS-7 HS-07B	N/A	N/A	N/A	CONTACT	RUN	FIELD	YES	
17	PLC-7	DO	WELL 7 LIGHTS ON COMMAND	MEAD_WL_P7_LIGHTS_CMD	CONTACTOR	N/A	N/A	N/A	CONTACT	LIGHTS ON	FIELD	YES	
18													
19	PLC-8	AI	DISCHARGE PRESSURE	MEAD_WL_P8_TRNS_PRS	PIT-08	4-20 ma	0-100 psig	4-WIRE	N/A	N/A	N/A	NO	
20	PLC-8	AI	DRAW DOWN LEVEL	MEAD_WL_P8_TRNS_LVL	LT-08	4-20 ma	0-45'	2-WIRE	N/A	N/A	N/A	N/A	
21	PLC-8	AI	FLOW	MEAD_WL_P8_TRNS_FLOW	FIT-08	4-20 ma	0-2000 GPM	2-WIRE	N/A	N/A	N/A	N/A	
22	PLC-8	AI	POWER	MEAD_WL_P8_TRNS_PWR	RVS-8 JT-08	4-20 ma	BY SUPPLIER	4-WIRE	N/A	N/A	N/A	N/A	
23	PLC-8	DI	BUILDING INTRUSION	MEAD_WL_P8_INT_AL1	ZS-08B	N/A	N/A	N/A	CONTACT	BUILDING INTRUSION	LOCAL	NO	
24	PLC-8	DI	COMMON ALARM	MEAD_WL_P8_AL	RVS-8	N/A	N/A	N/A	CONTACT	ALARM	LOCAL	NO	
25	PLC-8	DI	PLC PANEL INTRUSION	MEAD_WL_P8_INT_AL2	PLC_PNL_ZS-08B	N/A	N/A	N/A	CONTACT	PLC PANEL INTRUSION	LOCAL	NO	
26	PLC-8	DI	POWER FAILURE	MEAD_WL_P8_PWR_AL1	PLC_PNL_ES-08A	N/A	N/A	N/A	CONTACT	POWER FAIL	LOCAL	NO	
27	PLC-8	DI	PRESSURE SWITCH LOW	MEAD_WL_P8_PRS_LOW	PSL-08	N/A	N/A	N/A	CONTACT	LOW PRESSURE	LOCAL	NO	
28	PLC-8	DI	FLOW SWITCH CLOSED	MEAD_WL_P8_FS_AL	FS-08	N/A	N/A	N/A	CONTACT	CONTACT MADE	LOCAL	NO	
29	PLC-8	DI	PUMP IN AUTO	MEAD_WL_P8_AUT_ST_HW	RVS-8 HS-08B	N/A	N/A	N/A	CONTACT	IN-AUTO	LOCAL	NO	
30	PLC-8	DI	RUNNING	MEAD_WL_P8_RUN	RVS-8 YL-08A	N/A	N/A	N/A	CONTACT	RUNNING	LOCAL	NO	
31	PLC-8	DI	UPS BYPASSED	MEAD_WL_P8_PWR_AL2	BYP_SW_ES-08B	N/A	N/A	N/A	CONTACT	UPS BYPASSED	LOCAL	NO	
32	PLC-8	DI	WELL 8 EYEWASH ALARM	MEAD_WL_P8_EYE_AL	EYE WASH	N/A	N/A	N/A	CONTACT	ALARM	LOCAL	NO	
33	PLC-8	DI	UPS FAILURE	MEAD_WL_P8_UPS_AL3	UPS_ES-08C	N/A	N/A	N/A	CONTACT	UPS FAIL	LOCAL	NO	

Item	Panel ID	Type	Service Description	Tag	Field Device	Analog Data			Discrete Data			Comments/ Notes	
						Signal Type	Calibrated Range	Power	Signal Type	Closed State	P S o o w u e r c e		Interp Relay
34	PLC-8	DI	UPS LOW BATTERY	MEAD_WL_P8_UPS_AL4	UPS ES-08D	N/A	N/A	N/A	CONTACT	UPS LOW BATTERY	LOCAL	NO	
35	PLC-8	DI	WELL FACILITY GATE CLOSED	MEAD_WL_GATE_CLS_STAT	LENEL	N/A	N/A	N/A	CONTACT	ALARM	LOCAL	NO	
36	PLC-8	DI	WELL FACILITY GATE OPENED	MEAD_WL_GATE_OPN_STAT	LENEL	N/A	N/A	N/A	CONTACT	ALARM	LOCAL	NO	
37	PLC-8	DO	WELL FACILITY GATE CLOSE CMD	MEAD_WL_GATE_CLS_CMD	LENEL	N/A	N/A	N/A	CONTACT	CLOSE	FIELD	YES	
38	PLC-8	DO	WELL 8 LIGHTS ON COMMAND	MEAD_WL_P8_LIGHTS_CMD	CONTACTOR	N/A	N/A	N/A	CONTACT	LIGHTS ON	FIELD	YES	
39	PLC-8	DI	EYEWASH SHOWER ALARM	MEAD_WL_P8_EYE_AL	PLC PNL ZS-08C	N/A	N/A	N/A	CONTACT	EYEWASH ALARM	LOCAL	NO	
40	RWPS-PLC	AI	GROUND STORAGE RESERVOIR 1	LEVEL	LSHH-1	4-20 mA	0-X FT	4-WIRE	N/A	N/A	N/A	NO	
41	RWPS-PLC	AI	GROUND STORAGE RESERVOIR 2	LEVEL	LIT-2	4-20 mA	0-X FT	4-WIRE	N/A	N/A	N/A	NO	
42	RWPS-PLC	AI	MEADOW WOODS FILL VPC-12	POSITION	FILL VPC-12	4-20 mA	0-100%	4-WIRE	N/A	N/A	N/A	NO	
43	RWPS-PLC	AI	RECLAIMED PUMP 4	AMPERAGE	AFD-4	4-20 mA	0-XXX KVA	4-WIRE	N/A	N/A	N/A	NO	
44	RWPS-PLC	AI	RECLAIMED PUMP 4	SPEED	AFD-4	4-20 mA	0-100%	4-WIRE	N/A	N/A	N/A	NO	
45	RWPS-PLC	AI	RECLAIMED PUMP 3	AMPERAGE	AFD-4	4-20 mA	0-XXX KVA	4-WIRE	N/A	N/A	N/A	NO	
46	RWPS-PLC	AI	RECLAIMED PUMP 3	SPEED	AFD-4	4-20 mA	0-100%	4-WIRE	N/A	N/A	N/A	NO	
47	RWPS-PLC	AI	RECLAIMED PUMP 2	AMPERAGE	AFD-4	4-20 mA	0-XXX KVA	4-WIRE	N/A	N/A	N/A	NO	
48	RWPS-PLC	AI	RECLAIMED PUMP 2	SPEED	AFD-4	4-20 mA	0-100%	4-WIRE	N/A	N/A	N/A	NO	
49	RWPS-PLC	AI	RECLAIMED PUMP 1	AMPERAGE	AFD-4	4-20 mA	0-XXX KVA	4-WIRE	N/A	N/A	N/A	NO	
50	RWPS-PLC	AI	RECLAIMED PUMP 1	SPEED	AFD-4	4-20 mA	0-100%	4-WIRE	N/A	N/A	N/A	NO	
51	RWPS-PLC	AI	RECLAIMED PUMP STATION	DISCHARGE FLOW	FIT-01	4-20 mA	0-X GPM	4-WIRE	N/A	N/A	N/A	NO	
52	RWPS-PLC	AI	RECLAIMED PUMP STATION	DISCHARGE PRESSURE	PIT-02	4-20 mA	0-150 PSI	2-WIRE	N/A	N/A	N/A	NO	
53	RWPS-PLC	AI	RECLAIMED PUMP STATION	SYSTEM PRESSURE	PIT-01	4-20 mA	0-150 PSI	2-WIRE	N/A	N/A	N/A	NO	
54	RWPS-PLC	AO	RECLAIMED PUMP 4	SPEED COMMAND	AFD	4-20 mA	0-100%	4-WIRE	N/A	N/A	N/A	NO	
55	RWPS-PLC	AO	RECLAIMED PUMP 3	SPEED COMMAND	AFD	4-20 mA	0-100%	4-WIRE	N/A	N/A	N/A	NO	
56	RWPS-PLC	AO	RECLAIMED PUMP 2	SPEED COMMAND	AFD	4-20 mA	0-100%	4-WIRE	N/A	N/A	N/A	NO	
57	RWPS-PLC	AO	RECLAIMED PUMP 1	SPEED COMMAND	AFD	4-20 mA	0-100%	4-WIRE	N/A	N/A	N/A	NO	
58	RWPS-PLC	DI	GROUND STORAGE RESERVOIR 1	HIGH HIGH LEVEL	LSHH-1	N/A	N/A	N/A	CONTACT	HIGH HIGH	LOCAL	NO	
59	RWPS-PLC	DI	GROUND STORAGE RESERVOIR 2	HIGH HIGH LEVEL	LSHH-2	N/A	N/A	N/A	CONTACT	HIGH HIGH	LOCAL	NO	
60	RWPS-PLC	DI	RECLAIMED PUMP 4	AUTO	AFD	N/A	N/A	N/A	CONTACT	AUTO	LOCAL	NO	
61	RWPS-PLC	DI	RECLAIMED PUMP 4	FAIL	AFD	N/A	N/A	N/A	CONTACT	PUMP FAIL	LOCAL	NO	
62	RWPS-PLC	DI	RECLAIMED PUMP 4	RUNNING	AFD	N/A	N/A	N/A	CONTACT	RUNNING	LOCAL	NO	
63	RWPS-PLC	DI	RECLAIMED PUMP 4	HAND	AFD	N/A	N/A	N/A	CONTACT	HAND	LOCAL	NO	
64	RWPS-PLC	DI	RECLAIMED PUMP 4	RUNNING BYPASS	AFD	N/A	N/A	N/A	CONTACT	BYPASS	LOCAL	NO	
65	RWPS-PLC	DI	RECLAIMED PUMP 3	AUTO	AFD	N/A	N/A	N/A	CONTACT	AUTO	LOCAL	NO	
66	RWPS-PLC	DI	RECLAIMED PUMP 3	FAIL	AFD	N/A	N/A	N/A	CONTACT	PUMP FAIL	LOCAL	NO	
67	RWPS-PLC	DI	RECLAIMED PUMP 3	RUNNING	AFD	N/A	N/A	N/A	CONTACT	RUNNING	LOCAL	NO	
68	RWPS-PLC	DI	RECLAIMED PUMP 3	HAND	AFD	N/A	N/A	N/A	CONTACT	HAND	LOCAL	NO	
69	RWPS-PLC	DI	RECLAIMED PUMP 3	RUNNING BYPASS	AFD	N/A	N/A	N/A	CONTACT	BYPASS	LOCAL	NO	
70	RWPS-PLC	DI	RECLAIMED PUMP 2	AUTO	AFD	N/A	N/A	N/A	CONTACT	AUTO	LOCAL	NO	
71	RWPS-PLC	DI	RECLAIMED PUMP 2	FAIL	AFD	N/A	N/A	N/A	CONTACT	PUMP FAIL	LOCAL	NO	
72	RWPS-PLC	DI	RECLAIMED PUMP 2	RUNNING	AFD	N/A	N/A	N/A	CONTACT	RUNNING	LOCAL	NO	
73	RWPS-PLC	DI	RECLAIMED PUMP 2	HAND	AFD	N/A	N/A	N/A	CONTACT	HAND	LOCAL	NO	
74	RWPS-PLC	DI	RECLAIMED PUMP 2	RUNNING BYPASS	AFD	N/A	N/A	N/A	CONTACT	BYPASS	LOCAL	NO	
75	RWPS-PLC	DI	RECLAIMED PUMP 1	AUTO	AFD	N/A	N/A	N/A	CONTACT	AUTO	LOCAL	NO	
76	RWPS-PLC	DI	RECLAIMED PUMP 1	FAIL	AFD	N/A	N/A	N/A	CONTACT	PUMP FAIL	LOCAL	NO	
77	RWPS-PLC	DI	RECLAIMED PUMP 1	RUNNING	AFD	N/A	N/A	N/A	CONTACT	RUNNING	LOCAL	NO	
78	RWPS-PLC	DI	RECLAIMED PUMP 1	HAND	AFD	N/A	N/A	N/A	CONTACT	HAND	LOCAL	NO	
79	RWPS-PLC	DI	RECLAIMED PUMP 1	RUNNING BYPASS	AFD	N/A	N/A	N/A	CONTACT	BYPASS	LOCAL	NO	
80	RWPS-PLC	DI	RECLAIMED PUMP STATION	BUILDING INTRUSION	ZS-09A	N/A	N/A	N/A	CONTACT	BUILDING INTRUSION	LOCAL	NO	
81	RWPS-PLC	DI	RECLAIMED PUMP STATION	PLC PANEL INTRUSION	ZS-09B	N/A	N/A	N/A	CONTACT	PLC PANEL INTRUSION	LOCAL	NO	
82	RWPS-PLC	DI	RECLAIMED PUMP STATION	POWER FAILURE	PLC PNL ES-09A	N/A	N/A	N/A	CONTACT	POWER FAIL	LOCAL	NO	
83	RWPS-PLC	DI	RECLAIMED PUMP STATION	UPS BYPASSED	PLC PNL ES-09B	N/A	N/A	N/A	CONTACT	UPS BYPASSED	LOCAL	NO	
84	RWPS-PLC	DI	RECLAIMED PUMP STATION	UPS FAILURE	UPS ES-09C	N/A	N/A	N/A	CONTACT	UPS FAILURE	LOCAL	NO	
85	RWPS-PLC	DI	RECLAIMED PUMP STATION	UPS LOW BATTERY	UPS ES-09D	N/A	N/A	N/A	CONTACT	UPS LOW BATTERY	LOCAL	NO	
86	RWPS-PLC	DI	RECLAIMED PUMP STATION GATE	CLOSED	YS-09A	N/A	N/A	N/A	CONTACT	CLOSED	LOCAL	NO	
87	RWPS-PLC	DI	RECLAIMED PUMP STATION GATE	OPENED	YS-09B	N/A	N/A	N/A	CONTACT	OPENED	LOCAL	NO	
88	RWPS-PLC	DI	RECLAIMED SYSTEM TIE REC-114	CLOSED	TIE REC-114	N/A	N/A	N/A	CONTACT	CLOSED	LOCAL	NO	
89	RWPS-PLC	DI	RECLAIMED SYSTEM TIE REC-114	OPENED	TIE REC-114	N/A	N/A	N/A	CONTACT	OPENED	LOCAL	NO	
90	RWPS-PLC	DI	RECLAIMED SYSTEM TIE REC-114	REMOTE	TIE REC-114	N/A	N/A	N/A	CONTACT	REMOTE	LOCAL	NO	
91	RWPS-PLC	DI	SOUTH RECLAIMED SYSTEM REC-300	CLOSED	SRS REC-300	N/A	N/A	N/A	CONTACT	CLOSED	LOCAL	NO	
92	RWPS-PLC	DI	SOUTH RECLAIMED SYSTEM REC-300	OPENED	SRS REC-300	N/A	N/A	N/A	CONTACT	OPENED	LOCAL	NO	
93	RWPS-PLC	DI	SOUTH RECLAIMED SYSTEM REC-300	REMOTE	SRS REC-300	N/A	N/A	N/A	CONTACT	REMOTE	LOCAL	NO	
94	RWPS-PLC	DI	EAST RECLAIMED SYSTEM REC-200	CLOSED	ERS REC-200	N/A	N/A	N/A	CONTACT	CLOSED	LOCAL	NO	
95	RWPS-PLC	DI	EAST RECLAIMED SYSTEM REC-200	OPENED	ERS REC-200	N/A	N/A	N/A	CONTACT	OPENED	LOCAL	NO	
96	RWPS-PLC	DI	EAST RECLAIMED SYSTEM REC-200	REMOTE	ERS REC-200	N/A	N/A	N/A	CONTACT	REMOTE	LOCAL	NO	

Item	Panel ID	Type	Service Description	Tag	Field Device	Analog Data			Discrete Data			Comments/ Notes	
						Signal Type	Calibrated Range	Power	Signal Type	Closed State	PS o o w u e r c e		Interp Relay
97	RWPS-PLC	DO	GATE CONTROL	OPEN/CLOSE COMMAND	GATE	N/A	N/A	N/A	CONTACT	CLOSE COMMAND	FIELD	YES	
98	RWPS-PLC	DO	EAST RECLAIMED SYSTEM REC-200	CLOSE COMMAND	ERS REC-200	N/A	N/A	N/A	CONTACT	CLOSE COMMAND	FIELD	YES	
99	RWPS-PLC	DO	EAST RECLAIMED SYSTEM REC-200	OPEN COMMAND	ERS REC-200	N/A	N/A	N/A	CONTACT	OPEN COMMAND	FIELD	YES	
100	RWPS-PLC	DO	MEADOW WOODS FILL VPC-12	CLOSE COMMAND	FILL VPC-12	N/A	N/A	N/A	CONTACT	CLOSE COMMAND	FIELD	YES	
101	RWPS-PLC	DO	MEADOW WOODS FILL VPC-12	OPEN COMMAND	FILL VPC-12	N/A	N/A	N/A	CONTACT	OPEN COMMAND	FIELD	YES	
102	RWPS-PLC	DO	RECLAIMED PUMP 4	START/STOP COMMAND	AFD	N/A	N/A	N/A	CONTACT	START/STOP COMMAND	FIELD	YES	
103	RWPS-PLC	DO	RECLAIMED PUMP 3	START/STOP COMMAND	AFD	N/A	N/A	N/A	CONTACT	START/STOP COMMAND	FIELD	YES	
104	RWPS-PLC	DO	RECLAIMED PUMP 2	START/STOP COMMAND	AFD	N/A	N/A	N/A	CONTACT	START/STOP COMMAND	FIELD	YES	
105	RWPS-PLC	DO	RECLAIMED PUMP 1	START/STOP COMMAND	AFD	N/A	N/A	N/A	CONTACT	START/STOP COMMAND	FIELD	YES	
106	RWPS-PLC	DO	RECLAIMED SYSTEM TIE REC-114	OPEN COMMAND	TIE VG-13	N/A	N/A	N/A	CONTACT	OPEN COMMAND	FIELD	YES	
107	RWPS-PLC	DO	RECLAIMED SYSTEM TIE REC-114	CLOSE COMMAND	TIE VG-13	N/A	N/A	N/A	CONTACT	CLOSE COMMAND	FIELD	YES	
108	RWPS-PLC	DO	SOUTH RECLAIMED SYSTEM REC-300	CLOSE COMMAND	SRS REC-300	N/A	N/A	N/A	CONTACT	CLOSE COMMAND	FIELD	YES	
109	RWPS-PLC	DO	SOUTH RECLAIMED SYSTEM REC-300	OPEN COMMAND	SRS REC-300	N/A	N/A	N/A	CONTACT	OPEN COMMAND	FIELD	YES	

SOFTWARE CONTROL BLOCK DESCRIPTIONS

PART 1 - GENERAL

1-1. SCOPE. This section provides functional descriptions of the PLC and computer software requirements for the Instrumentation and Control System as indicated on the Drawings. These descriptions are intended to provide an overview of the operating concept of the plant process equipment rather than describing in detail every operating feature or interlock.

1-1.01. Control System. The Instrumentation and Control System section shall apply to all systems described in this section.

PART 2 – PRODUCTS

2-1. GENERAL. The descriptions are applicable to the software specified in the Computer System Software section and Programmable Logic Controller section.

PART 3 - EXECUTION

3-1. PLC PROGRAMMING FUNCTIONAL REQUIREMENTS. The following paragraphs describe general configuration tasks that are required for the system PLC(s). These tasks shall be programmed in any applicable PLC. Each PLC may have multiple instances of each of these tasks, or may have no instances of some or all of these tasks. The input/output lists (located in these documents as specified in the Instrumentation and Control System section) and detailed equipment control descriptions (included herein) shall be referenced to determine the requirements for each PLC.

The following paragraphs cover functional requirements of the software, which are generic and may or may not be related to any specific control loop.

3-1.01. Available Process Values. All PLC-generated process alarm, equipment status, and process variable values shall be available at any operator workstation.

3-1.02. Flow Values. Flow values shall be integrated, totalized, and stored in the PLC registers so the values displayed on the HMI computers and on the field processor will be identical.

3-1.03. System Failure. Failure of a PLC shall result in safe shutdown of associated process equipment. Interposing relays shall be provided where required to assure that equipment will revert to its fail-safe condition. Failure of any PLC or its communication shall be alarmed on the HMI computer.

3-1.04. HMI Computers. The HMI computers shall function as a control and monitoring interface to the control systems. The computer shall download set points and other information to the PLCs, and the PLCs shall perform all control algorithms.

3-1.05. Rack/Module Configuration. The rack and module definitions for each PLC, as well as the PLC communications configuration shall be completely configured to allow proper addressing of all field connected I/O points. This shall include configuration of any remote input/output (RIO) racks.

3-1.06. PLC Database Definition. The PLC database will include both field I/O points and internally generated points required for programming. All field I/O points and internal programming points shall be fully defined according to database naming conventions approved by Owner. As a minimum, each database point shall be provided with a tag name, engineering unit, alarm parameters, and description.

3-1.07. Analog Scaling. Each analog input and output will be appropriately scaled for use in internal PLC programming, monitoring by the HMI computers, or transmission to other PLCs. Requirements for raw count values shall be coordinated with the operator interface software to ensure compatibility.

3-1.08. Equipment Runtimes. For each equipment item whose "run" status is monitored by a PLC, an internal equipment runtime shall be accumulated by the respective PLC. The runtime procedure will monitor the status of the equipment "run" contact and, when the equipment is running, increment a software timer that maintains equipment runtime to within a one-minute resolution. The timer shall stop incrementing, but not reset, when the "run" contact indicates that the equipment is not running. The timer value shall increment an hour counter that maintains an integer value representing the equipment run time in hours. The counter value shall be available for display on the HMI computer. A manual reset of the runtime value shall be available at the HMI computers for personnel at the supervisor level and above.

3-1.09. Change-of-State Alarms. For all equipment that the PLC controls and monitors, add a Fail-to-Start alarm in the HMI. A Fail-to-Start alarm will be generated any time a piece of equipment is called to run and the Running feedback is not received within 10 seconds (operator adjustable). When a device generates a Fail-to-Start alarm, it will automatically be placed in the remote OFF mode. The alarm will be cleared either when the field HOA is removed from AUTO or the HMI controls are placed to remote MANUAL or remote AUTO. Resetting the alarm through the HMI will also clear the alarm. No Fail-to-Start alarm will be generated for equipment when the field HOA is in the HAND or OFF positions or for equipment that does not have a running status.

When a pump is called to run, a secondary process instrument (pressure switch or check valve with limit switch or flow transmitter low flow setpoint) will be used to verify proper operation. If a pump is running and the secondary switch input is not active for a preset time, a flow failure alarm shall be generated. When a flow fail alarm is active for a pump, it shall be automatically placed in the remote OFF mode if it was in the remote MANUAL or remote AUTO mode. This alarm is latched for each pump individually in the PLC requiring operator resets to clear. A flow fail alarm is an indication of a pump problem or an instrument failure.

3-1.10. Equipment Availability. In general, equipment with PLC control has been provided with a local selector switch that transfers control to the PLC. The PLC shall monitor the position of this switch to determine if the equipment is available for PLC control. If the equipment is not available, the PLC program shall not attempt to implement remote manual or automatic status changes for the equipment. The PLC program may, however, need to implement special routines if equipment unavailability affects a sequence (as described in the detailed equipment descriptions).

3-1.11. Maintained/Momentary Outputs. The need for maintained or momentary control outputs shall be determined from the input/output listing and the electrical schematics. In general, equipment with only one control output indicated in the I/O list shall be programmed for a maintained control output. Equipment with two (or more) control outputs shall be programmed for momentary outputs. Provisions shall be made, in either case, to remove the active state (start, open, forward, initiate, etc.) control output when an equipment failure is sensed or when the equipment transitions from available to unavailable (local switch change).

3-1.12. Equipment Mode Changes. Unless otherwise indicated in the equipment control descriptions, equipment in automatic mode shall be transitioned to manual mode (and stopped) if the equipment fails or becomes unavailable or if the PLC processor resets.

3-1.13. Manual/Auto Bumpless Transfer. Unless otherwise indicated in the equipment control descriptions, equipment changes from automatic to manual control shall be bumpless. Equipment running or stopped in automatic mode shall remain running or stopped when manual mode is selected.

3-1.14. Transmitter Failure. A transmitter fail alarm shall be added to the HMI for each analog input. When the PLC analog input status determines an input failure or if the PLC does not have this feature, the analog input for a device drops below 2 mA or rises above 22 mA, an alarm shall be generated. If equipment is dependent on the transmitter reading, the equipment shall automatically be placed in a safe state. If the analog signal is used in a control loop, the control loop will be placed to manual and hold the last value. Any alarms derived from a transmitter shall automatically be disabled when the transmitter is failed.

3-2. HMI FUNCTIONAL REQUIREMENTS. The following paragraphs describe general configuration tasks that are required for the HMI and related software.

3-2.01. Database. The system database, including field I/O and internal points shall be expanded according to the database point naming conventions currently in place. Database generation for field I/O shall include all required coordination with PLC level addresses.

3-2.02. Trend Displays. Trend displays shall be developed to present real-time and historical process data in an X-Y graph format. Real-time trends shall utilize current process values to generate temporary graphs that do not retain data values. Historical trends shall utilize historically collected data and shall access the data files directly for use in the trend display. Historical trends shall allow paging forward and back to the limits of the collected data. The trending package shall be configured to automatically retrieve historical data from the proper data file to accommodate the paging functions. Content of the trends will be determined after meeting with Owner and will utilize the “pen set” technique with a reusable trend chart, as

described in Section 13500. 4 real-time trend displays and 4 historical trend displays shall be provided for each well and the pump station.

3-2.03. Alarms. Alarms shall be configured for the new equipment and shall follow existing conventions for each HMI.

3-2.04. Reporting. System reporting shall be accomplished using the standard operator interface software-reporting package. All necessary report development, including macro development in spreadsheets, shall be supplied to access real-time and historical data for reporting. Report quantities are outlined in Section 13500.

3-2.05. Historical Data Collection. System data shall be collected for historical archiving and for use in trending and reporting functions. Requirements for data collection shall be as needed to support the trends and reports developed.

3-2.06. Manual Entry of Data. The human machine interface (HMI) computers shall allow manual entry of laboratory data and other variables, which shall then be available for display and use in reports. Operator entered commands from any of the HMI computers shall be logged at all HMI computers.

3-3. EQUIPMENT CONTROL AND CONTROL MODE OVERVIEW. The following paragraphs explain the general format and control modes that are used in the detailed equipment descriptions. These paragraphs apply to the attached, project specific, equipment control descriptions included herein.

3-3.01. General. Appended to this section are the equipment control programming requirements, with requirements for both PLC programming and the minimum operator interface functions. The HMI requirements represent the anticipated display generation requirements and shall be adjusted if the PLC programming warrants adjustment.

3-3.02. Control Hierarchy and Nameplates. Two primary levels of operational control exist for all equipment and systems: Local and Remote. In general, a Hand-Off-Auto field switch will be provided at each piece of equipment and a software Manual-Off-Auto switch will be provided for selected equipment.

To ensure compatibility and consistency of designs, the following definitions will be used for both hardwired control stations and software control station control switch nameplates:

- LOCAL: Control is performed local to the device.
- REMOTE: Control is performed remote from local equipment.
- Control is performed by the PLC.

3-3.02.01 Field Hand-Off-Auto Switch.

- HAND: This is a manual hand switch position. When this position is selected, the final control element or device will change state to “Run” or “On.”
- OFF: This is a manual hand switch position. When this position is selected, the final control element or device will change state to “Off.”
- AUTO (Manual Hand Switch): This is a manual hand switch position that is wired as an input to the PLC. When this position is selected, the final control element or device is

controlled by the main plant PLC system.

3-3.02.02 Software Manual-Off-Auto Switch.

- **Manual:** This is a software provided hand switch position. This software switch is only active when the hardware hand switch has already been selected to the AUTO position. When the hardware switch is in AUTO and the software switch is in MANUAL, the output from the PLC to the device will be energized.
- **OFF:** This is a software provided hand switch position. This software switch is only active when the hardware hand switch has already been selected to the AUTO position. When the hardware switch is in AUTO and the software switch is in OFF, the output from the PLC to the device will be de-energized.
- **AUTO (Software Switch):** This is a software provided hand switch position. This software switch is only active when the hardware hand switch has already been selected to the AUTO position. When both hardware and software switches are in AUTO, the main plant PLC will automatically control the output functions.

Descriptions for local control are included in the detailed equipment control descriptions. They are provided primarily for documentation purposes and for information. These controls are hardwired and require no programming effort.

3-4. DETAILED EQUIPMENT CONTROL DESCRIPTIONS. The following paragraphs describe specific function requirements for various software control blocks in the control system. These descriptions are intended to provide an overview of the operational concept for the facilities, rather than describing in detail every operating feature or interlock.

Loop Description

Raw Water Well 7 and 8 Pumps – The new interface PLC, 90-PLC-1, located at the SRWSF shall be programmed such that its 2 network interface modules shall be connected to their associated network interfaces to exchange data from existing HSP PLC, 50-PLC-1 on the SRWSF PLC subnet and either new Well PLC-7 or 8 on the Meadow Woods subnet (A) as shown on the control block diagram.

Associated Equipment

P7, LT-07, PIT-07, FIT-07
P8, LT-08, PIT-08, FIT-08

Associated PLC

Existing 50-PLC-1, New 90-PLC-1, New 10-PLC-7 and 8

Associated P&ID(s)

I-4

Local Manual Mode

Local manual controls are provided at the reduced voltage solid state (RVSS) starter. The following controls shall be provided on the front of the RVSS for local control and monitoring of

the pump:
HAND-OFF-AUTO selector switch
RUNNING indication light
OFF indication light
FAIL indication light
RVSS operator keypad

Pumps shall be interlocked within the RVSS in all control modes to shutdown on high temperature from temperature switches within the motor windings. An adjustable timer in the RVSS shall delay the pump from starting immediately after a power failure.

Local Auto Mode

None

Remote Manual Mode

Remote Manual controls shall be provided as currently programmed:

A MANUAL-OFF-AUTO shall be provided at the HMI. In MANUAL the pump shall be commanded to run. In OFF the pump shall be stopped. In AUTO the pump shall run as specified in the Remote Auto Mode description.

On loss of communication with the central HMI, the pump shall be placed in the AUTO mode if it was running in the MANUAL mode. It shall remain in the OFF mode if it was in the OFF mode when a loss of communication occurred.

Pumps shall be software interlocked in all remote control modes to be placed in OFF mode and shutdown on LOW DRAIN DOWN SHUTDOWN LEVEL, HIGH-HIGH GROUND WATER STORAGE TANK LEVEL, LOCAL control mode selected, FAIL-TO-START, PUMP FAILURE ALARM, and FLOW FAILURE.

A FLOW FAILURE alarm shall be generated when the pump is running for an adjustable time period and the low pressure switch has been activated.

Refer to PLC Programming Functional Requirements (Paragraph 3-1) for additional requirements.

Remote Auto Mode

Six well sites (pumps) are currently responsible for maintaining the level in the two ground storage tanks (GST). The two new Wells, 7 and 8 shall be added to the algorithm as currently programmed:

As the level falls in the GST, pumps shall be called to run and as the level rises, pumps shall be stopped. Well Pumps use stage tables to determine automatic equipment sequencing. Pumps and level setpoints are assigned for each step that the main plant PLC uses for staging up or staging down as well as operator adjustable delay timers.

Staging Up

When the reading drops below the start setpoint, a timer will start. When the timer reaches its

preset, the stage will be incremented and pumps will be called to start or stop, depending on their stage assignments. Each stage will have an operator adjustable stage up delay timer displayed, which can be modified with appropriate login access. The stage can also be manually incremented by the operator by using the up arrow on the sequence popup.

Staging Down

When the reading rises above the stop setpoint, a timer will start. When the timer reaches its preset, the stage will decrement and pumps will be called to start or stop, depending on their stage assignments. Each stage will have an operator adjustable stage up delay timer displayed, which can be modified with appropriate login access. The stage can also be manually decremented by the operator by using the down arrow on the sequence popup.

Pumps Control

Any pumps in AUTO that are assigned to the active stage will be called to run and any pumps not assigned to the active stage will have the start command removed. Any pump that is not in AUTO or has an active failure alarm shall be removed from the stage table and placed in OFF. If a pump is running in MANUAL and placed in AUTO, the pump shall continue to run or stop as it is assigned in the current stage.

Alarms

The following alarms shall be provided for each pump: PUMP FAILURE, FLOW FAIL, LOW DRAIN DOWN SHUTDOWN LEVEL (generated), FAIL TO START (generated), LOW FLOW (generated), HIGH DISCHARGE PRESSURE (generated), Well 7 and 8 Communications Failure.

Status Indications

The HMI shall indicate the following status for each pump: RUN status, REMOTE/LOCAL status, POWER indication, DISCHARGE PRESSURE indication, FLOW indication, DRAWDOWN LEVEL indication,

The HMI shall indicate the following: COMBINED WELL FLOW (calculated)

PLC Powerup

On PLC powerup, control of the pump shall be set to OFF mode.

Power Failure

Control of the pump shall resume with the control mode established prior to the power failure. If either well is running and in the well control matrix, the matrix will stage down, reducing the required raw water flow to the Ozone Generators resulting in a reduction of the amount of Ozone generated.

PLC Communications Loss

On loss of communications between the Well PLC and the SRWSF interface PLC, control of the pump shall be set to OFF mode and removed from the matrix. If either well is running and in the well control matrix, the matrix will stage down, reducing the required raw water flow to the Ozone Generators resulting in a reduction of the amount of Ozone generated.

HMI Requirements

The wells (pumps) shall be depicted on an overview screen showing run, fail, and control mode

status. The well graphic shall be a selectable navigation target to an individual well screen similar to the P&ID.

Loop Description

Reclaimed Pump Station Pumps – The existing interface PLC, located at the SWRF shall be programmed such that its network interface modules shall be connected to their associated network interfaces to exchange data from existing S7-400 Data Concentrator on the SWRF PLC subnet and the new S7-317 PLC on the Meadow Woods subnet (B) as shown on the control block diagram.

Associated Equipment

Pump 1 through 4, LIT-01, LIT-02, PIT-02 FIT-01

Associated PLC

Existing Data Concentrator, New S7-317 PLC

Associated P&ID(s)

I-6

Local Manual Mode

Local manual controls are provided at the Adjustable Frequency Drive (AFD). The following controls shall be provided on the front of the AFD for local control and monitoring of the pump:

HAND-OFF-AUTO selector switch

RUNNING indication light

OFF indication light

FAIL indication light

AFD operator keypad

Local Auto Mode

None

Remote Manual Mode

Remote Manual controls shall be provided as follows:

A MANUAL-OFF-AUTO shall be provided at the HMI. In MANUAL the pump shall be commanded to run. In OFF the pump shall be stopped. In AUTO the pump shall run as specified in the Remote Auto Mode description.

On loss of communication with the central HMI, the pump shall be placed in the AUTO mode if it was running in the MANUAL mode. It shall remain in the OFF mode if it was in the OFF mode when a loss of communication occurred.

Pumps shall be software interlocked in all remote control modes to be placed in OFF mode and shutdown on LOW GST LEVEL, LOCAL control mode selected, FAIL-TO-START, and PUMP FAILURE ALARM.

Refer to PLC Programming Functional Requirements (Paragraph 3-1) for additional requirements.

Remote Auto Mode

Reclaimed Pump Station Pumps are used to supply water to the reclaimed system from the ground storage tanks to maintain reclaimed system pressure..

Pump Start Control

Pressure below the setpoint will call the lead adjustable frequency pump. When the lead pump speed is greater than 98% and pressure is still below the setpoint the lag constant speed high service pump will start. Simultaneously with the lag pump start, the lead adjustable frequency pump will ramp down initially to minimize setpoint overshoot.

Pump Speed Control

The system pressure will be maintained by modulating the speed of the AFD. The output from a PID controller will adjust the AFD speed based on an operator-entered set point and the measured system pressure. When the measured pressure is below set point, the PID will increase the speed of the AFD and when the measured pressure is above set point, the PID will decrease the speed of the AFD.

If the minimum speed configured in the AFD is 50 percent; when the pump is started with no speed output signal, the speed feedback shall ramp from zero to 50 percent as the AFD ramps from OFF to minimum speed. The output from the PLC shall be configured so that 4mA=minimum speed and 20mA=100 percent speed. The speed feedback signal shall be scaled so that 4mA=0 percent speed and 20mA=100 percent speed.

Ground Water Storage Tanks (GST)

The Reclaimed System Pumps use the GST level transmitters to derive a LOW-LOW LEVEL LOCKOUT. A controlling Level Transmitter shall be selected on the HMI screen for the proper lockout if a tank is out of service.

Alarms

The following alarms shall be provided for each pump: PUMP COMMON FAILURE, FAIL TO START (generated), FLOW FAIL (generated)

Status Indications

The HMI shall indicate the following status for each pump: RUN status, AUTO status, SPEED indication, POWER indication

The HMI shall indicate the following: DISCHARGE PRESSURE indication, FLOW indication,

PLC Powerup

On PLC powerup, control of the pump shall be set to OFF mode.

Power Failure

Control of the pump shall resume with the control mode established prior to the power failure. The control system shall not alarm failure of a pump on power restoration due to power failure restart delays. Multiple pumps shall not be restarted at the same time.

HMI Requirements

The pumps shall be depicted on an overview screen showing run, fail, and control mode status. The pump graphic shall be a selectable navigation target to an individual pump control pop-up screen.

Loop Description

Fill Valve

Associated Equipment

VPC-02, LIT-01, LIT-02,

Associated PLC

Existing Data Concentrator, New S7-317 PLC

Associated P&ID(s)

I-6

Local Manual Mode

None

Local Auto Mode

None

Remote Manual Mode

Remote Manual controls shall be provided as follows:

A MANUAL-OFF-AUTO shall be provided at the HMI. In MANUAL the valve shall be commanded to the Operator entered valve position, 0-100%. When percentage open is selected, both solenoid valves shall energize to open the valve. One solenoid is de-energized to halt the valve when it reaches its commanded position. When a lower percentage position is selected, both solenoid valves shall de-energize to move the valve towards close. One solenoid is de-energized to halt the valve when it reaches its new commanded position. When zero percentage is entered, both solenoid valves shall de-energize to close the valve. When a high high level is detected by the ball float in either GST, both solenoid valves shall de-energize to close the valve.

Remote Auto Mode

The Fill Valve will be controlled by the PLC to actuate to fill the GST based on system pressure and GST level. The valve will start to open based on comparison of the system pressure and the Operator entered dead band setpoints as well as GST level. The GST will continue to fill until the GST level reaches the Operator entered close setpoint or system pressure drops to the minimum allowed system pressure. While the system pressure is within the dead band, the valve will remain at maximum open position filling the GST. As pressure drops to the bottom of the dead band, the valve will modulate towards close to maintain system pressure. The valve max at % open shall be adjusted during startup to reduce the impact on the rest of the system. When a high high level is detected by the ball float in either GST, both solenoid valves shall de-energize to close the valve.

Alarms

The following alarms shall be provided for the GSTs: GST HIGH LEVEL, GST HIGH HIGH LEVEL, GST LOW LEVEL, GST LOW LOW LEVEL.

Status Indications

The HMI shall indicate the following: VALVE POSITION, GST 1 LEVEL AND GST 2 LEVEL

PLC Powerup

On PLC powerup, control of the valve shall be set to AUTO mode.

Power Failure

Control of the valve shall resume with the control mode established prior to the power failure.

HMI Requirements

The fill valve and GSTs shall be depicted on an overview screen showing the equipment. The valve graphic shall be a selectable navigation target to an individual valve control pop-up screen.

Loop Description

System and Tie Valves

Associated Equipment

VG-01, VG-03, VG-04

Associated PLC

Existing Data Concentrator, New S7-317 PLC

Associated P&ID(s)

I-6

Local Manual Mode

Local manual controls are provided at the valve. The following controls shall be provided on the valve operator:

LOCAL-REMOTE selector switch

OPEN-STOP-CLOSE push buttons

OPENED indication light

CLOSED indication light

Local Auto Mode

None

Remote Manual Mode

Remote Manual controls shall be provided as follows:

A MANUAL-OFF-AUTO shall be provided at the HMI. In MANUAL the valve shall be commanded to the Operator entered OPEN or CLOSED position by pressing the OPEN or

CLOSED HMI buttons.

Remote Auto Mode

None.

Alarms

The following alarms shall be provided for the VALVE FAIL TO OPEN, VALVE FAIL TO CLOSE.

Status Indications

The HMI shall indicate the following: VALVE OPEN, VALVE CLOSED, VALVE REMOTE.

PLC Powerup

No REMOTE AUTO mode available.

Power Failure

Control of the valve shall resume with the control established prior to the power failure.

HMI Requirements

The valves shall be depicted on an overview screen showing the equipment. The valve graphic shall be a selectable navigation target to an individual valve control pop-up screen.

End of Section

PANEL MOUNTED INSTRUMENTS

PART 1 - GENERAL.

1-1. SCOPE. The Panel Mounted Instrument section covers the furnishing of all panel mounted instruments and accessories required for the Instrumentation and Control System as indicated on the drawings.

Equipment and services provided under this section shall be subject to the Instrumentation and Control System section. This section shall be used and referenced only in conjunction with the Instrumentation and Control System section. Supplementing the Instrumentation and Control System section, instrument data, special requirements, and options are indicated on the drawings or the Instrument Device Schedule.

When multiple instruments of a particular type are specified, and each requires different features, the required features are described on the drawings or the Instrument Device Schedule.

1-2. DESIGN CRITERIA. The instruments shall be installed to measure, monitor, or display the specified process at the ranges and service conditions indicated on the drawings or as indicated in the Instrument Device Schedule. The instruments shall be installed at the locations indicated on the drawings or the Instrument Device Schedule.

Where possible, each instrument shall be factory calibrated to the calibration ranges indicated on the drawings or in the Instrument Device Schedule. Transmitters or similar measurement instruments shall be calibrated using National Institute of Standards and Technology (NIST) approved bench calibration procedures, when such procedures exist for the instrument type. For "smart" devices, calibration data shall be stored digitally in each device, including the instrument tag designation indicated on the drawings and/or Instrument Device Schedule.

1-3. SUBMITTALS. Submittals shall be as specified in the Instrumentation and Control System section.

PART 2 - PRODUCTS

2-1. GENERAL. The following paragraphs describe minimum device stipulations. The drawings or Instrument Device Schedule shall be used to determine any additional instrument options, requirements, or service conditions.

2-1.01 Programming Device. For systems that require a dedicated programming device for calibration, maintenance, or troubleshooting, one such programming device shall be provided for each Owner facility (quantity required shall be as indicated in the Instrumentation and Control System section). The programming device shall include appropriate operation manuals and shall be included in the training stipulations. For systems that allow the programming device functions to be implemented in software, running on a laptop computer, the software shall be provided instead of the programming device.

2-1.02 Configuration Software/Serial Interface. Devices indicated as requiring a serial interface shall be provided with all accessories to properly communicate over the serial link. An appropriate cable shall be provided to allow the transmitter serial interface to be connected to a personal computer. One licensed copy of the diagnostic/interface software shall be provided for each Owner facility (quantity required shall be as indicated in the Instrumentation and Control System section). Software shall be capable of running under the Windows XP operating system. If the software furnished performs the same functions as the programming device, specified elsewhere, then the programming device shall not be furnished.

2-2. PANEL FRONT MOUNTED DEVICES.

2-2.01. Annunciators. Not used.

2-2.02. Totalizers. Not used.

2-2.03. Digital Panel Indicators. Not used.

2-2.04. Electronic Bar Graph Indicators. Not used.

2-2.05. Edgewise Panel Indicators. Not used.

2-2.06. Manual Loading Stations. Not used.

2-2.07. Ratio Stations. Not used.

2-2.08. Electronic Indicating Control Stations. Not used.

2-2.09. 1/4 DIN Single-Loop Control Stations. Not used.

2-2.10. 1/4 DIN Manual/Auto Backup Stations. Not used.

2-2.11. Large Case Recorders. Not used.

2-2.12. Strip Chart Recorders. Not used.

2-2.13. Panel-Mounted Pressure Gauges. Not used.

2-2.14. Digital and Panel Clocks. Not used.

2-2.15. Switches, Lights, and Push Buttons.

2-2.15.01. Selector Switches. Not used.

2-2.15.02. Indicating Lights. Not used.

2-2.15.03. Push Buttons. Not used.

2-2.16. Alarm Horns. Not Used.

2-3. PANEL INTERIOR MOUNTED DEVICES. Panel devices that utilize both alternating current and direct current shall be installed such that each type of wiring, AC and DC is separated by 1 foot where the wiring is installed in an parallel orientation.

2-3.01. Integrators. Not used.

2-3.02. Power Supplies. Regulated dc power supplies for instrument loops shall be designed and arranged so that loss of one supply does not affect more than one instrument loop or system. Each power supply shall be supplied 120 VAC power by a dedicated protected power feed. Power supplies shall be suitable for an input voltage variation of ± 10 percent, and the supply output shall be fused or shortcircuit protected. Output voltage regulation shall be by the instrumentation equipment supplied. Multiloop or multisystem power supplies will be acceptable if backup power supply units are provided which will automatically supply the load upon failure of the primary supply. The backup supply systems shall be designed so either the primary or the backup supply can be removed, repaired, and returned to service without disrupting the instrument system operation. Multiloop power supply connections shall be individually fused so a fault in one instrument loop will be isolated from the other loops being fed from the same supply. Fuses shall be clearly labeled and shall be located for easy access. Multiloop supply systems shall be oversized for an additional 10 percent future load. Failure of a multiloop supply shall be indicated on the respective instrument panel or enclosure.

2-3.03. Relays. Relays indicated to be provided in panels, enclosures, or systems furnished under this section shall be of the plug-in socket base type with dustproof plastic enclosures unless noted otherwise. Relays shall be UL recognized and shall have not less than double-pole, double-throw contacts. Control circuit relays shall have silver cadmium oxide contacts rated 10 amperes at 120 V ac. Electronic switching-duty relays shall have gold-plated or gold alloy contacts suitable for use with low-level signals. Relays used for computer input, alarm input, or indicating light service shall have contacts rated at least 3 amperes. Time delay relays shall have dials or switch settings engraved in seconds and shall have timing repeatability of ± 2 percent of setting. Latching and special purpose relays shall be for the specific application. Unless otherwise indicated, all relays shall have an integral pilot light that illuminates to indicate an energized condition. Relays shall be Omron without exception.

2-3.04. Intrinsically Safe Relays. Not used.

2-3.05. Electronic Signal Booster/Isolators. Not used.

2-3.06. Electronic Signal Selectors. Not used.

2-3.07. Electronic Signal Summers. Not used.

2-3.08. Fixed Deadband Signal Monitors. Not used.

2-3.09. Adjustable Deadband Signal Monitors. Not used.

2-3.10. Strip Heaters. Not used.

2-3.11. Intrinsically Safe Barriers. Not used.

PART 3 – EXECUTION

3-1 FIELD SERVICES. Manufacturer's field services shall be provided for installation, field calibration, startup, and training as specified in the Instrumentation and Control System section. Instruments shall not be shipped to the Work Site until two weeks prior to the scheduled installation. SYSTEM SUPPLIER shall be responsible for coordinating the installation schedule with the Installation Contractor. Each shipment shall contain a listing of protective measures required to maintain sensor operation, including a listing of any common construction or cleaning chemicals that may affect instrument operation.

End of Section

Section 13562
FLOW INSTRUMENTS

PART 1 - GENERAL

1-1. SCOPE. The Flow Instrument Section covers the furnishing of flow instruments and accessories required for the Instrumentation and Control System as indicated on the drawings.

Equipment and services provided under this section shall be subject to the Instrumentation and Control System section. This section shall be used and referenced only in conjunction with the Instrumentation and Control System section. Supplementing the Instrumentation and Control System section, instrument data, special requirements, and options are indicated on the drawings or the Instrument Device Schedule.

When multiple instruments of a particular type are specified, and each requires different features, the required features are described on the drawings or the Instrument Device Schedule.

1-2. DESIGN CRITERIA. Each device shall be a pre-assembled, packaged unit. Upon delivery to the work site, each device or system shall be ready for installation with only minor piping and electrical connections required by Contractor.

Primary elements shall derive any required power from the transmitter, unless otherwise indicated.

The instruments shall be installed to measure, monitor, or display the specified process at the ranges and service conditions indicated on the drawings or as indicated in the Instrument Device Schedule. The instruments shall be installed at the locations indicated on the drawings or in the Instrument Device Schedule.

Where possible, each instrument shall be factory wet flow calibrated to the full scale flow range of the sensors or calibration ranges indicated on the drawings or in the Instrument Device Schedule. Transmitters or similar measurement instruments shall be calibrated using National Institute of Standards and Testing (NIST) approved bench calibration procedures, when such procedures exist for the instrument type. Calibration and configuration data shall be stored digitally in each device, including the instrument tag designation indicated on the drawings or Instrument Device Schedule.

1-3. SUBMITTALS. Submittals shall be made as specified in the Instrumentation and Control System section.

1-4. SHIPMENT, PROTECTION, AND STORAGE. Equipment provided under this section shall be shipped, protected, and stored as specified in the Instrumentation and Control System section. Identification of packaging shall be as specified in the Instrumentation and Control System section.

PART 2 - PRODUCTS

2-1. GENERAL. The following paragraphs provide minimum device requirements. The drawings or Instrument Device Schedule shall be used to determine any additional instrument options, requirements, or service conditions.

2-1.01. Interconnecting Cable. For instruments where the primary element and transmitter are physically separated, interconnecting cable from the element to the transmitter shall be provided. The cable shall be the type approved by the instrument manufacturer for the intended purpose of interfacing the element to the transmitter. Length of cable shall be a minimum of three meters or as indicated on the drawings or in the Instrument Device Schedule.

2-1.02. Programming Device. For instruments that require a dedicated programming device for calibration, maintenance, or troubleshooting, one such programming device shall be provided for each Owner facility (quantity required shall be as indicated in the Instrumentation and Control System section). The programming device shall include appropriate operation manuals and shall be included in the training requirements. For systems that allow the programming device functions to be implemented in software, running on a laptop computer, the software shall be provided instead of the programming device.

2-1.03. Configuration Software/Serial Interface. Devices indicated as requiring a serial interface shall be provided with all accessories required to properly communicate over the serial link. As a minimum, an appropriate cable shall be provided to allow the transmitter serial interface to be connected to a personal computer. One licensed copy of the diagnostic/interface software shall be provided for each Owner facility (quantity required shall be as indicated in the Instrumentation and Control System section). Software shall be capable of running under the Windows XP operating system. If the software furnished performs the same functions as the programming device, specified elsewhere, then the programming device shall not be furnished.

2-2. FLOW INSTRUMENTATION.

2-2.01. Differential Pressure Flow Transmitters. Not used.

2-2.02. Magnetic Flowmeters, Signal Converters, and Accessories.

2-2.02.01. Magnetic Flowmeter. The magnetic flowmeter shall be a completely obstructionless, in-line flowmeter with no constrictions in the flow of fluid through the meter. The meter shall consist of a metallic tube with flanged ends and with grounding rings or grounding electrodes as required by the application. Flange diameter and bolt drilling pattern shall comply with ANSI/ASME B16.5 for line sizes from one-half inch to 24 inches or AWWA C207 for line sizes larger than 24 inches. Flange class ratings and meter maximum pressure ratings shall be compatible with the adjoining piping. Flangeless wafer insert style meters may be used for pipe sizes up to 6 inches [150 mm], where compatible with adjacent piping flanges. Self-cleaning electrodes shall be provided for all meters used for sludge metering. Electrode and liner materials shall be fully compatible with the process fluid as approved by the Engineer and shall comply with the requirements specified in the instrument device schedules. Each meter shall be factory wet flow calibrated to the sensors full flow capacity, at a facility, which is traceable to NIST or other standard acceptable to Engineer, and a copy of the calibration, report shall be submitted as part of the operation and maintenance manual submittal.

The meter shall be capable of standing empty for extended periods of time without damage to any components.

The meter housing shall be of a splash-proof and drip-proof design, unless indicated on the drawings or in the Instrument Device Schedule to be submersible. Where required to be submersible, the meter housing shall withstand submergence in 30 feet [9.1 m] of water for 48 hours without damage.

Meters shall be as manufactured by ABB, or Siemens without exception.

2-2.02.02. Magnetic Flowmeter Signal Converters. Separately mounted, microprocessor-based signal converters shall be provided for the magnetic flowmeters. The signal converters shall include output damping, self-testing, built-in calibration capability, and an "empty pipe zero" contact input. The overall accuracy of the magnetic flowmeter transmitter and signal converter shall be ± 0.5 percent of actual flow rate for full-scale settings of 3 to 30 fps [0.91 to 9.14 m/s]. The meter manufacturer shall furnish the signal cable between the converter and the magnetic flowmeter. The signal converter shall be housed in a corrosion-resistant, weatherproof NEMA Type 4X housing and shall be suitable for operation over an ambient temperature range of -30 to +140°F [-34 to +60°C], and relative humidity of 10 to 100 percent. The converter shall have an analog output of 4-20 mA dc. Transmitters tagged on the drawings or specified to be of the indicating type shall contain a local indicator with a minimum four digit LCD type display, scaled to read in engineering units of flow.

Magnetic flowmeter systems shall provide zero flow stability by means of automatic zero adjustment of a DC excited metering circuit. Converters shall be capable of bi-directional flow measurement. Signal converters shall be of the same brand as the magnetic flowmeters.

The signal converter shall be diagnosed and recalibrated with the use of a hand-held communicator/calibrator device. One device shall be furnished for all converters provided by a single manufacturer.

2-2.03. Open Channel Ultrasonic Flow meters. Not used.

2-2.04. Open Channel Admittance Probe Flowmeters. Not used.

2-2.05. Doppler Ultrasonic Flowmeters. Not used.

2-2.06. In-Line Type Ultrasonic Flowmeters (Single Path). Not used.

2-2.07. In-Line Type Ultrasonic Flowmeters (Multi-Path). Not used.

2-2.08. Averaging Pitot Type Flow Elements. Not used.

2-2.09. Thermal Dispersion Flowmeters. Not used.

2-2.10. Propeller Flowmeters. The flowmeter body shall consist of a ductile iron or fabricated steel metering tube with flanged ends having a diameter and drilling conforming to ANSI/ASME B16.1, Class 125. The assembly shall be coated inside and outside with an epoxy or acrylic enamel. The coating shall be suitable for use with potable water. The assembly shall

have an internal flow-straightening vane and a three-blade polypropylene propeller supported on long-life ceramic bearings. The propeller/meter head assembly shall be flanged to allow easy removal from the metering tube.

The flowmeter shall have a local register, which is magnetically coupled to a three bladed conical shaped propeller. The register head shall have a six-digit totalizer. Where tagged on the drawings or specified to be the indicating type, the register shall have a rate-of-flow indicator.

The flowmeter accuracy shall be ± 2 percent of actual rate over a 6 to 1 operating range. The flowmeter shall be Invensys "Model 102", or McCrometer/Water Specialties "Model ML-04".

Where indicated on the drawings or in the Instrument Device Schedule, the flowmeter shall be provided with a signal converter/transmitter that receives a pulse signal from the flowmeter register and transmits an isolated 4-20 mA dc output signal that is proportional to the calibrated flow range. The converter/transmitter shall be integral mounted in a NEMA Type 4X enclosure. Power supply to the converter shall be 24 volts dc, loop power. A separate 120 V ac to DC power supply shall be provided if required to power the loop.

The converter/transmitter shall be a McCrometer/Water Specialties "Model E7000" or "Model TR-16".

2-2.11. Turbine Flowmeters. Not used.

2-2.12. Orifice Plates. Not used.

2-2.13. Differential Pressure Flow Indicators. Not used.

2-2.14. Gas Service Rotameters. Not used.

2-2.15. Liquid Service Rotameters. Not used.

2-2.16. Target-Type Flow Switches. Target-type flow switches shall utilize a vane or paddle type target to actuate the switch. For pipe sizes greater than or equal to 2 inch [50 mm], switches shall have an NPT connection for insertion into the process piping. For pipe sizes less than 2 inches, the flow switch shall be factory installed in a spool piece, suitable for flange or thread mounting in the process piping. Switch wetted components shall be compatible with the process fluid. Switches shall contain at least one non-mercury SPDT contact, rated 5 amp [A] at 120 volts ac. The switch enclosure shall be a minimum NEMA Type 4 housing. Switches shall be factory calibrated to actuate at the specified flow rates for the given pipe size. All flow switches shall be installed in horizontal piping.

Switches shall be Magnetrol, or equal.

2-2.17. Coriolis Mass Flowmeters. Not used.

PART 3 - EXECUTION

3-1. FIELD SERVICES. Manufacturer's field services shall be provided for installation, field calibration, startup, and training as specified in the Instrumentation and Control System section.

Instruments shall not be shipped to the Work Site until two weeks prior to the scheduled installation. The System Supplier shall be responsible for coordinating the installation schedule with the Installation Contractor. Each shipment shall contain a listing of protective measures required to maintain sensor operation, including a listing of any common construction or cleaning chemicals that may affect instrument operation.

End of Section

PRESSURE AND LEVEL INSTRUMENTS

PART 1 - GENERAL

1-1. SCOPE. The Pressure and Level Instruments section covers the furnishing of pressure and level instruments and accessories required for the Instrumentation and Control System as indicated on the drawings.

Equipment and services provided under this section shall be subject to the Instrumentation and Control System section. This section shall be used and referenced only in conjunction with the Instrumentation and Control System section. Supplementing the Instrumentation and Control System section, instrument data, special requirements, and options are indicated on the drawings or the Instrument Device Schedule.

When multiple instruments of a particular type are specified, and each requires different features, the required features are described on the drawings or the Instrument Device Schedule.

1-2. DESIGN CRITERIA. Each device shall be a pre-assembled, packaged unit. Upon delivery to the work site, each device or system shall be ready for installation with only minor piping and electrical connections required by Contractor.

Primary elements shall derive any required power from the transmitter, unless otherwise indicated.

The instruments shall be installed to measure, monitor, or display the specified process at the ranges and service conditions indicated on the drawings or as indicated in the Instrument Device Schedule. The instruments shall be installed at the locations indicated on the drawings or in the Instrument Device Schedule.

Where possible, each instrument shall be factory calibrated to the calibration ranges indicated in the drawings or in the Instrument Device Schedule. Transmitters or similar measurement instruments shall be calibrated using National Institute of Standards and Technology (NIST) approved bench calibration procedures, when such procedures exist for the instrument type. Calibration data shall be stored digitally in each device, including the instrument tag designation indicated on the drawings and/or Instrument Device Schedule.

1-3. SUBMITTALS. Submittals shall be made as specified in the Instrumentation and Control System section.

1-4. SHIPMENT, PROTECTION, AND STORAGE. Equipment provided under this section shall be shipped, protected, and stored in accordance with the requirements of the Instrumentation and Control System section. Identification of packaging shall be as described in the Instrumentation and Control System section.

PART 2 - PRODUCTS

2-1. GENERAL. The following paragraphs provide minimum device stipulations. The drawings or Instrument Device Schedule shall be used to determine any additional instrument options, requirements, or service conditions.

2-1.01. Interconnecting Cable. For systems where the primary element and transmitter are physically separated, interconnecting cable from the element to the transmitter shall be provided. The cable shall be the type approved by the instrument manufacturer for the intended purpose of interfacing the element to the transmitter. Length of cable shall be a minimum of three meters or as indicated in the drawings or Instrument Device Schedule.

2-1.02. Programming Device. For systems that require a dedicated programming device for calibration, maintenance, or troubleshooting, one such programming device shall be provided for each Owner facility (quantity required shall be as indicated in the Instrumentation and Control System section.) The programming device shall include appropriate operation manuals and shall be included in the training requirements. For systems that allow the programming device functions to be implemented in software, running on a laptop computer, the software shall be provided instead of the programming device.

2-1.03. Configuration Software/Serial Interface. Devices indicated as requiring a serial interface shall be provided with all accessories required to properly communicate over the serial link. An appropriate cable shall be provided to allow the transmitter serial interface to be connected to a personal computer. One licensed copy of the diagnostic/interface software shall be provided for each Owner facility (quantity required shall be as indicated in the Instrumentation and Control System section). Software shall be capable of running under Microsoft's Windows 7 operating system. If the software furnished performs the same functions as the programming device, specified elsewhere, then the programming device shall not be furnished.

2-2. PRESSURE AND LEVEL INSTRUMENTATION.

2-2.01. Pressure and Pressure Sensing Level Transmitters. Transmitters shall be an all solid state electronic two-wire device that does not require a direct power connection to the transmitter. Process fluid shall be isolated from the sensing elements by AISI Type 316 stainless steel, Hastelloy-C, ceramic, or cobalt-chromium-nickel alloy diaphragms, and the transducer may use a silicone oil fluid fill. Transmitters shall have self-diagnostics and electronically adjustable span, zero, and damping. Transmitters shall be enclosed in a NEMA Type 4X housing and shall be suitable for operation at temperatures from 0° to 180°F [-17° to +82°C], and relative humidity of 5 to 100 percent. All parts shall be cadmium-plated carbon steel, stainless steel, or other corrosion-resistant materials. Transmitters shall have over-range protection to maximum line pressure. Accuracy of the transmitter shall be 0.075 percent of span, and transmitter output shall be 4-20 mA dc without the need for external load adjustment. Transmitters shall not be damaged by reverse polarity. Transmitters shall have an elevated or suppressed zero. For calibrated spans of less than 8 psig [55 kPa gage] a differential pressure type transmitter with side vents shall be utilized. Transmitters shall be provided with brackets for wall and pipe-stand mounting.

Transmitters shall be factory calibrated to the required range and provided with the manufacturer's standard hand-held communications/calibration device. One device shall be furnished for all transmitters provided by a single manufacturer.

Transmitters tagged on the drawings or specified to be indicating type shall be furnished with LCD type digital indicators.

Transmitters will have a turndown ration of 30:1, or more.

Transmitters shall be Foxboro "Model IGP10-D", Rosemount Model 2051, or Siemens Sitrans P.

2-2.02. Premium Accuracy Pressure and Pressure Sensing Level Transmitters. Not used.

2-2.03. Differential Pressure Transmitters. Not used.

2-2.04. Premium Accuracy Differential Pressure Transmitters. Not used.

2-2.05. Flange-Mounted Pressure Sensing Level Transmitters. Not used.

2-2.06. Ultrasonic Level Transmitters. Each ultrasonic level transmitter shall be a microprocessor-based electronic unit consisting of a sensor assembly, a signal converter/transmitter, and an interconnecting cable. The sensor shall be encapsulated in a chemical and corrosion-resistant material such as kynar or CPVC, and shall be suitable for operation over a temperature range of -20° to +150°F [-28° to +66°C] and a relative humidity of 10 to 100 percent. The sensor shall be compatible with the process media being measured. Where indicated on the drawings or in the Instrument Device Schedule, the sensor shall be an explosion-proof or intrinsically safe design suitable for use in all hazardous areas. Sensors mounted in areas subject to freezing shall be provided with special transducers or protected against icing by heaters. Sensors mounted in direct sunlight shall be provided with sunshades.

The supplier shall coordinate the sensor mounting requirements and furnish drawings complete with dimensions and elevations. General installation requirements are indicated on the drawings.

The ultrasonic level transmitter shall have automatic compensation for changes in air temperature at the sensor location. If separate temperature sensing probes are provided, they shall be mounted with or adjacent to the ultrasonic sensor, as recommended by the manufacturer. The transmitter shall have a four-digit LCD display scaled to read in engineering units. Digit height shall be approximately 1/2 inch [12 mm]. The transmitter shall be designed to ignore momentary level spikes, false targets, or momentary loss-of-echo. A loss-of-echo condition shall be indicated on the transmitter unit and shall be available as an alarm contact output. The transmitter output shall be an isolated 4-20 mA dc signal linearly proportional to the measured level range, or where indicated on the drawings or in the Instrument Device Schedule, shall be characterized to be proportional to the tank volume. Calibration parameters shall be entered through a keypad on the unit and shall be stored in nonvolatile EEPROM memory. Accuracy of the transmitted signal shall be ±0.5 percent of the level range.

A sufficient length of sensor-to-transmitter signal cable shall be furnished with the instrument to locate the sensor 25 to 200 feet [7.6 to 61 m] from the signal converter.

For indoor installation, the signal converter electronics shall be housed in a NEMA Type 12 enclosure suitable for wall or pipestand mounting and for operating temperatures of +30° to +120°F [-1° to +49°C].

For outdoor installation, the signal converter electronics shall be housed in a weatherproof, corrosion-resistant NEMA Type 4 enclosure suitable for wall or pipestand mounting and for operating temperatures of -15° to +125°F [-26° to +51°C] and a relative humidity of 10 to 100 percent. A thermostatically controlled strip heater shall be provided in the signal converter enclosure.

The signal converter shall be of the ac-powered type. The ultrasonic level transmitter shall be Siemens HydroRanger 200 without exception.

2-2.07. Admittance Probe Level Transmitters. Not used.

2-2.08. Submersible Pressure Sensing Level Transmitters. The level transmitter system shall consist of a submersible pressure sensor/transmitter unit that is suitable for direct submersion into the liquid being measured. Sensor size shall not exceed 1-1/4 inch [32 mm] diameter by 9-inch [225 mm] length. The sensor shall be a solid-state variable capacitance or diffused silicon semiconductor type that shall provide an output signal directly proportional to the sensed pressure over a factory-calibrated range. The sensor assembly shall have a stainless steel or titanium housing and shall be supported by a polyethylene or urethane jacketed cable with a minimum 200 lb [90.7 kg] test strength. The System Supplier shall determine the static water level elevation of the well and the grade elevation of the downtube on the well pump base and utilize this information such that the sensor cable shall be of sufficient length so that no splice or connector is required in the wet or inaccessible area, and the vent tube termination point is located in an area protected from dirt and moisture.

The transmitter shall have a two-wire type 4-20 mA dc current output that is proportional to level. The output shall have surge protection, and shall not be damaged by reverse polarity. The transmitter shall be suitable for an operating temperature range of 0° to +50°C. Accuracy of the level transmitter shall be ±0.25 percent "best straight line", with an overall combined accuracy of ±1 percent over the entire operating temperature/pressure range.

Submersible pressure sensing level transmitters shall be In-Situ Model PXD-261 without exception.

2-2.09. Bubbler System Components. Not used.

2-2.10. Fixed-Mount Float Type Level Switches. Not used.

2-2.11. Weighted Float Type Level Switches. Each level switch shall consist of a single-pole, double-throw mercury switch, rated not less than 3 amp [A] ac, sealed and housed in a chemical-resistant polypropylene casing. The switch assembly shall be weighted and suspended on a waterproof, three-conductor, synthetic covered flexible cable with 19 AWG [0.5 mm²] conductors and of such length that no splice or junction box is required in the wet well. Switches shall be suitable for operation at up to 150 V ac within an ambient temperature range of 0 to 60°C. Switches shall be suitable for use in a sanitary wastewater wet well. Adjustable mounting hardware shall be provided for supporting each level switch. Switches shall be B/W Controls "Series 7010", U.S. Filter Control Systems "Model LSC", Flygt "Type ENM-10", or Warrick Controls "Series M".

2-2.12. Adjustable Deadband Float Type Level Switches. Not used.

2-2.13. Electrode/Conductance Relay Level Switches. Not used.

2-2.14. Flange-Mounted Displacement Float Type Level Switches. Not used.

2-2.15. Pressure Switches. Pressure switches shall be diaphragm actuated type switches. Switches shall be field adjustable type, with trip point repeatability better than 1 percent of actual pressure. Switches shall have over-range protection to maximum process line pressure. Switches mounted inside panels shall have NEMA Type1 housings. All other switches shall have weatherproof housings. Switches shall be differential type where indicated in the Instrument Device Schedule. Switch wetted parts shall be compatible with the process fluid. Where the process is not defined, all wetted parts shall be Teflon-coated or viton and the connection port shall be stainless steel.

Panel-mounted and surface-mounted switches shall be provided with 1/4 inch [6 mm] NPT connections. All stem-mounted switches shall be provided with 1/2 inch [12 mm] NPT connections.

All pressure switches shall be ranged in psi [kPa] and all vacuum switches in inches [mm] of water. Unless otherwise indicated, switches shall have a fixed deadband and shall be auto-reset type. As a minimum, switches shall be SPDT, rated 10 amp [A] at 120 V ac.

Each switch shall be provided with a threaded end, ball-type shutoff valve. Shutoff valve materials shall be compatible with the process fluid. Where the process is not specified, valves shall have AISI Type 316 stainless steel wetted parts and Teflon seals. Multi-port valves shall have all unused ports plugged. Shutoff valve construction shall be as detailed in Section 13565.

Where indicated on the drawings or in the Instrument Device Schedule, the switch shall be provided with a pressure snubber. Each snubber shall be of a size and pressure range compatible with the switch served. Snubbers shall be Ashcroft "Pulsation Dampers", or approved equal.

Where indicated on the drawings or in the Instrument Device Schedule, a diaphragm seal shall be provided for the respective switch. Diaphragm seals shall be thread-attached type with removable AISI Type 316 stainless steel diaphragm, zinc or cadmium plated carbon steel upper housing, and stainless steel lower housing. The upper housing shall be contoured to fit and provide a seat and seal for the diaphragm and shall be designed to permit removal of the switch with the system under pressure. The lower housing shall be provided with a tapped and plugged 1/4 inch [6 mm] NPT flushing connection. Each diaphragm seal and the switch served shall be factory assembled, filled with a suitable fluid, and calibrated as a unit.

Switches shall be installed at the locations indicated on the drawings, with installation conforming to the installation details. All switches, snubbers, and diaphragm seals shall be installed in the vertical, upright position. Thread sealer, suitable for use with the associated process, shall be used in the assembly of threaded connections. All connections shall be free from leaks. Lines shall be purged of trapped air at switch locations prior to installation of the switch or diaphragm seal.

Switches shall be manufactured by Ashcroft, Barksdale, NeoDyn, Mercoid Controls, or S.O.R.

2-2.16. Flood Level Switches. Not used.

2-2.17. Ultrasonic Level Switches. Not used.

2-2.18. Field-Mount Pressure Gauges. Pressure gauges shall be of the indicating dial type, with C-type phosphor bronze Bourdon tube; stainless steel rotary geared movement; phenolic or polypropylene open front turret case; adjustable pointer; stainless steel, phenolic, or polypropylene ring; and acrylic plastic or shatterproof glass window.

Gauge dial shall be 4-1/2 inch [114 mm] size, with white background and black markings. The units of measurement shall be indicated on the dial face. Subdivisions of the scale shall conform to the requirements of the governing standard. Pointer travel shall be not less than 200 degrees or more than 270 degrees of arc.

Surface-mounted gauges shall be provided with 1/4 inch [6 mm] NPT connections. All stem-mounted gauges shall be provided with 1/2 inch [12 mm] NPT connections. Where indicated in the drawings or on the Instrument Device Schedule, stem mounted gauges shall have an adjustable viewing angle to allow the gauge to be positioned for optimum viewing.

All pressure gauges shall measure in psi [kPa] and all vacuum gauges in inches [mm] water. All gauges shall have a suitable range to give mid-scale readings under normal conditions. Gauge accuracy shall be 0.5 percent of scale range.

Each gauge shall be provided with a threaded end, ball-type gauge valve. Gauge valve materials shall be compatible with the measured process. Where the process is not defined, gauge valves shall have AISI Type 316 stainless steel wetted parts and Teflon seals. Multi-port gauge valves shall have all unused ports plugged. Gauge valve construction shall be as detailed in Section 13565.

Where indicated on the drawings or the Instrument Device Schedule, the pressure gauge shall be provided with a pressure snubber. Each snubber shall be of a size and pressure range compatible with the gauge served. Snubbers shall be Ashcroft "Pulsation Dampers", or approved equal.

Gauges shall be installed at the locations indicated on the drawings, with installation conforming to the installation details. All gauges, snubbers, and diaphragm seals shall be installed in the vertical, upright position. Thread sealer, suitable for use with the associated process, shall be used in the assembly of threaded connections. All connections shall be free from leaks. Lines shall be purged of trapped air at gauge locations prior to installation of the gauge or diaphragm seal.

Each gauge shall be provided with all required mounting hardware to securely mount the unit according to the mounting requirements indicated in the drawings or the Instrument Device Schedule.

Unless otherwise indicated, mounting and installation hardware shall be Type 316L stainless steel.

Pressure gauges shall be Ashcroft "1279 Duragauge", or equal.

2-2.19. Annular Type Pressure Sensors. Not Used.

PART 3 - EXECUTION

3-1. FIELD SERVICES. Manufacturer's field services shall be provided for installation, field calibration, startup, and training as specified in the Instrumentation and Control System section.

Instruments shall not be shipped to the Work Site until two weeks prior to the scheduled installation. System Supplier shall be responsible for coordinating the installation schedule with the Installation Contractor. Each shipment shall contain a listing of protective measures required to maintain sensor operation, including a listing of any common construction or cleaning chemicals that may affect instrument operation.

End of Section

MISCELLANEOUS INSTRUMENTS

PART 1 - GENERAL

1-1. SCOPE. The Miscellaneous Instruments section covers the furnishing of all miscellaneous instruments and accessories required for the Instrumentation and Control System as indicated on the drawings.

Equipment and services provided under this section shall be subject to the Instrumentation and Control System section. This section shall be used and referenced only in conjunction with the Instrumentation and Control System section. Supplementing the Instrumentation and Control System section, instrument data, special requirements, and options are indicated on the drawings or the Instrument Device Schedule.

When multiple miscellaneous instruments of a particular type are indicated, and each requires different selectable features, the required features are described on the drawings or in Instrument Device Schedule.

1-2. DESIGN CRITERIA. Each device shall be a pre-assembled, packaged unit. Upon delivery to the work site, each device or system shall be ready for installation with only minor piping and electrical connections required by System Supplier.

Primary elements shall derive any required power from the transmitter, unless otherwise indicated.

The instruments shall be installed to measure, monitor, or display the specified process at the ranges and service conditions indicated on the drawings or as indicated in the Instrument Device Schedule. The instruments shall be installed at the locations indicated on the drawings or the Instrument Device Schedule.

Where possible, each instrument shall be factory calibrated to the calibration ranges indicated in the Instrument Device Schedule. Transmitters or similar measurement instruments shall be calibrated using National Institute of Standards and Technology (NIST) approved bench calibration procedures, when such procedures exist for the instrument type. Calibration data shall be stored digitally in each device, including the instrument tag designation indicated on the Instrument Device Schedule.

1-3. SUBMITTALS. Submittals shall be made as specified in Instrumentation and Control System section.

1-4. SHIPMENT, PROTECTION, AND STORAGE. Equipment provided under this section shall be shipped, protected, and stored as specified in the Instrumentation and Control System section. Identification of packaging shall be as described in the Instrumentation and Control System section.

PART 2 - PRODUCTS

2-1. GENERAL. The following paragraphs provide minimum device stipulations. The Instrument Device Schedule shall be used to determine any additional instrument options, requirements, or service conditions.

2-1.01. Interconnecting Cable. For systems where the primary element and transmitter are physically separated, interconnecting cable from the element to the transmitter shall be provided. The cable shall be the type approved by the instrument manufacturer for the intended purpose of interfacing the element to the transmitter. Length of cable shall be a minimum of three meters or as indicated in the Instrument Device Schedule.

2-1.02. Programming Device. For instruments that require a dedicated programming device for calibration, maintenance, or troubleshooting, one such programming device shall be provided for each Owner facility (quantity required shall be as indicated in the Instrumentation and Control System section). The programming device shall include appropriate operation manuals and shall be included in the training requirements. For systems that allow the programming device functions to be implemented in software, running on a laptop computer, the software shall be provided instead of the programming device.

2-1.03. Configuration Software/Serial Interface. Devices indicated as requiring a serial interface shall be provided with all accessories required to properly communicate over the serial link. An appropriate cable shall be provided to allow the transmitter serial interface to be connected to a personal computer. One licensed copy of the diagnostic/interface software shall be provided for each Owner facility (quantity required shall be as indicated in the Instrumentation and Control System section). Software shall be capable of running under Microsoft's Windows 7 operating system. If the software furnished performs the same functions as the programming device, specified elsewhere, then the programming device shall not be furnished.

2-2. MISCELLANEOUS INSTRUMENTS.

2-2.01. Resistance Temperature Detectors. Not used.

2-2.02. Resistance Temperature Transmitters. Not used.

2-2.03. Temperature Switches. Not used.

2-2.04. Temperature Gauges. Not used.

2-2.05. Field-Mounted Process Indicators. Not used.

2-2.06. Milliamp Calibrator. Not used.

2-2.07. Pressure Calibrator. Not used.

2-2.08. Multi-function Instrument Calibrator. The calibrator shall be Fluke Model 744. The calibrator shall be equipped with 30 PSI Gauge Pressure Module, 100 PSI Gauge Pressure Module, Differential Pressure Module, Surface Temperature Probe, Hart capability, and carrying case without exception.

2-2.09. Manometer. Not used.

2-2.10. Proximity Switches.

2-2.10.01. Door Proximity Switches. The switches shall be magnetic proximity type, consisting of two sensors. One sensor shall be fixed to the door and the other to the door frame. The sensor mounted to the door shall have no electrical connections. Switches shall be provided with DPDT contacts rated 5 amperes at the voltage being switched. All necessary mounting hardware shall be provided to allow both the sensors to be installed at the locations indicated on the drawings.

2-2.11. Vibration Switches. Not used.

2-2.12. Instrument Shutoff Valves. Instrument shutoff valves shall be provided for instruments as indicated on the drawings and as detailed in the specifications. The indicated shutoff valves shall be provided by System Supplier for all instruments furnished under the Instrumentation and Control System section, the Panel Mounted Instruments section, the Flow Instruments section, the Pressure and Level Instruments section, the Analytical Instruments section, and the Miscellaneous Instruments section.. Shutoff valves shall be compatible with the measured process and shall be selected in accordance with the manufacturer's recommendations for the specified process. Unused ports of multi-port gauge valves shall be plugged. An instrument shutoff valve schedule shall be submitted indicating the quantity, material, size, and associated instrument. Permanent tagging of the instrument valves is not required; however, temporary hand-written tags or other means of identification shall be provided to ensure that the appropriate valve is installed for a given instrument.

Instrument shutoff valves shall be D/A Manufacturing, Anderson-Greenwood, or equal.

2-2.13. Limit Switches. Not used.

2-2.14. Modulating Valve Positioners. Not used.

2-2.15. Current-to-Pressure Transducers. Not used.

2-2.16. Valve Position Transmitters. Not used.

PART 3 - EXECUTION

3-1. FIELD SERVICES. Manufacturer's field services shall be provided for installation, field calibration, startup, and training as specified in the Instrumentation and Control System section.

Instruments shall not be shipped to the Work Site until two weeks prior to the scheduled installation. The System Supplier shall be responsible for coordinating the installation schedule with the Contractor. Each shipment shall contain a listing of protective measures required to maintain sensor operation, including a listing of any common construction or cleaning chemicals that may affect instrument operation.

End of Section

PANELS, CONSOLES, AND APPURTENANCES

PART 1 - GENERAL

1-1. SCOPE. The Panels, Consoles and Appurtenances section covers the furnishing of panels, consoles, and appurtenances as indicated on the drawings.

1-1.01. Control System. The Instrumentation and Control System section shall apply to all equipment furnished under the Panels, Consoles and Appurtenances section.

1-2. GENERAL. Equipment furnished and installed under this section shall be fabricated and assembled in full conformity with the drawings, specifications, engineering data, instructions, and recommendations of the equipment manufacturer, unless exceptions are noted by Engineer.

1-2.01. General Equipment Stipulations. The General Equipment Stipulations shall apply to all equipment and materials provided under this section. If requirements in this specification differ from those in the General Equipment Stipulations, the requirements specified herein shall take precedence.

1-2.02. Drawings. General dimensions and arrangements are indicated on the drawings. System Supplier shall be responsible for coordinating the console and enclosure sizes and arrangements to accommodate the equipment provided.

1-3. SUBMITTALS. Submittals shall be made as specified in the Instrumentation and Control System section.

1-4. DELIVERY, STORAGE, AND SHIPPING. Delivery, storage and shipping shall be as per The Instrumentation and Control System section.

1-5. SPARE PARTS. Spare parts shall be provided in a quantity of 10 percent of fuses, terminal components, relays, relay bases, lamps, switches, and other replaceable components.

PART 2 - PRODUCTS

2-1. PANEL DESIGN AND FABRICATION FEATURES. All panels furnished shall conform to the stipulations of NEMA ICS-6-1993. Unless indicated otherwise on the drawings, the following paragraphs describe general fabrication specifications for the PLC cabinets, instrument panels, consoles, enclosures, and subpanels.

2-1.01. Piping. Pneumatic tubing shall be 1/4 inch [6 mm] OD, soft annealed copper with compression fittings. Tubing and fittings shall be as specified in the Miscellaneous Piping section.

2-1.01.01. Fittings. Compression type bulkhead fittings shall be provided near the bottom or the top of the panel for all field connections. Compression nuts and sleeves shall be provided for the

field connections. Indicators, recorders, controllers, and other pneumatic devices shall be provided with plugged test connections and shutoff valves for isolation.

2-1.01.02. Valves. All devices shall have separate air supply shutoff valves. Valves and compression fittings shall be as manufactured by Nupro, Parker Hannifin, Swagelock, Tylok, or Whitey.

2-1.02. Power Entrance. The power entrance to each panel shall be provided with a surge protection device. Surge protectors shall be nominal 120 volts ac with a nominal clamping voltage of 200 volts. Surge protectors shall be of a nonfaulting and noninterrupting design, with a response time of not more than 5 nanoseconds. Surge protectors shall be Innovative Technology "PTX 080-1P101", Power Integrity Corporation "ZTAS-30", or Transtector "ACP 100 BW3".

2-1.03. Power Wiring. Power distribution wiring on the line side of panel fuses shall be minimum 12 AWG. Secondary power distribution wiring shall be minimum 14 AWG. Wiring for ac power distribution, dc power distribution, and control circuits shall have different colors and shall agree with the color-coding legend on System Supplier's panel wiring diagrams. With the exception of electronic circuits, all interconnecting wiring and wiring to terminals for external connection shall be stranded copper, insulated for not less than 600 volts, with a moisture resistant and flame retardant covering rated for not less than 90°C.

2-1.04. Instrument and Control Wiring. All internal panel wiring shall be type MTW stranded copper wiring rated not less than 600 volts. Electronic analog circuits shall be twisted and shielded pairs rated not less than 300 volts. Analog circuits shall be separated from ac power circuits. Wires within the panel shall conform to the minimum size as shown in the table below for Well 7 and 8.

Type	Min. Wire Size	Color
AC Control	16 AWG	Red
DC Control	16 AWG	Blue
Analog Circuits	18 AWG Twisted Pair	

Wires within the panel shall conform to the minimum size as shown in the table below for the Reclaimed Pump Station.

Type	Min. Wire Size	Color
AC Control	16 AWG	Black
DC 24 Volt Control	16 AWG	Blue DC +
DC 12 Volt Control	16 AWG	Red DC +
DC Negative	16 AWG	Grey DC -
Neutral	16 AWG	White
Analog Circuits	18 AWG Twisted Pair	
Ground	16 AWG	Green

All wiring shall be grouped or cabled and firmly supported inside the panel. Each individual wire in power, control, and instrumentation circuits shall be provided with identification markers at each point of termination. The wire markers shall be positioned to be readily visible for

inspection and the identification numbers shall match the identification on the supplier's panel wiring drawings. Wiring shall be bundled in groups and bound with nylon cable ties or routed in Panduit or similar nonmetallic slotted ducts. Ducts shall be readily accessible within the panel, with removable covers, and with space equal to at least 40 percent of the depth of the duct remaining available for future use after completion of installation and field wiring. Sufficient space shall be provided between cable groups or ducts and terminal blocks for easy installation or removal of cables.

2-1.05. Terminal Blocks. Terminal blocks for external connections shall be suitable for 12 AWG wire and shall be rated 30 amperes at not less than 300 volts. Terminal blocks shall be fabricated complete with marking strip, covers, and pressure connectors. Terminals shall be labeled to agree with identification shown on the supplier's submittal drawings. A terminal shall be provided for each conductor of external circuits, plus one ground for each shielded cable. Not less than 8 inches of clearance shall be provided between the terminal strips and the base of vertical panels for conduit and wiring space. Not less than 25 percent spare terminals shall be provided. Each control loop or system shall be individually fused, and all fuses or circuit breakers shall be clearly labeled and located for easy maintenance.

2-1.06. Device Tag Numbering System. All devices shall be provided with permanent identification tags. The tag numbers shall agree with the Instrument Device Schedule and with the supplier's equipment drawings. All field-mounted transmitters and devices shall have stamped stainless steel identification tags. Panel, subpanel, and rack-mounted devices shall have laminated phenolic identification tags securely fastened to the device. Hand-lettered labels or tape labels will not be permitted.

2-1.07. Nameplates. Nameplates shall be provided on the face of the panel or on the individual device. Panel nameplates shall have approximate dimensions and legends, as indicated on the drawings, and shall be made of laminated phenolic material having engraved letters approximately 3/16 inch [5 mm] high extending through the black face into the white layer. Nameplates shall be secured firmly to the panel. Panel face nameplates do not replace the requirement for device identification tags as specified under the Device Tag Numbering System paragraph.

2-1.08. Painting. Interior and exterior surfaces of all non-stainless steel, metal panels shall be thoroughly cleaned and painted with rust inhibitive (universal) primer. The panel interior shall be painted white with the manufacturer's standard coating. All pits and blemishes in the exterior surface shall be filled. Exterior surfaces shall be painted with one or more finish coats of the manufacturer's standard coating. Finish coats shall have a dry film thickness of at least 4 mils [100 µm]. Color samples shall be submitted to Engineer for color selection. One quart [1 liter] of paint shall be furnished with the panels for future touchup painting.

2-1.09. Factory Test. Panels shall be factory tested electrically and pneumatically by the panel fabricator before shipment.

2-2. FREESTANDING VERTICAL PANELS. The following paragraphs specify the freestanding vertical panels:

2-2.01. Construction. Panel construction shall be an indoor, dusttight, completely enclosed cubicle formed from steel structural members and steel plates. The base shall be formed of steel

channels, with flanges extending upwards. The base shall be provided with 1/2 inch [12.5 mm] diameter holes at 12 inch [300 mm] centers so that the base can be bolted to the concrete equipment base. Welds, seams, and edges on all exposed surfaces shall be ground smooth. Suitable lifting facilities shall be provided for handling and shipment.

2-2.02. Structure. Panel structure shall be suitably braced and of sufficient strength to support all equipment mounted on or within, to withstand handling and shipment, to remain in proper alignment, and to be rigid and freestanding. Top, sides, and back shall be fabricated from USS 10 gage [3.42 mm thick] or heavier carbon steel sheets, with stationary back suitable for back to wall installation, or designed for rear access with hinged back doors. Doors shall not be greater than 24 inches [600 mm] wide or spaced not greater than 36 inches [900 mm] center to center. Rear access doors shall be fabricated from USS 14 gage [1.9 mm thick] or heavier carbon steel.

2-2.03. Panel Front. The front shall be a hinged door, or doors, with mounted instruments and control devices, fabricated from USS 10 gage [3.42 mm thick] carbon steel sheet and suitably braced and supported to maintain alignment. Panels with hinged fronts shall be of sufficient width to permit door opening without interference with rear projection of flush mounted instruments.

2-2.04. Doors. Doors shall be essentially full height, having turned back edges and additional bracing to ensure rigidity and prevent sagging. Doors shall be mounted with strong, continuous, piano type hinges. Positive latches, acting from a common door handle, shall hold doors securely compressed at top, side, and bottom against rubber gaskets.

2-2.05. Mounted Instruments. The front shall be a hinged door, or doors, with mounted instruments and control devices, fabricated from 3/16 inch [5 mm] carbon steel plate. Panel fronts shall be suitably reinforced between mounting cutouts and drilling to support instruments and devices without deformation and shall be free from waves and other imperfections, Panel fronts shall be recessed at the base. Adjoining panel sections shall be accurately shop fitted to assure satisfactory assembly in the field.

2-2.05.01. Instrument Arrangement. Panel instruments and control devices, such as HMI Operator Workstation LCD panel and associated keyboard/mouse shall be arranged in a logical configuration for the Operators.

2-2.06. Conduit Entrance. The bottom shall be open, and components shall be arranged for external wiring conduit and piping to enter from below. The top shall be provided with nominal 1 square foot [0.09 m³] removable access plates, which may be drilled to accommodate external wiring and conduit to be installed from above.

2-2.07. Size and Arrangement. Panel dimensions and general instrument arrangement shall be as indicated on the drawings.

2-2.08. Interior Lighting. Illumination of panel interiors shall be provided by ceiling mounted lamp fixtures spaced at approximately 2'-6" [760 mm] and near the door. Fixtures shall be 100 watt, incandescent or fluorescent tube type, with a common "On-Off" switch near each end door. Duplex-grounded receptacles shall be provided for service and maintenance tools at spacing not greater than 5 feet [1.52 m] throughout the length of a panel. The lighting and

receptacle circuit shall be fused separately from the instrumentation systems and need not be UPS-backed.

2-3. FILTER CONSOLES. Not used.

2-4. WALL-MOUNTED CABINETS. Cabinets, which contain the system components indicated on the drawings, shall be NEMA Type 12, 3R, 4, or 4X enclosures, suitable for wall mounting. The enclosures shall be fabricated from USS 14 gage [1.9 mm thick], or heavier, carbon steel, stainless steel, or fiberglass. Cabinets shall be equipped with full size gasketed doors with hinges and a chromium-plated or stainless steel three-point latch. A screened vent shall be provided in the bottom of enclosures that contain pneumatic devices.

All wall-mounted cabinets shall meet the requirements of the panel fabrication paragraph of this section.

2-5. FIBER OPTIC TERMINATION CABINETS (FOTC). Fiber optic termination cabinets (also commonly referred to as patch panels) shall be furnished to terminate fibers at the Fiber Optic Modules, and any other data highway attached equipment. The cabinets shall meet the following requirements:

- a. The termination cabinet shall be the wall mounted type, having provisions for terminating multiple fiber optic cables. Splice trays, strain relief cable attachment points, fiber organizers and bend radius hardware shall be furnished with each termination cabinet.
- b. Panel size shall be suited to the number of fibers to be terminated within the cabinet. Bayonet/flanged couplings shall be furnished and mounted for each fiber to be terminated.
- c. Fiber terminations shall be spliced to pigtail cables (specified below) having ST connectors. The pigtails shall be terminated in an orderly method.

2-6. FREE STANDING EIA 19-INCH RACK ENCLOSURES. Not used.

2-7. DATA SERVER ENCLOSURES. Not used.

2-8. WALL MOUNTED INSTRUMENT SUBPANELS. Instrument subpanels shall be constructed from 1/8 inch [3.2 mm] thick carbon steel and shall be reinforced and braced to form a rigid assembly. Panels designed for wall mounting shall have 1 inch [25 mm] turned back edges and a minimum 2 inch [51 mm] air space between the panel and the wall surface. All components on wall-mounted panels shall be mounted so as to be easily removable without requiring rear access to the subpanel.

2-9. CONTROL SYSTEM CONSOLES AND ENCLOSURES. Not used.

2-10. CONTROL SYSTEM FURNITURE. Not used.

2-11. PANEL MOUNTED UNINTERRUPTIBLE POWER SUPPLY. A UPS shall be furnished to provide power to the PLC and other critical devices within the control panels. A UPS shall be furnished in the control panel. The UPS shall be of a design that the inverter is a

double conversion (continuous service) and that no switching transients occur in the event of input power failure. The system shall convert incoming single phase, 60 Hz, power into dc power, maintain and charge backup batteries and reconvert outgoing power into a sinusoidal single phase, 60 Hz, ac power source. The system shall consist of a rectifier, battery charger, batteries, inverter, and maintenance bypass switch. Additional accessories and appurtenances shall be provided as specified herein and as required to provide a complete and properly operating system.

The contractor shall furnish a report certifying that the UPS will provide the required backup time (20 minutes) at the specified UPS loading and UPS ambient temperature. The report shall include anticipated continuous electrical load calculations, backup time calculations and shall indicate the battery end-voltage used in the analysis.

The UPS system shall conform to the following standards and features.

Capacity	As required to power the loads within the control panel plus 30%.
Capacity, peak (minimum)	150 percent of continuous power rating for 10 seconds.
Frequency stability, battery mode	±0.5 percent.
Harmonic distortion (max)	5 percent.
Efficiency, overall on-line	75 percent minimum.
Operating temperature-humidity	40 to 90°F; 0 to 95 percent relative humidity, non-condensing.
Recharge time (max)	4 hours.
Input Voltage at 60Hz +10 - 120 15 percent	
Output Voltage at 60Hz AC	120

All systems supplied under this contract shall be of the same Manufacturer. The uninterruptible power supply systems shall be as manufactured by MGE, Eaton, Powerware, Liebert, or equal.

Wiring for external circuits, including all alarm contacts, shall be brought to grouped terminal blocks located for convenient connection. Provisions shall include suitable marked terminal blocks for connection of 4.0 mm² control wiring. Terminal designations shall agree with manufacturer's wiring diagram.

The battery charger and the rectifier shall have the following characteristics:

- a. The rectifier shall convert the incoming ac power to dc power to energize the static inverter.
- b. The battery charger shall supply a float current to the batteries to maintain them at a fully charged state while incoming power is being provided. The charging voltage shall be temperature-compensated over the entire operating temperature range to avoid overcharging or undercharging the batteries. The battery charger shall automatically apply an elevated voltage (equalization charge) to the batteries if and as required by the battery manufacturer.
- c. The batteries shall provide backup power for the UPS when

incoming commercial power is not available. The batteries shall be valve-regulated or gelled-electrolyte lead-acid type. The batteries shall be integral to the UPS. Batteries shall have capacity to supply the dc power to the UPS while operating at full load for a period of not less than as required at 75 F. The batteries shall have an expected life of 5 years and shall carry a one-year warranty.

The solid-state inverter shall employ silicon-controlled rectifiers (SCRs) and other devices for converting direct current power to essentially sinusoidal alternating current power. The static inverter shall conform to the following characteristics and requirements.

- a. Automatic Synchronization: During normal operation, the inverter shall provide power to critical loads. The utility electric system will act as an alternate supply. Inverter equipment shall include stable solid-state devices designed to automatically maintain inverter output in phase with the utility electric system.
- b. Overload, Short Circuit, and Load Loss: The inverter shall have input and output fuses and other equipment necessary to protect from overload, short circuit, and 100 percent loss of load. Current limiting features shall also be provided.
- c. Loss of Supply Voltages: The inverter shall include protective devices to prevent damage resulting from excursion, loss, or restoration of its synchronization voltage and its dc input voltage and any inrush current occurrences associated with such conditions.

Controls, indicators and alarms shall be provided as a part of the UPS. Control buttons and LED indicators shall be provided on the UPS panel and shall be permanently labeled. A dc battery circuit breaker, a mode selector switch, and system "ON" and "OFF" buttons shall be provided. A digital display for selection and indication of input, output, and battery voltages shall be provided. LED indicators for inverter ready, frequency, battery voltage, overload, over temperature, and impending shutdown conditions shall be provided.

The UPS shall have the following provisions for remote alarms. A dry, alarm contact rated 3 amperes at 120 volts ac shall be provided with the UPS for indication of general alarm. The contact shall close under any UPS fault condition. A second dry, alarm contact rated 3 amperes at 120 volts ac shall be provided with the UPS for indication of UPS Low Battery. A relay shall also be provided and connected across the incoming power to the control panel as the means of providing a contact for indication of a power failure condition.

2-11.01 Reclaimed Pump Station – A maintenance bypass switch shall be provided for the Reclaimed Pump Station so maintenance can be performed on the UPS without disrupting control system operation. The bypass switch shall be independent of the UPS electronics. A dry contact shall be provided rated at 3 amperes at 120 vac to indicate the UPS is bypassed. The maintenance bypass switch shall be the Eaton BPE01MBB1A or approved equal.

PART 3 - EXECUTION

3-1. GENERAL INSTALLATION REQUIREMENTS. Installation requirements are specified in the Instrumentation and Control System section. In addition, equipment furnished under this section shall conform to the following manufacturing stipulations.

3-1.01. Piping. All tubing shall be run in horizontal and vertical planes and shall be rigidly supported to withstand handling and shipment. Flexible polyethylene tubing shall be used to connect devices mounted on hinged doors.

3-1.02. Wiring. All wiring shall be grouped or cabled and firmly supported inside the panel. Wiring shall be bundled in groups and routed in Panduit or similar nonmetallic slotted ducts. Ducts shall be readily accessible within the panel with removable covers and shall have a space of at least 40 percent of the depth of the duct available for future use after installation is complete and all field wiring installed. Sufficient space shall be provided between cable groups or ducts and terminal blocks for easy installation or removal of cables.

3-1.03. More Than One Panel. Where signal or loop wiring must be routed to more than one panel or device, the required circuit routing shall be as indicated on the one-line diagrams. The panel fabricator shall provide such additional circuits as may be indicated on the electrical schematic drawings.

End of Section

Equipment Schedule 13570-S01

FREESTANDING VERTICAL PANELS

1.000	General					
1.010	Specification Section 13570					
2.000	Freestanding Vertical Panels					
2.010	Tag Number	RWPS- PLC				
2.020	Structure					
	Back to wall	X				
	Hinged rear doors					
	24 inches wide					
	36 inches center to center					
	Hinged front door with Operator Interface	X				
	Fixed front					
	Recessed base					
2.030	Conduit entrance					
	Bottom open					
	Removable top plates	X				
3.000	Exceptions, Clarifications, and Comments					
3.010	Size to fit equipment	X				

Equipment Schedule 13570-S02

Wall Mounted Cabinets

1.000	General							
1.010	Specification Section 13570							
2.000	Wall Mounted Cabinets							
2.010	Tag Number/Panel ID	10-PLC-7	10-PLC-8	90-PLC-1				
2.020	NEMA type enclosure							
	12							
	3R							
	4							
	4X	X	X	X				
2.030	Materials							
	Carbon steel							
	Stainless steel	X	X	X				
	Fiberglass polyester							
2.040	Required environmental controls							
	Sun shade							
	Cooling fan							
	Air conditioned							
3.000	Exceptions, Clarifications, and Comments							
3.010	36"L x 60"H x 16"D, Size to fit equipment	X						
	48"L x 60"H x 20"D		X					

NETWORK SYSTEMS

PART 1 - GENERAL

1-1. SCOPE. The Networks Systems section covers the furnishing of all hardware and software for network systems for the Computer Control System. Principal components of the network systems shall be as indicated on the block diagram drawings and as described below.

System Supplier shall furnish all necessary equipment, interconnecting cables, accessories, and appurtenances for proper network operation and to meet the functional requirements indicated on the drawings and specified herein. Configuration of all hardware shall be provided by the System Supplier.

Equipment and services provided under this section shall be subject to the general requirements specified in the Instrumentation and Control System section. Supplementing this section, network data, special requirements, and options may be indicated on the drawings.

The Owner is supplying and configuring any new routers.

1-1.01. Control System. The Instrumentation and Control System section shall apply to all systems described in this section. All applicable requirements specified in the Instrumentation and Control System section shall apply to equipment and services provided under this section.

1-1.02. Network Functional Description. The network system shall provide communications between the operator workstations, servers, and PLCs.

1-2. GENERAL. System Supplier shall select the equipment furnished under this section for its superior quality and the intended performance. The System Supplier shall install all equipment in accordance with the manufacturer's instructions. Equipment and materials used shall be subject to review and shall comply with the following requirements.

1-2.01. General Equipment Stipulations. The General Equipment Stipulations shall apply to all equipment and materials provided under this section. If requirements in this specification differ from those in the General Equipment Stipulations, the requirements specified herein shall take precedence.

1-2.02. Drawings. Supplementing this section, the drawings indicate locations and arrangement of hardware and enclosures, provide mounting details, and may show other information regarding the connection and interaction with other equipment.

1-2.03. Governing Standards. Governing Standards for network systems shall be as specified in the Instrumentation and Control System section.

1-2.04. Power and Instrument Signals. Unless otherwise specified, electric power supply to the network equipment will be unregulated 24 volts dc or 120 volts ac.

1-2.05. Appurtenances. Special power supplies, special cable, special grounding, and isolation

devices shall be furnished for proper performance of the equipment.

1-2.06. Interchangeability and Appearance. To the extent possible, components used for similar types of functions and services shall be the same brand and model line. Similar components of different network hardware shall be the products of the same manufacturer to facilitate maintenance and stocking of repair parts. Whenever possible, identical units shall be furnished.

1-2.07. Programming Devices. A programming or system-configuring device, or software required for programming, shall be provided for systems that contain any equipment that requires such a device or software for routine maintenance and troubleshooting. The programming device shall be complete, newly purchased for this project, and shall be in like-new condition when turned over to Owner at completion of startup. Programming software shall be licensed to the Owner.

1-3. SUBMITTALS. Submittals shall be made in accordance with the requirements of the Instrumentation and Control System section and as listed below.

The submittals shall include the following items for the Ethernet Network Design submittal (to be provided with the First Stage Submittals):

- a. A complete network topology diagram, detailing all hardware, cabling and the interconnections between all connected equipment. Interconnections to existing installed equipment and Owner-furnished equipment shall be included in the diagram.
- b. A complete listing of IP addresses to be assigned to all equipment furnished under this contract shall be provided. The assignment of IP addresses shall be coordinated with the Owner.

All above documentation shall also be provided in the O&M manuals.

1-4. DELIVERY, SHIPMENT, PROTECTION, AND STORAGE. Equipment provided under this section shall be shipped, protected, and stored as specified in the Instrumentation and Control System section. Identification of packaging shall be as described in the Instrumentation and Control System section.

1-5. CONNECTION TO OWNER NETWORKS. Network hardware and software provided shall be compatible with the Owner's existing network systems wherever a system interconnection is provided. System Supplier shall verify existing systems to ensure compatibility.

All connections to the Owner's existing network shall be fully coordinated between the Owner and the System Supplier. Prior to connecting to the existing network, the System Supplier shall provide a written request to the Owner for an Owner's representative to be available when existing systems are disconnected and at the time of any new connections.

1-6. COORDINATION WITH OWNER. The System Supplier shall coordinate all demolitions, installations and rework on the existing networks with the Owner and the Engineer. No work shall be performed without the written consent of the Owner. The System Supplier shall submit

a written request to perform work on the existing network, including date, time, scope of work, length of time, and any Owner's support that may be required.

PART 2 - PRODUCTS

2-1. GENERAL. The following paragraphs provide minimum Ethernet network device stipulations.

2-2. NETWORK CABLING SPECIFICATIONS. Individual network equipment and related devices shall be coordinated with items provided in the following sections:

13591 Network Cable

2-3. ETHERNET NETWORK HARDWARE. Ethernet network hardware shall be provided as specified and/or as shown on the drawings. All specified functionality of provided Ethernet network equipment shall adhere to the IEEE 802 standards. Ethernet Hubs will not be accepted for network systems. Ethernet switches shall be provided to connect multiple network segments together, selectively forwarding traffic between the segments.

2-3.01. Ethernet Switches. Not used.

2-3.02. Industrial (Panel-Mounted) Ethernet Switches. Each switch mounted in process areas shall include the following functionality:

- a. Ports: Switch shall support the quantity of 10/100BaseTX ports and 10BaseFL/100BaseFX fiber ports to meet the functionality indicated on the drawings, with a minimum of 20% spare auto-negotiating 10/100Base-T, RJ-45 ports, and two multimode fiber uplink ports. A minimum of four UTP ports shall be provided.
- b. Each switch connection shall automatically sense the network speed of the devices to which it is connected.
- c. Path Redundancy: RSTP for Magnum 6KL Switches.
- d. Prioritization: IEEE 802.1p QoS Support.
- e. Network Segregation: Port VLAN.
- f. Management: SNMPv3 and Browser-based management shall be supported.
- g. LED indication of the link activity for each port.
- h. Environmental: Suitable for installation in industrial environments. Operating Temperature Range: -40 to 60C.
- i. Conformal coating option for use in hazardous environments.
- j. Mounting: DIN-rail mounted suitable for panel installation.
- k. All necessary memory upgrades, software feature sets, and cables needed for proper operation of these switches shall be furnished with each switch.

Switches shall be GarrettCom Magnum 6KL Series, without exception.

2-3.03. Network Routers. Not used.

2-3.04. Network Firewall. Not used.

2-3.05. Ethernet Connectors. Ethernet wiring connectors shall be RJ-45 male modular plug connectors.

2-3.05.01. Standard RJ45 Connectors. Standard connectors shall be polycarbonate, clear connectors. Connectors shall conform to RJ-45 and ISO 8877 standards. Contacts shall be gold plated with a 0.5A current rating and a -25° to 60° C temperature rating. Connectors shall accept unshielded Cat-5e or Cat-6, AWG 24, solid conductor cable.

2-3.05.02. Industrial RJ45 Connectors. Not used.

2-3.06. Media Converters. The System Supplier shall supply fiber optic media converters for all systems requiring conversion from copper media to fiber optic media. All converters shall be mounted in the PLC panels. The System Supplier shall coordinate the media converter and termination requirements with the fiber optic cable and network protocols.

2-3.06.01. Fiber to Copper Converters. Fiber optic to copper media converters for all computer networks shall convert twisted pair 10/100BaseT cable transmissions to 10/100BaseFX fiber optic cable transmissions. Converters shall provide auto-sensing detection of network speed and full duplex or half duplex signaling. Converters shall have diagnostic LEDs for network speed and network traffic. Converter copper port shall be 100BaseTX (RJ-45). Converter fiber port shall be compatible with connectors provided with fiber cable jumpers and compatible with fiber cable type and light wavelength. Transmission Speed shall be 100Mbps on both ports. The converter shall be powered from 120 volts ac, or shall be provided with a plug-in transformer to provide the required voltage to the device. Converters shall be as manufactured by Transition Networks, D-Link, Black Box, or equal.

2-3.07. Frame Relay Routers. Not used.

2-4. ETHERNET NETWORKS SOFTWARE. All switches shall be managed from a graphical user interface on a Microsoft Windows operating system computer. Network management software and all network equipment provided by the System Supplier shall be compatible with each other, allowing management of each device from the provided software. Network management software shall be Intravue without exception see Section 13520.

2-5. SPARE PARTS. Spare parts shall be provided as specified below.

<u>Spare parts</u>	<u>Quantity</u>
Switches	1 of each type per facility
Converters	1 of each type per facility

PART 3 - EXECUTION

3-1. NETWORK INSTALLATION REQUIREMENTS. Additional network installation requirements are specified in the Instrumentation and Control System section. Networks shall be installed and tested in accordance with the following requirements.

3-2. NETWORK CONFIGURATION. The System Supplier shall fully configure all network devices. All device selections shall be fully coordinated with the Owner to ensure compatibility with existing systems and standards.

3-2.01. Ethernet Switches. The System Supplier shall fully configure all Ethernet switches. The following shall be configured:

- a. Unused ports shall be disabled for security purposes.
- b. Spanning Tree or other appropriate redundancy scheme shall be configured for all redundant links. Trunking or other bandwidth sharing redundancy schemes shall be utilized where available to minimize switching times, and increase available bandwidth.
- c. Management Password Security
- d. Quality of Service, with any traffic to/from PLCs getting priority over all other traffic.

3-2.02. Routers. Not used.

3-2.03. Firewalls. Not used.

3-2.04. Network Configuration Report. The System Supplier shall provide a configuration report to the Owner detailing all connections, addresses, and port assignments

3-2.05. Management Software. Management software shall be fully configured for all network devices provided.

3-3. NETWORK TESTING. After each network has been installed, a technical representative of System Supplier shall test the network and shall provide a written report for each test.

3-3.01. Field Testing. After each network has been installed, a technical representative of System Supplier shall test the network and shall provide a written report for each test. Specific testing requirements are described in the individual network specification sections.

3-3.02. Systems Check. A technical representative of System Supplier shall participate in the checkout of network systems. Systems check requirements shall be as specified in the Instrumentation and Control System section.

3-3.03. Test Equipment. Unless specified otherwise, all test equipment for the calibration and checking of system components shall be provided by System Supplier for the duration of the testing work and this test equipment will remain the property of System Supplier.

3-3.03.01. Ethernet Network Minimum Test Requirements. The following minimum tests are to be performed by the System Supplier:

- a. Verify Link Integrity Status LED is lit on both sides of each link
- b. Verify proper operation and failover of each redundant component and redundant link.
- c. Verify alarming of each link failure.
- d. Verify bandwidth Usage

3-3.03.02. Ethernet Network Test Reports. Upon completion and testing of the installed Ethernet network, the System Supplier shall submit test reports to the Engineer in printed form. Test reports are to show all test results performed by the System Supplier for each port and piece of equipment. Date of calibration of the test equipment is also to be provided.

3-4. NETWORK TROUBLESHOOTING. It is the System Supplier's responsibility to provide trouble-free and reliable networks. The System Supplier shall employ any means necessary to ensure operational networks. The System Supplier shall obtain any needed test equipment, including but not limited to time-domain reflectometers, protocol analyzers and network sniffers, to troubleshoot any problems. The System Supplier shall utilize the services of a trained and certified Network Engineer that is regularly involved in troubleshooting network problems, in the event that operational or reliability problems exist. Acceptable certifications include Cisco CCNP, Cisco CCIE, or Network Professional Association Certified Network Professional (CNP).

3-5. CUSTOMER TRAINING. Training for Ethernet Networks is covered under Network Training in the Instrumentation and Control System section.

End of Section

NETWORK CABLE

PART 1 - GENERAL

1-1. SCOPE. The Network Cable section covers the furnishing and installation of cable systems to provide communications for the Computer Control System as indicated on the drawings.

Accessories and appurtenances shall be provided as specified herein to provide a complete and properly operating system.

Equipment and services provided under this section shall be subject to the General Computer Control System Requirements specified in the Instrumentation and Control System Section and the Network Systems section . Supplementing the Network Cable section, network data, special requirements, and options are indicated on the drawings.

1-2. SUBMITTALS. Submittals shall be made as specified in the Instrumentation and Control System section.

1-2.01. Qualifications. The name, address and telephone number of the proposed contractor or subcontractor, including specific personnel to perform the work shall be included with the submittals. Provide the experience record of the subcontractor and personnel in performing work similar to that specified. Include the agency, contact person, and telephone number of at least three (3) previous network installation projects completed by the proposed subcontractor. The Engineer shall review and approve the network installation subcontractor and personnel prior to any of the related work being performed. This review will be conducted during the project submittal phase, as described below.

1-2.02. Drawings and Data. All material and equipment documentation shall be submitted for review in accordance with the Submittals section. Each sheet of descriptive literature submitted shall be clearly marked to identify the material or equipment.

Product data shall include the following in the Submittals section:

- a. Cut sheets and catalog literature for proposed fiber optic cable, and fiber optic cable accessories (pigtails, connectors, etc.)
- b. Manufacturer specifications and data that clearly shows that the fiber optic cable meets all requirement specified herein.
- c. Sample of the proposed cable.
- d. Physical dimension drawings of all fiber optic accessories.
- e. Proposed fiber identification sequence and labeling.
- f. Provide off-line maintenance aids and on-line diagnostics to check the performance of the communication links and interfaces of devices on the data highway.
- g. Provide a Recommended Spare Parts List (RSPL).
- h. Provide a list of recommended special tools for fiber installation testing or

maintenance.

1-2.03. Operations and Maintenance Manuals. Operation and Maintenance Manuals shall have the following items included in addition to those items specified in other sections:

- a. Description of all components.
- b. Methods of connection.
- c. Connection diagram.
- d. OTDR trace plots for all fibers.

1-3. SHIPMENT, PROTECTION, AND STORAGE. Equipment provided under this section shall be shipped, protected, and stored in accordance with the requirements of the Instrumentation and Control System section.

1-4. QUALIFICATIONS. Due to the specialized nature of installing, splicing, terminating, and testing optical fiber cable, the Contractor shall utilize personnel who are experienced in such practices. The installing Contractor or Subcontractor shall be a certified Corning installer shall have performed similar installation and testing work on at least three projects of similar size and complexity. The personnel assigned to the installation and testing shall also have experience on at least three projects of similar size and complexity. The installation shall be provided with a 25 year warranty.

PART 2 - PRODUCTS

2-1. GENERAL. All fiber optic cable, fiber optic hardware and accessories shall be designed, assembled and connected in accordance with the requirements of these specifications and the drawings.

2-2. ETHERNET UNSHIELDED TWISTED PAIR (UTP) CABLE. Ethernet cables and connectors shall be provided for a complete and working system, and/or as shown on the drawings. Cable for Ethernet wiring shall be UTP Cat-5e or Cat-6 cable. Cable shall be Cat-5e for network speeds up to 100 MHz, and Cat-6 for network speeds greater than 100 MHz. Jacket color coding for cables shall be as follows:

- a. Standard Cat-5e PLC Networks. Blue
- b. Standard Cat-5e Enterprise Networks. White
- c. Standard Cat-6. Yellow
- d. Crossover cables. Red

Cable shall meet the following characteristics:

2-2.01. Category 5e UTP Cable. Not used.

2-2.02. Category 6 UTP Cable. Cat-6 cable shall meet the following requirements:

- a. 24 AWG
- b. 4 pair solid strand FEP Teflon insulation
- c. 100 Ohm impedance
- d. 1-250 MHz frequency range
- e. Min attenuation 19.9 Db
- f. 100 Ohm impedance
- g. Min NEXT 44.3dB/100MHz
- h. Min PS-NEXT 42.3dB/100MHz
- i. Min ELFEXT 27.8dB/100MHz
- j. Min PS-ELFEXT 24.8dB/100MHz
- k. Min return loss 20.1 dB/100 MHz
- l. Max delay skew 45 ns
- m. Max propagation delay 540 ns

Plenum rated cable shall have FEP insulation jacketing and FEP insulation for conductors. Non plenum rated cable shall have PVC insulation jacketing and polyethylene insulation for conductors. Cat-6 cable shall be Belden 1872 or equal.

2-2.03. Ethernet Patch Cables. Pre-wired and terminated patch cables with RJ-45 connectors and lever protecting boot shall be furnished for all connections to computers, network equipment, and controller equipment except where physical conditions (i.e. length over 12 ft. or conduit size) require unterminated wire to be installed. Patch cables shall be Cat-5e for networks speeds up to 100 MHz, and Cat-6 for networks speeds greater than 100 MHz and shall meet the requirements of Cat-5e and Cat-6 cable specified in this section. Straight through cables shall be wired using the T568-B standard for both connectors as shown in section 3-1.02. Crossover cables shall be wired using the T568-A standard for one connector and the T568-B standard for the opposite end.

2-3. FIBER OPTIC CABLE. The fiber optic cable must meet all of the requirements of the following paragraphs.

- a. The fiber optic cable must meet the following requirements of the National Electrical Code (NEC) Article 770.
- b. Riser Applications – Applicable Flame Test UL 1666.
- c. Finished cables shall conform to the applicable performance requirements of Table 8-6 and 8-7 in the Insulated Cable Engineers Association, Inc. (ICEA) Standard for Fiber Optic Premises Distribution Cable (ICEA S-83-596).
- d. Every fiber in the cable must be usable and meet required specifications.
- e. All optical fibers shall be sufficiently free of surface imperfections and inclusions to meet the optical, mechanical, and environmental requirements of this specification.
- f. Each optical fiber shall consist of a doped silica core surrounded by a concentric

glass cladding. The fiber shall be a matched clad design.

- g. All optical fibers shall be proof tested by the fiber manufacturer at a minimum load of 100 kpsi.
- h. All optical fibers shall be 100 percent attenuation tested. The attenuation shall be measured at 850 nm and 1300 nm for multimode fibers. The attenuation shall be measured at 1310 nm and 1550 nm for single-mode fibers. The manufacturer shall store these values for a minimum of 5 years. These values shall be available upon request.

The storage temperature range for the cable on the original shipping reel shall be -40°C to $+70^{\circ}\text{C}$. The operating temperature range shall be -40°C to $+70^{\circ}\text{C}$. Testing shall be in accordance with FOTP-3.

Every fiber in the cable shall meet the following requirements:

- a. The attenuation specification shall be a maximum attenuation for each fiber at $23 \pm 5^{\circ}\text{C}$.
- b. The attenuation of the cabled fiber shall be uniformly distributed throughout its length such that there are no discontinuities greater than 0.2 dB at 850 nm/1300 nm (multimode) in any one kilometer length of fiber.
- c. Required Fiber Grade: Maximum Fiber Attenuation at 850 nm shall be 3.5 dB/km.

Fiber optic cable shall meet the following construction requirements:

- a. Optical fibers shall be placed inside a loose buffer tube. The nominal outer diameter of the buffer tube shall be 3.0 mm.
- b. The cable shall contain 12 fibers. Each buffer tube shall contain up to 12 fibers.
- c. The fibers shall not adhere to the inside of the buffer tube.
- d. Each fiber shall be distinguishable from others by means of color coding in accordance with TIA/EIA-598-A, "Optical Fiber Cable Color Coding."
- e. The fibers shall be colored with ultraviolet (UV) curable inks.
- f. Buffer tubes containing fibers shall also be color coded with distinct and recognizable colors in accordance with TIA/EIA-598-A, "Optical Fiber Cable Color Coding."
- g. In buffer tubes containing multiple fibers, the colors shall be stable during temperature cycling and not subject to fading or smearing onto each other. Colors shall not cause fibers to stick together.
- h. The buffer tubes shall be resistant to kinking.
- i. The cable jacket color shall be black.
- j. Fibers may be included in the cable core to lend symmetry to the cable cross-section where needed. Fibers shall be placed so that they do not interrupt the consecutive positions of the buffer tubes. In dual layer cables, any fillers shall be placed in the inner layer. Fillers shall be nominally 3.0 mm in outer diameter.

- k. The jacket shall be continuous, free from pinholes, splits, blisters, or other imperfections. The jacket shall have a consistent, uniform thickness; jackets extruded under high pressure are not acceptable. The jacket shall be smooth, as consistent with the best commercial practice. The jacket shall provide the cable with a tough, flexible, protective coating, able to withstand the stresses expected in normal installation and service.
- l. The outer cable jacket shall be marked with the manufacturer's name or UL file number, date of manufacture, fiber type, flame rating, UL symbol, and sequential length markings every two feet (e.g. "62.5/125 MICRON – TYPE OFNR – (UL) 00001 Feet"). The print color shall be white.
- m. The cable shall be all-dielectric.
- n. The cable shall be gel-free.
- o. The outside diameter of the cable shall not exceed 7 mm.
- p. Flammability – All cables shall comply with the requirements of the 1996 NEC Article 770. All cables shall pass UL 1666.

Fiber optic cable shall be as manufactured by Corning Cable Systems, without exception.

2-3.01. Multimode Fiber. Multimode fiber shall be 62.5/125µm core diameter.

62.5 µm core diameter multimode fiber optic cable shall meet the following requirements:

- a. The multimode fiber utilized in the cable specified herein shall meet EIA/TIA-492AAAA-1989, "Detail Specification for 62.5µm Core Diameter/125µm Cladding Diameter Class Ia Multimode, Graded Index Optical Waveguide Fibers."
- b. Core diameter: 62.5 ± 3.0 micrometers.
- c. Cladding diameter: 125.0 ± 2.0 micrometers.
- d. Core-to-Cladding Offset: ≤ 3.0 micrometers.
- e. Cladding non-circularity: $\leq 2.0\%$. Defined as: $[1-(\text{min. cladding dia.} + \text{max. cladding dia.})] \times 100$.
- f. Core non-circularity: $\leq 6.0\%$. Defined as: $[1-(\text{min. core dia.} + \text{max. core dia.})] \times 100$.
- g. Coating Diameter: 245 ± 10 micrometers.
- h. Graded index.
- i. Numerical Aperture: 0.275 ± 0.015 .
- j. Attenuation Uniformity: There shall be no point discontinuities greater than 0.2 dB at either 850 nm or 1300 nm.
- k. Minimum Bandwidth Requirement shall be 160/500 MHz-km at 850/1300 nm.

2-3.02. Singlemode Fiber. Not used.

2-3.03. Fiber optic cable connectors. All optical fibers shall be terminated with connectors that are type ST for multimode cable and type SC for singlemode cable.

2-3.03.01. Epoxy Connectors. Not used.

2-3.03.02. Crimp Style Connectors. Crimp style connectors shall be provided to terminate each fiber in the cable. Connector style, ST, SC, or other, shall be coordinated with the patch panels. Connector loss shall be no greater than 0.3 dB. Connectors shall not require epoxy or polishing. Loss measurement shall be performed at the time of splicing and documentation shall be furnished for each termination. Connectors shall be Corning Cable Systems UniCam Connectors, or equal.

2-3.04. Fiber Optic Jumper Cables. Fiber optic jumper cables shall be furnished and installed for equipment interfacing and between termination cabinets. The jumpers shall meet the following requirements:

- a. The jumpers shall be 62.5/ 125 microns, multimode for operation at 1300 nm. They shall be tight-buffered and be protected by Kevlar-type strength material.
- b. The jumpers shall be supplied with connectors on each end. Connector types (ST, SC, LC, etc.) shall be matched to the equipment provided. Jumpers shall be sized to provide a single connection between the fiber optic hardware being connected.

2-4. PLC COMMUNICATIONS MEDIA. Not used.

2-5. INDUSTRIAL COMMUNICATIONS CABLING. Not used.

2-6. ETHERNET CABLE TEST EQUIPMENT. Not used.

PART 3 - EXECUTION

3-1. INSTALLATION. The System Supplier shall be responsible for the coordination of the installation of all cable furnished hereunder. The System Supplier shall be responsible for the termination of all cable furnished hereunder.

3-1.01. Cable Damage. If the cable becomes damaged during installation, the Contractor shall stop work and notify the Engineer immediately. The Owner and Engineer will decide whether to replace the entire reel of cable or to install a splice at the damaged section. If the Owner decides to replace the entire reel of cable, the Contractor shall begin the installation at the last designated splice point. The damaged cable between these points shall be removed, coiled, tagged, and given to the Owner. Installation of new cable to replace damaged cable shall not be a basis of extra payment or contract completion time. In addition to installation of the new cable, the Contractor shall reimburse the Owner for the entire cost of the replacement reel of cable. This cost will be withheld from the contract price. If the Owner decides to install a splice at the damaged point, and the cable is damaged a second time, the entire reel of damaged cable (and all subsequent damaged reels) shall be replaced with new reels at the Contractor's expense.

3-1.02. Ethernet Cable Installation. Straight through cables shall be wired using the T568-B standard for both connectors as shown in the table below (connector pin numbers are left to right with the clip down). Crossover cables shall be wired using the T568-A standard for one connector and the T568B standard for the opposite end as shown in the table below.

Connector Pin	568A Wiring Conductor	568B Wiring Conductor
1	White/Green	White/Orange
2	Green	Orange
3	White/Orange	White/Green
6	Orange	Green
4	Blue	Blue
5	White/Blue	White/Blue
7	White/Brown	White/Brown
8	Brown	Brown

3-1.03. Fiber Optic Cable Installation. The cable manufacturer shall provide installation procedures and technical support concerning the items contained in this specification. Fiber optic cable installation shall meet the following requirements:

- a. All fiber optic cable shall be installed, terminated, and tested by the System Supplier or his fiber subcontractor as specified above.
- b. In pulling the cable, strain-release, or other tension limiting devices shall be used to limit the pull tension to less than 600 lbs.
- c. Minimum bend radius restrictions shall be satisfied both during and after cable installation.
- d. Horizontal, unsupported cable runs shall be supported at continuous distances of 5 feet or less.
- e. All conduit and cabinet entrances shall be sealed with RTV or other re-enterable sealant material to prevent ingress of water, dust or other foreign materials.
- f. Cable routing within occupied office areas shall conform to Federal, State, and local electrical and fire codes.
- g. Any non-terminating (field) splices shall be documented as to the physical location and cable meter mark (prior to stripping). Field splices shall be OTDR-tested and documented prior to final cable acceptance testing.
- h. Fiber optic cables shall be installed in accordance with NECA 301-2004, Installing And Testing Fiber Optic Cables.

3-2. CABLE TESTING. After the network cabling has been installed, each network cable shall be tested.

3-2.01. Test Equipment. Unless specified otherwise, all test equipment for the calibration and checking of system components shall be provided by System Supplier for the duration of the testing work and this test equipment will remain the property of System Supplier.

3-2.02. Ethernet UTP Cable Testing. The System Supplier shall utilize the previously specified test equipment, and additional tools as needed to validate the Ethernet UTP cable installation. All test equipment shall bear current calibration certification from a certified calibration laboratory, as appropriate. Each cable shall be tested for open pairs, shorted pairs, crossed pairs, reversed pairs and split pairs. A check off sheet shall be utilized, shall be signed by the technician testing the cables, and shall be submitted for approval. Any identified faults shall be corrected at no additional cost.

3-2.03. Fiber Optic Cable Testing. Acceptance testing of the data highway (fiber and electronic equipment) shall be conducted as a part of integrated system field testing, as specified elsewhere. Prior to such tests, however, the fiber optic cable shall be tested as specified herein.

The System Supplier, or his fiber subcontractor, shall conduct fiber optic cable testing as specified below. The Contractor shall bear the cost for factory witnessed testing in accordance with Section 01610, General Equipment Stipulations. A test plan shall be submitted prior to the proposed test dates. The test plan and procedures shall be mutually agreed to prior to conducting the tests.

Each optical fiber of each fiber optic cable shall be OTDR (Optical Time Domain Reflectometer) tested on the reel at the factory, on the reel upon arrival at the jobsite, and after installation and termination. For each fiber, an OTDR (Optical Time Domain Reflectometer) trace soft/hardcopy is required to be provided to the Owner and Engineer. OTDR traces shall be provided for each test (at the factory, on the reel at the job-site, and after installation). A 100 foot launch cable shall be spliced to each fiber for each fiber OTDR test, to ensure accurate results. This end-to-end trace shall be performed from BOTH ends of the fiber. Also for each fiber, an end-to-end power attenuation (insertion loss) test shall be performed. The attenuation test shall use a stabilized optical source and an optical power meter calibrated to the appropriate operating wavelength (1300 nm).

For each installed fiber, the power attenuation shall not exceed the following, tested from connector to connector at the respective patch panels:

$$(0.0035)L + (0.25)N + 3.0 \text{ dB}$$

Where L = The length of the fiber optic cable in meters and
N = the number of splices in the fiber.

Any fiber optic cables containing one or more fibers not meeting this performance will not be accepted by the Owner, and shall be repaired or replaced at no additional cost.

Each fiber optic jumper cable shall be tested and must exhibit an end-to-end attenuation of less than 2.0 dB at 1300 nm. Any jumper exceeding this level shall be replaced at no additional cost to the owner. Any damaged cable still on the reel shall be returned to the manufacturer for replacement at no additional cost to the Owner.

All fiber cable testing shall be documented on pre-approved test forms. Three (3) copies of all documentation (including OTDR traces) shall be submitted to the Engineer upon successful completion of the testing.

End of Section

ELECTRONIC SECURITY EQUIPMENT

PART 1 - GENERAL

1-1. SCOPE. This section covers furnishing the design and installation of an Intrusion Alarm, Monitoring, and Control System which includes, but is not limited to, security control panels, power supplies, keypad, fiber optic transceivers and proximity card readers. All associated equipment, devices, and controls necessary for proper operation shall be included.

The card access systems shall be compatible with OWNER existing card access control system. The System Supplier shall be responsible to provide all equipment specified herein, so as to be successfully connected to the existing systems which are located at locations remote from this site.

The System Supplier shall be responsible for the integration and configuration of the card access control systems equipment with the existing equipment such that personnel at Owner designated sites will be able to access and make changes that may be necessary to the separate card access control systems to control access to the Meadow Woods entrance gates. User authentication will be accomplished by the Owner.

All associated equipment, devices, cabling (fiber-optic and copper), system configuration, and controls necessary for proper operation shall be included.

1-2. GENERAL. The System Supplier shall furnish all installation drawings, tools, equipment, conduit, wiring, materials, and supplies and shall perform all labor to complete the work as specified, and in compliance with all applicable codes, standards, and regulations.

System Supplier shall coordinate with CONTRACTOR and any sub-contractors (including electrical) to provide all additional conduit and wiring required for a complete operable system beyond the use of conduit marked for security use as shown on drawings.

The Supplier shall review the specifications and supply equipment that meets the functional requirements indicated, and shall furnish and install additional or differing components if required.

1-2.01. Supplier's Qualifications. The design, equipment, installation, and installation supervision furnished under this section shall be provided by a manufacturer or supplier who has been engaged in the business of supplying these types of equipment for at least 5 years.

1-2.02. Governing Standards. All wiring and components shall meet the applicable requirements of the NEC.

1-2.03. Nameplates. Major components of equipment shall be identified with a permanently affixed nameplate bearing the manufacturer's name and address, and type or style and catalog number of the item.

1-2.04. Tags. Keys and locks, where required, shall be furnished with tags bearing stamped identification number. Cable and conduit runs, wiring circuits, and all spare parts supplied to maintain the equipment shall be furnished with hard phenolic or stainless steel tags.

1-2.05. Power Requirements. Primary power supply to all components will be 120 volts, 60 Hz, single phase. The Supplier shall be responsible for meeting all additional power supply requirements and shall furnish any transformers or other power supply equipment needed.

1-3. SUBMITTALS. Complete wiring diagrams; assembly and installation drawings; detailed specifications; and data covering the materials used and the parts, devices, and other accessories forming a part of the equipment furnished shall be submitted in accordance with the submittals section. The equipment submittals shall include the following:

- A complete description of all components, including certification of listing by UL.
- Complete sequence of operation for all functions of the equipment.
- Complete wiring diagram for all components and interfaces to equipment supplied under other sections or by the Owner.
- Location drawings for all components.
- A listing of the manufacturer's representatives responsible for installation and servicing.
- Conduit and cabling to all equipment locations.

1-4. SECURITY SYSTEM DESCRIPTIONS.

1-4.01. Electronic Card Access System Well 7 and 8. The system shall be furnished as a complete package consisting of a security panel, gate card reader control panel gate keypad and proximity card readers to monitor and control access to the Meadow Woods well access gate . The system shall consist of one (1) security control and gate card access panel located in the Well 8 building, , one (1) keypad, one (1) proximity card reader for the gate. Any additional equipment required to provide a functional system shall be provided by the system supplier.

1-4.02. Electronic Card Access System Reclaimed Pump Buildin. The existing system shall be recommissioned as a complete package consisting of a security panel, gate card reader control panel gate keypad and proximity card readers to monitor and control access to the Meadow Woods Reclaimed Pump Station access gate. Any additional equipment required to provide a functional system shall be the responsibility of the System Supplier.

1-5. COMPONENTS. Where required by NEC or local codes, all security equipment and materials, devices, and assemblies shall be listed and/or labeled by UL or another accepted testing laboratory for the intended purpose. The equipment shall not be installed, altered, or modified in any way that would void the label or listing.

All control equipment shall have transient voltage protection devices in compliance with UL 864.

1-6. SPARE PARTS AND SPECIAL TOOLS. Spare parts and special tools as recommended by the equipment supplier and as may be listed below shall be furnished. These will include three sets of any disposable parts which would normally be changed during routine equipment maintenance and any special tools required for disassembly of the equipment.

The following minimum spare parts shall be supplied with the security equipment; one (1) each of each type of card reader.

Spare parts shall be suitably packaged for shipment.

1-7. OPERATION, MAINTENANCE AND INSTRUCTION MANUALS. Operation, Maintenance and Instruction Manuals for the equipment and systems identified in Section 01620 – EQUIPMENT SCHEDULE, and as may be required in this section of these project specifications shall be furnished in accordance with Section 01730 – OPERATION, MAINTENANCE AND INSTRUCTION MANUALS.

1- 8. MANUFACTURERS’ FIELD SERVICES. Equipment manufacturers or suppliers shall provide the services of a factory-trained manufacturer’s representative or agent and maintenance personnel as required to participate in installation, check-out, and testing of equipment and systems, and in the training of Owner plant operating personnel. The representative shall have complete knowledge of proper installation, operation, and maintenance of the equipment and systems supplied.

The manufacturer’s representative or agent shall visit the site or classroom designated by the Owner, for the minimum person-days listed below, travel time excluded. The time listed below shall be extended as required to meet the manufacturer’s service representative or agent requirements included in Section 01650 – Startup Requirements and any additional requirements of the manufacturer’s service representative or service personnel as may be identified in this section of these project specifications.

- Full time as required. The System Supplier shall provide on-site supervision of installation.
- 3 days. Inspection, checking, and adjustment of equipment.

PART 2 - PRODUCTS.

2-1. ELECTRONIC CARD ACCESS EQUIPMENT.

2-1.01. Security Panel. Panel shall be capable of supporting the number of inputs and outputs required for the card readers indicated on the drawings. The panel shall have ample room for wiring and circuit boards, be capable of storing up to 32,000 cards per site, retain last 6000 transactions, monitor forced entry and held open conditions, heavy duty 10 amp relays monitored by the plant control system, fiber optic patch panel, fiber optic transceiver, Lenel card reader(s) and Lenel Intelligent System Controller.

The control panel shall operate from a 120 volt AC, 60 Hz power supply. Control panel shall be manufactured by Lenel, Inc. and no other.

The System Supplier shall be responsible to connect and fully integrate the System Controller Panel to OWNER existing card access system used at other OWNER facilities.

2-1.02. Remote Card Reader Control Panel. Panel shall provide interface for the swing gate proximity card reader. The panel shall have ample room for wiring and circuit boards, monitor forced entry and held open conditions, contain fiber optic patch panel, fiber optic transceiver and Lenel card reader.

2-1.03. Proximity Card Reader. Microprocessor based magnetic type card reader terminals shall be located as shown on the drawings, one mounted at automobile height shall be located at the SRWSF entrance gate. Card Readers shall have an operating temperature of -22 to 150 degrees Fahrenheit, and shall have an operating humidity of 0-95% non-condensing. Card Readers shall have a typical read range of up to 9 inches. Card Readers shall read encoded data from access card and transmit the data back to the Card Reader Control Panel. Card Reader shall give an audible and visual indication of a properly read card. Card Readers shall operated from a 10-28 volt DC power supply. Card Readers shall be furnished with transient voltage surge suppression devices. Card Readers for the operations building shall be the HID ProxPro 5355.

2-2. ENCLOSURES.

2-2.01. General. All components supplied shall be mounted in a NEMA rated enclosure designed for use in the environment in which they will be installed.

All enclosures shall be fitted for direct connection of conduit and shall be designed for wall or column mounting unless otherwise specified or indicated on the drawings. Any special mounting components or brackets shall be provided by the System Supplier.

2-3. CABLE AND RACEWAYS.

2-3.01. The System Supplier shall provide all wiring and fiber optic cabling in accordance with Section 16050 and as shown on the drawings in coordination with CONTRACTOR and electrical sub-contractor. Electrical sub contractor to supply conduits, raceways and boxes as shown on the drawings. System Supplier shall provide any additional boxes or conduits required for system operation but not shown on the drawings. Cable used for the intrusion equipment shall be multi-conductor cable, at least 18 AWG size, specifically designed for industrial systems and UL listed for indoor/outdoor installations.

Fiber Optic cabling used solely for the Security shall be independent of other fiber optic cabling provided at the site, and shall be compatible with the security system. Fiber Optic cabling shall be multi-mode, 12 fiber minimum. All fibers shall be terminated after installation. Connecters shall be as required to coordinate with network switch connections.

PART 3 - EXECUTION.

3-1. GENERAL. All work shall be installed in accordance with the manufacturer's diagrams and recommendations except where otherwise indicated.

After completion of the installation, the System Supplier shall clean the inside and the outside of the security equipment and shall remove any dirt and debris from the site.

3-1.01. Cable. Cable shall be installed in accordance with Section 16050. The conductors shall be installed in conduits or junction boxes separate from conductors of other systems. Conduit fill shall meet applicable NEC requirements.

3-1.02. Raceways. Conduit shall be installed in accordance with section 16050. Exposed conduit systems shall be rigid steel. Concealed conduit systems shall be PVC schedule 40.

3-2. FIELD QUALITY CONTROL, CHECKOUT AND TESTING. The Contractor shall perform field quality control, checkout, and testing, and shall submit required documentation in accordance with Section 01400 – QUALITY CONTROL, Section 01650 – START-UP REQUIREMENTS, and any special field testing requirements as may be listed below or elsewhere in this section of these project specifications. Shop testing, if required, is addressed elsewhere in this section.

End of Section

REMOVAL OF ABOVEGROUND FUEL STORAGE TANK

PART 1 – GENERAL

1-1. SCOPE. This section covers the removal of one existing 4,000 gallon above ground fuel storage tank at the Meadow Woods WSF site, and associated fuel tank accessories. Contractor shall provide necessary labor, materials, and supervision required to remove and dispose of the equipment pad and all related above and below ground piping and day tank.

All such work must be accomplished in accordance with all federal, state, county, and local requirements as well as accepted safety standards. Before initiating work, the appropriate government agencies, including Orange County Risk Management, shall be consulted concerning applicable regulatory requirements and to obtain any permits required.

The Storage Tank Closure Assessment report has been filed by the County and has been accepted by DEP and is included in the Contract Documents as an Appendix.

1-2 GENERAL. Equipment removed under this section shall be disassembled, removed from the site, and disposed of in full conformity with this specification and all local, state and federal regulations. In the event that state or local regulations exceed the requirements of this specification, the regulations shall take precedence.

All work shall be performed in accordance with the 1996 Edition of NFPA-30, Chapter 62-762 FAC, and Chapter 62-761 FAC.

1-3. SUBMITTALS. Prior to starting the work the Contractor shall submit the following;

- a. Name of all Subcontractors.
- b. Location and method of disposal for all waste materials for recording purposes only.
- c. A site specific health and safety plan and contingency plan.
- d. Schedule and sequence of each tank removal.

PART 2 – PRODUCTS

2-1. PREPARATION AND PERFORMANCE OF TANK REMOVAL. The Contractor shall be responsible for performing the tasks as identified in the FDEP Storage Tank System Closure Assessment Requirements, Chapter 62-762.801 F.A.C. and Chapter 62-761.800 F.A.C., which shall include, but shall not be limited to the following.

- a. The contractor shall inspect each tank prior to removal activities to the extent required to be able to safely perform the work.

- b. Remove and dispose of the storage tank, day tank, and all associated above and below ground piping. Remove and dispose of the concrete equipment pad, bollards, and any attachments.
 - Prior to disposing of the piping, the latest applicable waste disposal regulations shall be checked to determine if special attention of preparation is required.
- c. The above ground tank shall also be protected from flotation in accordance with NFPA 30, Section 2-6.

PART 3 – EXECUTION.

3.1. REMOVAL. The fuel storage tank and all accessories shall be carefully removed and disposed of by the Contractor in accordance with all requirements.

End of Section

Section 15010

VALVE INSTALLATION

PART 1 - GENERAL

1-1. SCOPE. This section covers the installation of new valves and actuators purchased by Contractor as part of this Work.

Existing water valve boxes that are to be converted to reclaimed service shall be replaced with reclaimed valve boxes per County standard.

Cleaning, disinfection, pressure and leakage testing, insulation, and pipe supports are covered in other sections.

The following specification sections are applicable to valves to be installed:

<u>Section</u>	<u>Title</u>
15091	Miscellaneous Ball Valves
15094	Backflow Preventers
15095	Solenoid Valves
15104	Resilient-Seated Gate Valves
15108	Air Release/Combination Air Valves

1-2. GENERAL. Equipment installed under this section shall be erected and placed in proper operating condition in full conformity with drawings, specifications, engineering data, instructions, and recommendations of the equipment manufacturer, unless exceptions are noted by Engineer.

Any valves and actuators that are identified as being provided by others will be furnished complete for installation by Contractor. Technical specifications under which the equipment will be purchased are available.

1-2.01. Coordination. When manufacturer's field services or installation check services are provided by the valve manufacturer, Contractor shall coordinate the services with the valve manufacturer. Contractor shall give Engineer written notice at least 30 days prior to the need for manufacturer's field services.

Submittals for equipment that will be furnished by others under each procurement contract will be furnished to Contractor upon completion of review by Engineer. Contractor shall review equipment submittals and coordinate with the requirements of the Work and the Contract Documents. Contractor accepts sole responsibility for determining and verifying all quantities, dimensions, and field construction criteria.

Flanged connections to valves including the bolts, nuts, and gaskets are covered in the appropriate pipe specification section.

1-3. DELIVERY, STORAGE, AND HANDLING.

1-3.01. Storage. Upon delivery, all equipment and materials shall immediately be stored and protected by Contractor in accordance with Handling and Storage section and the manufacturer's instructions until installed in the Work. Stored equipment shall be protected by Contractor against damage and exposure from the elements. At no time shall the equipment be stored on earth or grass surfaces or come into contact with earth or grass. Contractor shall keep the equipment dry at all times.

PART 2 - PRODUCTS

Not Applicable.

PART 3 - EXECUTION

3-1. INSPECTION. All valves and accessories shall be inspected for damage and cleanliness before being installed. Any material damaged or contaminated in handling on the job shall not be used unless it is repaired and re-cleaned to the original requirements by Contractor. Such material shall be segregated from the clean material and shall be inspected and approved by Owner or his representative before its use.

3-2. INSTALLATION.

3-2.01. General. Valves shall be installed with sufficient clearance for proper operation of any external mechanisms, and with sufficient clearance to dismantle the valve for in-place maintenance. Installation shall be in accordance with the valve manufacturer's recommendations.

Unless otherwise indicated on the drawings, all valves installed in horizontal runs of pipe having centerline elevations 4 feet 6 inches [1.3 m] or less above the finish floor shall be installed with their operating stems vertical. Valves installed in horizontal runs of piping having centerline elevations between 4 feet 6 inches [1.3 m] and 6 feet 9 inches [2 m] above the finish floor shall be installed with their operating stems horizontal. If adjacent piping prohibits this, the stems and operating handwheel shall be installed above the valve horizontal centerline as close to horizontal as possible. Valves installed in vertical runs of pipe shall have their operating stems oriented to facilitate the most practicable operation, as reviewed by Engineer.

3-2.02. Installation Checks. When specified in the valve sections, the valve manufacturer will provide installation checks. For installation checks, the manufacturer's field representative will inspect the valve installation immediately following installation by Contractor. The manufacturer's representatives will revisit the site as often as necessary to ensure installation satisfactory to Owner.

Contractor shall perform no Work related to the installation or operation of materials or equipment furnished by others without direct observation and guidance of the field representative, unless Engineer and manufacturer furnishing such materials concur otherwise.

3-2.03. AWWA Butterfly Valves. Not used.

3-2.04. Check Valves. Not used.

3-2.05. Eccentric Plug Valves. Not used.

3-2.06. Resilient Seated Gate Valves. Valves shall be handled and installed in accordance with the recommendations set forth in the Appendix to ANSI/AWWA C509 and with the recommendations of the manufacturer.

3-2.07. Double Disc Gate Valves. Not used.

3-2.08. Air Release and Combination Air Valves. The exhaust from each valve shall be piped to a suitable point acceptable to Engineer. Air release valve exhaust piping leading to a trapped floor drain shall terminate at least 6 inches [150 mm] above the floor.

3-2.09. Valve Boxes. Valve boxes shall be set plumb. Each valve box shall be placed directly over the valve it serves, with the top of the box brought flush with the finished grade. After each valve box is placed in proper position, earth fill shall be placed and thoroughly tamped around the box.

3-2.10. Yard Hydrants. A concrete slab 18 inches [450 mm] square and 4 inches [100 mm] thick shall be provided around the top of each 3/4 inch [19 mm] and 1-1/2 inch [38 mm] yard hydrant. Hydrants shall be installed plumb. Hydrant drainage shall be provided by installing below each hydrant at least 1 cubic foot [0.03 m³] of gravel or crushed stone.

Each 4 inch [100 mm] yard hydrant shall be set on a concrete foundation at least 18 inches [450 mm] square and 6 inches [150 mm] thick. Each hydrant shall be anchored in place or adequately blocked to prevent the hydrant from blowing off the supply connection. Hydrant drainage shall be provided by installing at least 7 cubic feet [0.20 m³] of gravel or crushed stone around the hydrant and below the top of the hydrant supply pipe.

An operating wrench shall be provided for each yard hydrant.

3-3. VALVE ACTUATORS. Valve actuators and accessories shall be installed in accordance with the equipment manufacturer's recommendations.

3-4. FIELD QUALITY CONTROL.

3.4.01. Field Testing. After installation, all valves shall be tested in conjunction with the Pipeline Pressure and Leakage Testing section.

3-4.01.01. Pressure Tests. Pressure testing shall be in accordance with the Pipeline Pressure and Leakage Testing section.

3-4.01.02. Leakage Tests. All valves shall be free from leaks. Each leak that is discovered within the correction period stipulated in the General Conditions shall be repaired by and at the expense of Contractor. This requirement applies whether pressure testing is required or not.

3-5. ADJUSTING. After installation, the opening and closing time shall be adjusted as needed for each pneumatic, hydraulic and electric actuated valve.

3-6. ASSET TABLE. For all valves installed below grade as part of the Work, Contractor shall provide an As-Built Asset Attribute Data Table, as specified in Section 01720 – PROJECT RECORD DOCUMENTS AND SURVEY. This asset table shall include, but not be limited to, the following: valve type, size, number of turns and location in State Plane coordinates.

End of Section

Section 15020

MISCELLANEOUS PIPING AND ACCESSORIES INSTALLATION

PART 1 - GENERAL

1-1. SCOPE. This section covers the installation of piping and accessories as indicated on the drawings for the following piping sections:

<u>Section</u>	<u>Description</u>
15060	Miscellaneous Piping and Accessories
15061	Ductile Iron Pipe
15067	Miscellaneous Plastic Pipe, Tubing, and Accessories
15070	Copper Tubing and Accessories

Contractor shall furnish all necessary jointing materials, coatings, and accessories that are specified herein.

Pipe supports and anchors shall be furnished by Contractor, and are covered in the Pipe Supports section. Pipe trenching and backfilling are covered in the Trenching and Backfilling section.

1-2. GENERAL.

1-2.01. Coordination. Materials installed under this section shall be installed in full conformity with drawings, specifications, engineering data, instructions, and recommendations of the manufacturer, unless exceptions are noted by Engineer.

1-3. SUBMITTALS.

1-3.01. Drawings and Data. Complete specifications, data, and catalog cuts or drawings shall be submitted in accordance with the Submittals section. Items requiring submittals shall include, but not be limited to, the following:

Watertight/dusttight pipe sleeves.

Materials as specified herein.

1-3.03. Spool Drawings. Not used.

1-4. QUALITY ASSURANCE.

1-4.01. Tolerances. These tolerances apply to in-line items and connections for other lines.

The general dimension, such as face-to-face, face or end-to-end, face- or end-to center, and center-to-center shall be 1/8 inch [3 mm].

The inclination of flange face from true in any direction shall not exceed 3/64 inch per foot [4 mm per meter].

Rotation of flange bolt holes shall not exceed 1/16 inch [1.5 mm].

1-5. DELIVERY, STORAGE, AND HANDLING. Shipping shall be in accordance with the Shipping section. Handling and storage shall be in accordance with the Handling and Storage section. All materials shall be stored in a sheltered location above the ground, separated by type, and shall be supported to prevent sagging or bending.

Plastic pipe, tubing, and fittings shall be stored between 40°F and 90°F [4°C and 32°C].

1-5.01. Coated Pipe. Handling methods and equipment used shall prevent damage to the protective coating and shall include the use of end hooks, padded calipers, and nylon or similar fabric slings with spreader bars. Bare cables, chains, or metal bars shall not be used. Coated pipe shall be stored off the ground on wide, padded skids. Plastic-coated pipe shall be covered or otherwise protected from exposure to sunlight.

PART 2 - PRODUCTS

2-1. SERVICE CONDITIONS. Pipe, tubing, and fittings covered herein shall be installed in the services indicated in the various pipe sections.

2-2. MATERIALS.

Threaded Fittings

Anti-Seize Lubricant	Thread	Jet-Lube "Nikal", John Crane "Thred Gard Nickel", Never-Seez "Pure Nickel Special", or Permatex "Nickel Anti-Seize".
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Teflon Thread Sealer		Paste type; Hercules "Real-tuff", John Crane "JC-30", or Permatex "Thread Sealant with Teflon".
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Teflon Thread Tape		Hercules "Tape Dope" or John Crane "Thread-Tape".
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Solvent Welded Fittings

Solvent cement for PVC Systems		ASTM D2564.
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Solvent cement for CPVC Systems		ASTM F493.
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Sodium Hypochlorite, Sodium Hydroxide, and Sodium Bisulfite Service		IPS Corporation "Weld-On 724"
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Primer for PVC Systems		ASTM F656.
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Insulating Fittings	
Threaded	Dielectric steel pipe nipple, ASTM A53, Schedule 40, polypropylene lined, zinc plated; Perfection Corp. "Clearflow Fittings".
Flanged	EpcO "Dielectric Flange Unions" or Central Plastics "Insulating Flange Unions".
Pipe Insulation	See Mechanical Insulation section.
Watertight/Dusttight Pipe Sleeves	O-Z Electrical Manufacturing "Thruwall" and "Floor Seals", or Thunderline "Link-Seals"; with modular rubber sealing elements, nonmetallic pressure plates, and galvanized bolts.
Pipe Sleeve Sealant	Polysulfide or urethane, as specified in the Caulking section or as indicated on the drawings.
Locating (Tracing) Wire	10-gauge single strand solid core copper wire with non-metallic insulation. Insulation color coded for the type of pipe being installed.
Detection Tape	Plastic and foil laminate, 3-inches wide, color coded and labeled as indicated in the specification. Labeling shall repeat every 20-36 inches.
Protective Coatings	
Tape Wrap	ANSI/AWWA C209, except single ply tape thickness shall not be less than 30 mils [760 µm]; Protecto Wrap "200" or Tapecoat "CT".
Primer	As recommended by the tape manufacturer.
Coal Tar Epoxy	High-build coal tar epoxy; Ameron "Amercoat 78HB Coal Tar Epoxy", Carboline "Bitumastic 300 M", Tnemec "46H-413 Hi-Build Tneme-Tar", or Sherwin-Williams "Hi-Mil Sher-Tar Epoxy".
Epoxy for aeration and process air piping	Shop or field applied high solids epoxy; suitable for protection at continuous pipe wall temperatures up to 300 F. Coating shall be abrasion resistant. The finished coating shall have a minimum total film thickness of 10 mils. The surface shall be prepared in accordance with SSPC-SP7 as a minimum unless otherwise recommended by the coating manufacturer. The coating shall be Carboline "Thermaline 450", Ameron "Amerlock 400 with Amercoat 880 Additive", or approved equal.

PART 3 - EXECUTION

3-1. INSPECTION. All piping components shall be inspected for damage and cleanliness before being installed. Any material damaged or contaminated in handling on the job shall not be used unless it is repaired and recleaned to the original requirements by Contractor. Such material shall be segregated from the clean material and shall be inspected and approved by Owner or his representative before its use.

3-2. PREPARATION.

3-2.01. Field Measurement. Pipe shall be cut to measurements taken at the site, not from the drawings. All necessary provisions shall be made in laying out piping to allow for expansion and contraction. Piping shall not obstruct openings or passageways. Pipes shall be held free of contact with building construction to avoid transmission of noise resulting from expansion.

3-3. INSTALLATION.

3-3.01. General. All instruments and specialty items shall be installed according to the manufacturer's instructions and with sufficient clearance and access for ease of operation and maintenance.

Flat faced wrenches and vises shall be used for copper tubing systems. Pipe wrenches and vises with toothed jaws will damage copper materials and shall not be used. Bends in soft temper tubing shall be shaped with bending tools.

3-3.02. Pipe Sleeves. Piping passing through concrete or masonry shall be installed through sleeves that have been installed before the concrete is placed or when masonry is laid. Pipe sleeves installed through floors with a special finish, such as ceramic or vinyl composition tile, shall be flush with the finished floor surface and shall be provided with nickel or chromium plated floor plates. Unless otherwise indicated on the drawings, in all other locations where pipes pass through floors, pipe sleeves shall project not less than 1 inch [25 mm] nor more than 2 inches [50 mm] above the floor surface, with the projections uniform within each area. In the case of insulated pipes, the insulation shall extend through pipe sleeves. Where the drawings indicate future installation of pipe, sleeves fitted with suitable plastic caps or plugs shall be provided.

Holes drilled with a suitable rotary drill will be considered instead of sleeves for piping which passes through interior walls and through floors with a special finish.

Unless otherwise indicated on the drawings, all pipes passing through walls or slabs which have one side in contact with earth or exposed to the weather shall be sealed watertight with special rubber-gasketed sleeve and joint assemblies, or with sleeves and modular rubber sealing elements.

3-3.03. Pipe Joints. Pipe joints shall be carefully and neatly made in accordance with the indicated requirements.

3-3.03.01. Threaded. Pipe threads shall conform to ANSI/ASME B1.20.1, NPT, and shall be fully and cleanly cut with sharp dies. Not more than three threads at each pipe connection shall

remain exposed after installation. Ends of pipe shall be reamed after threading and before assembly to remove all burrs. Unless otherwise indicated, threaded joints shall be made up with teflon thread tape, thread sealer, or a suitable joint compound.

Threaded joints in plastic piping shall be made up with teflon thread tape applied to all male threads. Threaded joints in stainless steel piping shall be made up with teflon thread sealer and teflon thread tape applied to all male threads. Threaded joints in steel piping for chlorine service shall be made up with teflon thread tape or litharge and glycerine paste applied to all male threads.

3-3.03.02. Compression. Ends of tubing shall be cut square and all burrs shall be removed. The tubing end shall be fully inserted into the compression fitting and the nut shall be tightened not less than 1-1/4 turns and not more than 1-1/2 turns past fingertight, or as recommended by the fitting manufacturer, to produce a leaktight, torque-free connection.

3-3.03.03. Flared. Ends of annealed copper tubing shall be cut square, and all burrs shall be removed prior to flaring. Ends shall be uniformly flared without scratches or grooves. Fittings shall be tightened as needed to produce leaktight connections.

3-3.03.04. Soldered and Brazed. Where solder fittings are specified for lines smaller than 2 inches [50 mm], joints may be soldered or brazed at the option of Contractor

Surfaces to be joined shall be thoroughly cleaned with flint paper and coated with a thin film of flux. At each joint, tubing shall enter to the full depth of the fitting socket.

Care shall be taken to avoid overheating the metal or flux. Each joint shall be uniformly heated to the extent that filler metal will melt on contact. While the joint is still hot, surplus filler metal and flux shall be removed with a rag or brush.

3-3.03.05. Solvent Welded. Solvent welded connections shall only be used for PVC or CPVC pipe. All joint preparation, cutting, and jointing procedures shall comply with the pipe manufacturer's recommendations and ASTM D2855. Pipe ends shall be beveled or chamfered to the dimensions recommended by the manufacturer. Newly assembled joints shall be suitably blocked or restrained to prevent movement during the setting time recommended by the manufacturer. Pressure testing of solvent welded piping systems shall not be performed until the applicable curing time, as set forth in Table X2.1 of ASTM D2855, has elapsed. Solvent welding shall be performed by bonding operators who have met the requirements of ASME B31.3 and A328.

3-3.03.06. Epoxy and Adhesive Bonded. Not Used.

3-3.03.07. Heat Fusion Bonded. Heat fusion bonded joints shall be used for polyethylene pipe with socket and butt fusion fittings. All joint preparation, cutting, jointing equipment, and jointing procedures shall comply with the pipe manufacturer's recommendations. The heating time, temperature, pressure applied to the joint during bonding, and cooling time shall consistently produce leaktight joints as strong as the pipe being joined.

3-3.03.08. Flanged. Flange bolts shall be tightened sufficiently to slightly compress the gasket and effect a seal, but shall not be torqued less than the minimum value required by the gasket

manufacturer. Flange bolts shall not be so tight as to fracture or distort the flanges. A plain washer shall be installed under the head and nut of bolts connecting plastic pipe flanges. Anti-seize thread lubricant shall be applied to the threaded portion of all stainless steel bolts during assembly.

Flange bolt holes shall be oriented as follows, unless otherwise indicated on the spool drawings:

Vertical flange face:	Bolt holes to straddle the vertical centerlines.
Horizontal flange face:	Bolt holes to straddle plant north-south centerlines.

Pipe sealants, thread compounds, or other coatings shall not be applied to flange gaskets unless recommended by the gasket manufacturer for the specified service and approved by Engineer.

Slip-on flanges shall be welded inside and outside. There shall be a distance of approximately 1/16 to 1/8 inch [1.5 to 3 mm] between the edge of the fillet weld and the face of the flange. The seal weld shall be applied so that the flange face shall be free of weld spatter and does not require refacing.

Flat-faced flanges shall be used when mating to Class 125 flanges. Full-face gaskets shall be used with flat-faced flanges and ring gaskets shall be used with raised faced flanges.

Weld neck flanges shall be used with butt-weld fittings. The bore of weld neck flanges shall match the pipe wall thickness.

Insulating joints connecting submerged (buried) piping to exposed piping shall be installed above the maximum water surface elevation and before the first pipe support not having coated anchor bolts or adhesive-bonded concrete anchors. All submerged (buried) metallic piping shall be isolated from the concrete reinforcement. Insulating flanges shall be tested for electrical isolation after installation and bolt-up but prior to introduction of conducting fluid.

3-3.03.09. Welded. Welding shall conform to the specifications and recommendations contained in the "Code for Pressure Piping", ANSI B31.1.

Weld cross-sections shall be equal to or greater than the pipe wall thickness. Welds shall be smooth and continuous and shall have interior projections no greater than 1/16 inch [1.5 mm]. Backing strips or rings shall not be used except with specific prior review by Engineer as to use, material, and design. Root gap inserts that are completely melted and consumed in the weld bead are acceptable only when reviewed in advance by Engineer.

Stainless steel welding shall be inert gas tungsten arc (TIG) or the direct current, straight polarity, inert gas metal arc process (MIG).

Carbon steel welding shall be made by the shielded metal arc process.

3-3.03.10. Grooved Couplings. Grooves for grooved couplings shall be cut with a specially designed grooving tool. Grooves cut in steel pipe shall conform to flexible grooving dimensions, as set forth in AWWA C606, and shall be clean and sharp without burrs or check marks.

3-3.03.11. Push-on. Gasket installation and other jointing procedures shall be in accordance with the recommendations of the manufacturer. Each spigot end shall be suitably beveled to facilitate assembly. All joint surfaces shall be lubricated with a heavy vegetable soap solution immediately before the joint is completed. Lubricant shall be suitable for use in potable water, shall be stored in closed containers, and shall be kept clean.

3-3.03.12. Rubber-Gasketed. Rubber-gasketed joints for hub and spigot type cast iron soil pipe shall have plain spigot ends, without beads. Cut ends of all pipe shall be cut square, beveled, and all burrs shall be removed. Spigot ends shall be coated with a lubricant recommended by the gasket manufacturer and fully seated in the gasket. Clamps for hubless cast iron soil pipe shall be installed in accordance with the manufacturer's recommendations.

3-3.03.13. Other Pipe Joints. Not Used.

3-3.04. Pipe. Pipe shall be installed as specified, as indicated on the drawings, or, in the absence of detail piping arrangement, in a manner acceptable to Engineer.

Piping shall be installed without springing or forcing the pipe in a manner which would induce stresses in the pipe, valves, or connecting equipment.

Piping shall be supported in conformance with the Pipe Supports section.

Piping shall be connected to equipment by flanges or unions as specified in the various piping sections. Piping connecting to equipment shall be supported by a pipe support and not by the equipment.

Water piping shall be provided with a shutoff valve and union at each fixture or unit of equipment, whether or not indicated on the drawings, to permit isolation and disconnection of each item without disturbing the remainder of the system. Air supply piping shall be provided with sectionalizing valves and valved air inlet connections as needed for isolation of portions of the system for periodic testing.

A union shall be provided within 2 feet [600 mm] of each threaded-end valve unless there are other connections which will permit easy removal of the valve. Unions shall also be provided in piping adjacent to devices or equipment which may require removal in the future and where required by the drawings or the specifications.

Water supply piping within structures shall be arranged, and facilities provided, for complete drainage. All piping serving metering equipment shall be uniformly graded so that air traps are eliminated and complete venting is provided.

Stuffing box leakage from water sealed pumps shall be piped to the nearest point of drainage collection.

Taps for pressure gauge connections on the suction and discharge of pumping units shall be provided with a nipple and a ball type shutoff valve.

Drilling and tapping of pipe walls for installation of pressure gauges or switches will not be permitted.

In all piping, insulating fittings shall be provided to prevent contact of dissimilar metals, including but not limited to, contact of copper, brass, or bronze pipe, tubing, fittings, valves, or appurtenances, or stainless steel pipe, tubing, fittings, valves, or appurtenances with iron or steel pipe, fittings, valves, or appurtenances. Insulating fittings shall also be provided to prevent contact of copper, brass, or bronze pipe, tubing, fittings, valves or appurtenances with stainless steel pipe, tubing, fittings, valves, or appurtenances.

Branch connections in horizontal runs of steam, air, and gas piping shall be made from the top of the pipe.

Buried PVC piping shall be "snaked" in the trench and shall be kept as cool as possible during installation. PVC pipe shall be kept shaded and shall be covered with backfill immediately after installation.

Polyethylene piping shall be installed in accordance with the manufacturer's recommendations. A continuous 10 AWG THHN insulated copper tracer wire shall be placed 6 inches [150 mm] above all portions of the buried pipe, but no more than 18 inches [450 mm] below the ground surface. Where the pipe extends above grade, a 2 foot [0.6 m] length of wire shall be coiled and attached to the pipe.

Piping adjacent to flow sensors shall be installed in accordance with the requirements of the manufacturer of the flow sensor and commonly accepted design practices of the appropriate straight pipe runs both upstream and downstream.

Drains required for operation are shown on the drawings. However, vents at all high points and drains at all low points in the piping that are required for complete draining for pressure test may not be shown on these drawings. Contractor shall add such items as found to be necessary during detail piping design and/or piping installation.

3-3.05. Reducers. Eccentric reducers shall be installed flat on the bottom for steam, condensate return and digester gas services.

3-3.06. Valves. Isolation valves provided with equipment and instruments shall be located in a manner which will allow ease of access and removal of the items to be isolated. Prior to soldering or brazing valves, teflon and elastomer seats and seals shall be removed to prevent damage.

3-3.07. Locating (Tracing) Wire. Locating wire, for electronically locating pipe after it is buried, shall be attached along the length of and installed with the pipe. This is applicable to all sizes and types of pressure mains. The tracing wire is to be attached to the pipe with nylon wire ties, as shown on the drawings. The wire itself shall be 10-gauge single strand solid core copper wire with non-metallic insulation. The insulation shall be color coded for the type of pipe being installed. Continuity must be maintained in the wire along the entire length of the pipe run. Permanent splices must be made in the length of the wire using wire connectors approved for underground applications as listed in the uniform electric code handbook. The wire shall extend to the surface and be connected to a test station box at valve locations in the manner, as shown on the drawings.

3-3.08. Detection Tape. Detection tape shall be installed with all pipe. Detection tape for potable water piping shall be blue in color and shall be labeled “CAUTION, BURIED WATER MAIN”. Detection tape for wastewater piping shall be green in color and shall be labeled “CAUTION, BURIED FORCE MAIN”. Detection tape for non-potable water shall be black in color and shall be labeled “CAUTION, BURIED SERVICE WATER MAIN”. Detection tape shall be installed in accordance with the Orange County Utilities standards.

3-4. PIPING ASSEMBLY.

3-4.01. General. Contractor shall only use labor that has been qualified by training and experience to capably perform the specified activities required to accomplish the work in a satisfactory manner

If there is a conflict between the mechanical drawings and piping and instrumentation drawings (P&IDs), the P&ID shall take precedence. Any deviations from the Specifications or piping locations shown on the drawings require prior review and approval by Engineer.

3-4.02. Buttwelded Piping. Not used.

3-5. PROTECTIVE COATING. Standard weight steel pipe in buried locations will have exterior surfaces protected with a shop applied plastic coating.

Where specified in the Miscellaneous Steel Pipe, Tubing, and Accessories section, extra strong steel pipe in buried locations will have exterior surfaces protected with a shop applied plastic coating or a shop applied tape wrap. Where not specified to be shop coated or wrapped in the Miscellaneous Steel Pipe, Tubing and Accessories section, a tape wrap shall be field applied. The exterior surfaces of all fittings, couplings, specials, and other portions of buried piping not protected with plastic coating shall be tape-wrapped in the field.

All surfaces to be tape-wrapped shall be thoroughly cleaned and primed in accordance with the tape manufacturer's recommendations immediately before wrapping. The tape shall be applied by two-ply (half-lap) wrapping or as needed to provide a total installed tape thickness of at least 60 mils [1.5 mm]. Joints in plastic-coated pipe shall be cleaned, primed, and tape-wrapped after installation.

Joints in galvanized steel piping in underground locations shall be field painted with two coats of coal tar epoxy coating.

3-5.01. Inspection. All shop-applied plastic coatings and tape wrap on pipe or fittings shall be inspected for holidays and other defects after receipt of the pipe or fitting on the job and immediately before installation. All field-applied tape wrap on pipe, joints, fittings, and valves shall be inspected for holidays and other defects following completion of wrapping. Inspection of plastic coatings after installation of the pipe or fitting in the trench shall be made where, in the opinion of Engineer, the coating may have been damaged during installation. Holidays and defects disclosed by inspection shall be repaired in accordance with the recommendations of the coating or tape wrap manufacturer, as applicable.

The inspection shall be made using an electrical holiday detector. The detector and inspection procedures shall conform to the requirements of Section 4.4 of ANSI/AWWA C209.

3-6. PRESSURE AND LEAKAGE TESTING. All specified tests shall be made by and at the expense of Contractor in the presence, and to the satisfaction of Engineer. Each piping system shall be tested for at least 1 hour with no loss of pressure. The Contractor shall coordinate this section with the Pipeline Pressure and Leakage Testing section. Piping shall be tested at the indicated pressures:

<u>Service</u>	<u>Test Pressure</u>	<u>Test Medium</u>
Raw water, potable water, and reclaimed water	1-1/2 times working pressure but not less than 100 psi [828 kPa]	Water

Compressed air or pressurized gas shall not be used for testing plastic piping unless specifically recommended by the pipe manufacturer.

Leakage may be determined by loss-of-pressure, soap solution, chemical indicator, or other positive and accurate method acceptable to Engineer. All fixtures, devices, or accessories which are to be connected to the lines and which would be damaged if subjected to the specified test pressure shall be disconnected and the ends of the branch lines plugged or capped as needed during the testing.

Unless otherwise required by the applicable codes, drainage and venting systems shall be water tested. For water testing, the drainage and venting system shall be filled with water to the level of the highest vent stack. Openings shall be plugged as necessary for the test. To be considered free of leaks, the system shall hold the water for 30 minutes without any drop in the water level.

All necessary testing equipment and materials, including tools, appliances and devices, shall be furnished and all tests shall be made by and at the expense of Contractor and at the time directed by Engineer.

All joints in piping shall be tight and free of leaks. All joints which are found to leak, by observation or during any specified test, shall be repaired, and the tests repeated.

3-6.01. Air and Gas Pressure Tests. Not used.

3-7. CLEANING. The interior of all pipe, valves, and fittings shall be smooth, clean, and free of blisters, loose mill scale, sand, dirt, and other foreign matter when installed. Before being placed in service, the interior of all lines shall be thoroughly cleaned, to the satisfaction of Engineer.

3-8. ACCEPTANCE. Owner reserves the right to have any section of the piping system which he suspects may be faulty cut out of the system by Contractor for inspection and testing. Should the joint prove to be sound, Owner will reimburse Contractor on a time-and-material basis as specified in the Contract. Should the joint prove to be faulty, the destructive test will continue joint by joint in all directions until sound joints are found. Costs for replacement of faulty work and/or materials shall be the responsibility of Contractor.

End of Section

BASIC MECHANICAL BUILDING SYSTEMS MATERIALS AND METHODS

PART 1 - GENERAL

1-1. SCOPE. This section covers general mechanical building system requirements as referenced from other sections and furnishing and installation of:

Mechanical identification
Special coatings

for the plumbing and heating, ventilating, and air conditioning systems. Protective coatings for ductwork and equipment without special coatings shall be as specified in the Protective Coatings and Architectural Painting sections.

1-2. GENERAL. Materials furnished and installed under this section shall be fabricated, assembled, erected, and placed in proper operating condition in full conformity with the Drawings, Specifications, engineering data, instructions, and recommendations of the manufacturer unless exceptions are noted by the Engineer.

1-2.01. Coordination. Where two or more units of the same class of materials are required, they shall be the product of a single manufacturer; however, all the component parts of the system need not be the products of one manufacturer.

1-2.02. General Equipment Stipulations. The General Equipment Stipulations shall apply to all materials furnished under this section. If requirements in this specification differ from those in the General Equipment Stipulations, the requirements specified herein shall take precedence.

1-2.03. Governing Standards. Except as modified or supplemented herein, all work covered by this section shall be performed in accordance with all applicable local codes and ordinances, laws, and regulations which pertain to such work. In case of a conflict between these specifications and any state law or local ordinance, the latter shall govern.

1-2.04. Metal Thickness. Metal thickness and gages specified herein are minimum requirements. Gages refer to US Standard gage.

1-3. SUBMITTALS.

1-3.01. Drawings and Data. Complete information, detailed specifications, and data covering materials, parts, devices, and accessories forming a part of the materials furnished, shall be submitted in accordance with the Submittals Procedures section.

Number Plates

Product data on number plates.

A listing of equipment to receive number plates shall be submitted.

Special Coatings

Name of manufacturer.

Coating type.
Color.
Chemical resistance data.
Temperature range data.
Surface preparation.
Application data.
Film thickness per coat.
Drying and curing time information.

Equipment Motors

Name of Manufacturer.
Type and Model.
Horsepower (kW) rating and service factor.
Temperature rise and insulation rating.
Full load rotative speed.
Type of bearings and method of lubrication.
Net weight.
Overall dimensions.
Efficiency at full, 3/4, and 1/2 loads.
Full load current and power factor.
Locked rotor current.

1-3.02. Samples. Not used.

1-4. QUALITY ASSURANCE.

1-4.01. Welding Qualifications. All welding procedures and welding operators shall be qualified by an independent testing laboratory in accordance with the applicable provisions of AWS Standard Qualification Procedures. All procedure and operator qualifications shall be in written form and subject to Engineer's review. Accurate records of operator and procedure qualifications shall be maintained by Contractor and made available to Engineer upon request.

1-4.02. Manufacturer's Experience. Unless the equipment manufacturer is specifically named in this section, the manufacturer shall have furnished equipment of the type and size specified which has been in successful operation for not less than the past 5 years.

1-5. EXTRA MATERIALS. The following extra materials shall be furnished for the listed equipment:

Touchup special coating material

Extra materials shall be packaged in accordance with the Product Delivery Requirements section, with labels indicating the contents of each package. Each label shall indicate manufacturer's name, equipment name, equipment designation, part nomenclature, part number, address of nearest distributor, and current list price. Extra materials shall be delivered to Owner as directed.

PART 2 - PRODUCTS

2-1. SERVICE CONDITIONS. All equipment shall be designed and selected to meet the

specified conditions. Where equipment is provided with special coatings, unit capacities shall be corrected to account for any efficiency losses from the selected special coating.

2-2. PERFORMANCE AND DESIGN REQUIREMENTS.

2-2.01. Dimensional Restrictions. Layout dimensions will vary between manufacturers and the layout area indicated on the Drawings is based on typical values of the first manufacturer listed. Contractor shall review the contract Drawings, the manufacturer's layout drawings, and installation requirements and shall make any modifications required for proper installation subject to acceptance by Engineer.

2-2.02. Elevation. Equipment shall be designed to operate at the elevation indicated in the Meteorological and Seismic Design Criteria section

2-2.03. Equipment Efficiencies. Unless otherwise indicated in the respective equipment paragraph, the equipment efficiency shall be in accordance with the requirements of ASHRAE Energy Standard 90.1.

2-2.04. Drive Units. Drive units shall be designed for 24 hour continuous service.

2-2.04.01. V-Belt Drives. Each V-belt drive shall include a sliding base or other suitable belt tension adjustment. V-belt drives shall have a service factor of at least 1.5 at maximum speed based on the nameplate horsepower [kW] of the drive motor unless otherwise indicated in the specific equipment paragraph. Multiple belts shall be provided in matched sets and shall be oil resistant, non-static type. External belts and drive assemblies shall be protected by a belt safety guard constructed in accordance with OSHA requirements. The guard shall be provided with a tachometer opening.

Unless otherwise indicated in the specific equipment paragraph, equipment with smaller than 10 horsepower motors shall have adjustable pitch sheaves and equipment with 10 horsepower and larger motors shall have fixed sheaves. Adjustable sheaves shall be selected so that the fan speed at the specified conditions is selected at the mid-position of the sheave range. Fixed sheaves shall be replaced as necessary with sheaves of the proper size during the air system balancing to provide the required speed for the specified airflow.

2-2.04.02. Electric Motors. Motor horsepower scheduled on the Drawings are minimum motor horsepower. Larger motors shall be provided if required to meet the specified capacities for the equipment furnished. Motors furnished with equipment shall meet the following requirements.

- a. Premium efficient motors with a minimum efficiency of at least that specified in the Common Motor Requirements for Process Equipment section shall be provided where available as a standard option. All other motors shall meet the minimum efficiency standards required by the Energy Policy Act (EPACT) of 1992.
- b. Designed and applied in accordance with NEMA, ANSI, IEEE, AFBMA, and NEC for the duty service imposed by the driven equipment, such as frequent starting, intermittent overload, high inertia, mounting configuration, or service environment.

- c. Rated for continuous duty at 40°C ambient.
- d. Motors used in applications which exceed the usual service conditions as defined by NEMA, such as higher than 40°C ambient, altitude exceeding 3,300 feet, explosive or corrosive environments, departure from rated voltage and frequency, poor ventilation, frequent starting, or adjustable frequency drive applications, shall be properly selected with respect to their service conditions and shall not exceed specified temperature rise limits in accordance with ANSI/NEMA MG 1 for insulation class, service factor, and motor enclosure type.
- e. To ensure long life, motors shall have nameplate horsepower equal or greater than the maximum load imposed by the driven equipment and shall carry a service factor rating as follows:

<u>Motor Size</u>	<u>Enclosure</u>	<u>Service Factor</u>
Fractional hp	Open	1.15
	Other Than Open	1.0
Integral hp	Open	1.15
	Other Than Open	1.0

Motors used with adjustable frequency drives shall have a 1.15 service factor on sine wave power and a 1.0 service factor on drive power.

- f. Designed for full voltage starting.
- g. Designed to operate from an electrical system that may have a maximum of 5 percent voltage distortion according to IEEE 519.
- h. Totally enclosed motors shall have a continuous moisture drain that also excludes insects.
- i. Bearings shall be either oil or grease lubricated.
- j. Motor nameplates shall indicate as a minimum the manufacturer name and model number, motor horsepower, voltage, phase, frequency, speed, full load current, locked rotor current, frame size, service factor, power factor, and efficiency.
- k. Dripproof motors, or totally enclosed motors at Contractor's option, shall be furnished on equipment in indoor, above-grade, clean, and dry locations.
- l. Totally enclosed motors shall be furnished on:
 - (1) Outdoor equipment.
 - (2) Equipment for installation below grade.
 - (3) Equipment operating in chemical feed and chemical handling locations.
 - (4) Equipment operating in wet or dust-laden locations.
- m. Explosionproof motors shall be furnished as specified by applicable codes or as specified in other sections.

- n. A manufacturer's standard motor may be supplied on packaged equipment and fans in which case a redesign of the unit would be required to furnish motors of other than the manufacturer's standard design. However, in all cases, the motor types indicated are preferred and shall be furnished if offered by the manufacturer as a standard option.
- o. Motors used with adjustable frequency drives shall have insulation system meeting the requirements of NEMA MG 1, Part 31.

2-3. MANUFACTURE AND FABRICATION.

2-3.01. Welding. All welds shall be continuous (seal type) on submerged or partially submerged components.

2-3.02. Anchor Bolts and Expansion Anchors. Anchor bolts, expansion anchors, nuts, and washers shall be as indicated in the Anchorage in Concrete and Masonry section unless otherwise indicated on the Drawings.

2-3.03. Edge Grinding. Sharp corners of cut or sheared edges which will be submerged in operation shall be dulled by at least one pass of a power grinder to improve paint adherence.

2-3.04. Surface Preparation. All iron and steel surfaces, except motors, shall be shop cleaned by sandblasting or equivalent, in strict conformance with the paint manufacturer's recommendations. All mill scale, rust, and contaminants shall be removed before shop primer is applied.

2-4. MATERIALS.

2-4.01. Mechanical Identification. Mechanical identification consisting of equipment number plates, equipment information plates, valve tags, and ductwork identification shall conform to the requirements of the Equipment and Valve Identification section and as indicated herein.

2-4.01.01. Number Plates. Not used.

2-4.01.02. Piping. Not used.

2-4.01.03. Valves. Not used.

2-4.01.04. Ductwork. Not used.

2-4.02. Seismic Design. Not used.

2-4.03. Special Coatings. Where indicated on the Drawings, sheet metal ductwork, dampers, registers, grilles, coils, and equipment shall be given a special coating suitable for the corrosive atmosphere indicated. Sheet metal ductwork, dampers, registers, grilles, coils, and equipment construction shall be suitable to allow proper application of the special coating system in accordance with the manufacturer's recommendation.

PART 3 - EXECUTION

3-1. INSTALLATION. Materials furnished under this section shall be installed in proper operating condition in full conformity with the drawings, specifications, engineering data, instructions, and recommendations of the manufacturer, unless exceptions are noted by the Engineer.

The installation of identifying devices shall be coordinated with the application of covering materials and painting where devices are applied to surfaces. All surfaces to receive adhesive number plates shall be cleaned before installation of the identification device.

End of Section

Section 15060

MISCELLANEOUS PIPING AND PIPE ACCESSORIES

PART 1 - GENERAL

1-1. SCOPE. This section covers the furnishing of miscellaneous piping and pipe accessories. Miscellaneous piping shall be furnished complete with all fittings, flanges, unions, and other accessories specified herein.

1-2. SUBMITTALS.

1-2.01. Drawings and Data. Complete specifications, data and catalog cuts or drawings shall be submitted in accordance with the submittals section. Submittals are required for all piping, fittings, gaskets, sleeves, and accessories, and shall include the following data:

- Name of Manufacturer
- Type and model
- Construction materials, thickness, and finishes
- Pressure and temperature ratings

Contractor shall obtain and submit a written statement from the gasket material manufacturer certifying that the gasket materials are compatible with the joints specified herein and are recommended for the specified field test pressures and service conditions.

1-3. DELIVERY, STORAGE, AND HANDLING. Shipping shall be in accordance with the Shipping section. Handling and storage shall be in accordance with the Handling and Storage section. All materials shall be stored in a sheltered location above the ground, separated by type, and shall be supported to prevent sagging or bending.

PART 2 - PRODUCTS

2-1. MATERIALS. Miscellaneous piping materials shall be as specified herein.

2-1.01. Material Classification BR-1.

BR-1 – Regular Weight Brass Pipe Gauge piping for cold water.	Pipe	ASTM B43, red brass, seamless, regular weight.
	Fittings	ANSI/ASME B16.15, Class 125.

2-1.02. Material Classification BR-2. Not used.

2-1.03. Material Classification HS-1. Not used.

2-1.04. Material Classification HS-2. Not used.

2-1.05. Material Classification TG-1. Not used.

2-1.06. Material Classification CRP-1. Not used.

2-1.07. Accessories. Accessories for the miscellaneous piping systems shall be as indicated.

Unions for brass pipe Fed Spec A-A-59617, Class 125.

PART 3 - EXECUTION

3-1. INSTALLATION. Materials furnished under this section will be installed in accordance with the Miscellaneous Piping and Accessories Installation section.

End of Section

Section 15061

DUCTILE IRON PIPE

PART 1 - GENERAL

1-1. SCOPE. This section covers the furnishing and installation of ductile iron pipe. Ductile iron pipe shall be furnished complete with all fittings, jointing materials, pipe hangers and supports, anchors, blocking, encasement, and appurtenances. Piping shall be furnished by Contractor.

Water supply piping 4 inches and larger shown on the plumbing drawings shall be ductile iron pipe.

Piping furnished hereunder shall be complete with all joint gaskets, bolts, and nuts required for installation of any valves and equipment furnished by others for installation under this contract.

Pipe hangers and supports, pressure and leakage testing, cleaning, disinfection, and cathodic protection are covered in other sections. Cast iron soil pipe is covered in the Miscellaneous Piping section. Pipe trenching, bedding, and backfill shall be as specified in the Earthwork section and in accordance with the details on the Drawings.

1-1.01. Main Pipe Supplier. All ductile iron pipe, fittings, and specials shall be fabricated, lined, coated, and furnished under the direction and management of one pipe supplier, (the Main Pipe Supplier). The Contractor shall designate the Main Pipe Supplier and notify them in writing of their responsibilities, which shall include, at a minimum; ensure and certify that all pipe, fittings, specials, and other materials specified herein, are being manufactured in full accordance with the contract documents; prepare and submit all submittal information and shop drawings; and make any corrections that may be required to submittal information and shop drawings.

1-1.02. Main Pipe Supplier's Experience and Field Services. The Main Pipe Supplier's minimum required experience qualifications shall include manufacture of a pipeline at least 1 mile [1.6 km] in length, of a diameter equal to or larger than the pipe to be provided, with joints, lining, and coating suitable for the same or a higher pressure rating, which has performed satisfactorily for the past 5 years.

All ductile iron pipe shall be installed in accordance with the Main Pipe Supplier recommendations.

The Main Pipe Supplier shall provide the services of an experienced, competent, and authorized field service representative who is acceptable to Owner to perform all field services specified herein. The field service representative minimum required experience shall include 5 years of practical knowledge and experience installing ductile iron pipe with joints, lining, and coating of the pipe to be furnished. The resume of the proposed field service representative which meets the specified minimum required experience qualifications shall be submitted for review. The Main Pipe Supplier's field service representative shall visit the site and inspect, check, instruct, guide, and direct Contractor's procedures for pipe handling, laying, and jointing at the start of

pipe installation for each crew and shall coordinate his services with Contractor. The field service representative shall revisit the site as often as necessary to perform an installation check.

The Main Pipe Supplier shall furnish a metal gauge to measure the restrained push-on joint grooves for pipe and fittings and each pipe or fitting shall be checked before installation.

Each joint, including restrained joints, shall be checked by Contractor as instructed by the Main Pipe Supplier's field service representative to verify that the joint and the restraints are installed properly.

The Main Pipe Supplier field service representative shall furnish to Owner, through Engineer, a written report certifying that Contractor's installation personnel have been properly instructed and have employed the proper pipe handling and installation procedures. The Main Pipe Supplier's representative shall also furnish to Owner, through Engineer, a written report of each site visit.

All costs for these services shall be included in the Contract Price.

1-2. SUBMITTALS. Drawings, details, specifications, and installation schedules covering all ductile iron pipe and accessories shall be submitted in accordance with the Submittals section. The drawings and data shall include, but shall not be limited to, the following:

Certification by manufacturer for each item furnished in accordance with the ANSI/AWWA Standards.

Restrained joints details.

Certification of pipe manufacturer's field services, including a copy of the initial services, and all subsequent inspection reports.

Field service representative's resume.

Certification of gaskets, certifying that gasket material is suitable for services intended.

Certification of joint lubricant.

Certification of proof-of-design tests for joints, including restrained joints.

Certification of pipe manufacturer of fabricator and certification of proof-of-design tests for welded-on outlets.

Laying schedule complete with an explanation of all abbreviations used in the schedule. For long, straight pipe runs, the laying schedule shall list the pipeline station and centerline elevation at least every 100 feet.

Two samples of the polyethylene encasement, each sample clearly identified as required by the Governing Standards and test results from an independent third party laboratory of the requirements specified in ANSI/AWWA C105/A21.5.

The method that the Contractor proposes to use for measuring deflection of pipe joints.

Submittal data shall clearly indicate the country of origin of pipe, fittings, flanges, restraining devices, and accessories. Certified copies of physical and chemical test results as outlined in ANSI/AWWA C151/A21.51 shall be submitted for the materials to be provided.

Contractor shall submit a written statement from the gasket material manufacturer certifying that the gasket materials are compatible with the joints specified herein and are recommended for the specified field test pressures and service conditions.

1-2.01. Emergency Repair Manual. Not used.

1-3. SHIPPING, HANDLING, AND STORAGE. Shipping shall be in accordance with the Shipping section. Handling and storage shall be in accordance with the Handling and Storage section, and as specified herein.

Pipe, fittings, and accessories shall be handled in a manner that will ensure installation in sound, undamaged condition. Equipment, tools, and methods used in handling and installing pipe and fittings shall not damage the pipe and fittings. Hooks inserted in ends of pipe shall have broad, well-padded contact surfaces. Unpadded hooks, wire brushes or other abrasive tools shall not be permitted to come into contact with polyethylene lining if such lining is specified.

Contractor-furnished pipe and fittings in which the lining has been damaged shall be replaced by and at the expense of Contractor. With the concurrence of Engineer, small and readily accessible damaged areas may be repaired.

If the lining of Owner-furnished pipe or fittings is damaged by Contractor during unloading or handling, the damaged pipe or fittings shall be replaced by and at the expense of Contractor. Where the damaged areas are small and readily accessible, Contractor may be permitted to repair the lining.

Contractor shall repair any damage to pipe coatings before the pipe is installed.

PART 2 - PRODUCTS

2-1. PIPE CLASS. The class of ductile iron pipe shall be as specified below based on pipe size . The specified class includes service allowance and casting allowance.

Pipe Size (inches)	Minimum Pressure Class
4-16	350
18-24	250
30-64	200

Pipe wall thickness for grooved and threaded end pipe shall be increased if necessary to comply with the following minimum thickness:

<u>Pipe Size</u>		<u>Minimum Class</u>	
<u>inches</u>	<u>Mm</u>	<u>Threaded Ends (1)</u>	<u>Grooved Ends (2)</u>
4-16	100-400	53	53
18	450	53	54
20	500	53	55
24	600	53	56
30-54	750-1400	53	--
60 & 64	1500-1600	350	--

(1) Complies with ANSI/AWWA C115/A21.15 for minimum pipe wall thickness for threaded flanges.

(2) Complies with ANSI/AWWA C606 for grooved and shouldered joint ductile iron pipe.

2-2. MATERIALS.

Pipe

Ductile iron, ANSI/AWWA C151/A21.51, Table 1 or Table 3.

Gaskets – All Joint Types

Synthetic rubber; natural rubber will not be acceptable. Gaskets for potable water service shall be certified as suitable at the pipe pressure and for chlorinated and chloraminated potable water; a certificate of gasket suitability shall be submitted. Gaskets shall be furnished by the pipe manufacturer.

Gas and oil-resistant gaskets shall be made of Nitrile (NBR [Acrylonitrile Butadiene]) rubber. The name of the material shall be permanently marked or molded on the gasket. Gaskets shall be certified as suitable where soils may be contaminated with gas and oil products. A certificate of gasket suitability shall be submitted.

Joint Lubricant

Vegetable-based lubricant recommended by the pipe manufacturer. Petroleum or animal-based lubricants will not be acceptable. Lubricants that will be in contact with treated or potable water shall be certified as being in compliance with ANSI/NSF 61.

Fittings

ANSI/AWWA C110/A21.10 (except shorter laying lengths will be acceptable for U.S. Pipe), or ANSI/AWWA C153/A21.53, minimum working pressure rating as follows, unless indicated otherwise on the drawings.

<u>Fitting Size</u> in. [mm]	<u>Material</u>	<u>Type</u>	<u>Min. Working Pressure Rating,</u> psi [kPa]
4 to 24 [100 to 600]	DI	Mechanical and Push-on joints	350 [2,400]
4 to 24 [100 to 600]	DI	Flanged joints	250 [1,700]
30 to 48 [750 to 1,200]	DI	All joints	250 [1,700]
54 to 64 [1,350 to 1,600]	DI	All joints	150 [1,000]

All fittings shall be ductile iron and suitable for a factory test pressure of rated working pressure plus 100 psi or 1.5 times rated working pressure, whichever is less, without leakage or damage.

Push-on Joints

ANSI/AWWA C111/A21.11.

Restrained Push-on Joints, gaskets with stainless steel gripping segments, (4 inch through 12 inch) [100 mm through 300 mm]

American "Fast Grip" or "Field Lok 350 Gasket" manufactured by U.S. Pipe and furnished to licensed Tyton® joint manufacturer.

Restrained Push-on Joints, locking wedge type, (4 inch through 24 inch) [100 mm through 600 mm]

EBAA Iron "Megalug" Series 1700; U.S. Pipe "TR Flex Gripper Ring"; Star Pipe Products "StarGrip 3100"; or American "Field Flex Ring", without exception.

Restrained Push-on Joints, positive locking segments and/or rings, (4 inch through 64 inch) [100 mm through 1,600 mm]

American "Flex-Ring," or "Lok-Ring"; Clow "Super-Lock"; U.S. Pipe "TR Flex"; or Griffin "Snap-Lok."

Flanged Joints

ANSI/AWWA C115/A21.15.

Flanges

Class 250
(where identified)

Ductile iron, flat faced, with ANSI/ASME B16.1, Class 250 diameter and drilling.

All Others	Ductile iron, Class 125, ANSI/AWWA C115/A21.15.
Flanges	All flanges shall be suitable for test pressure of 1.5 times rated pressure without leakage or damage.
Bolts	ASTM A307, chamfered or rounded ends projecting 1/4 to 1/2 inch [6.3 to 12.7 mm] beyond outer face of nut.
Nuts	ASTM A307, hexagonal, ANSI/ASME B18.2.2, heavy semifinished pattern.
Gaskets	ASTM D1330, Grade I rubber, full face type, 1/8 inch [3 mm] thick. Gaskets shall be furnished by the pipe manufacturer. Gaskets for potable water service shall be certified as suitable for chlorinated potable water; a certificate of gasket suitability shall be submitted.
Insulated Flanges	
Flanges	As specified herein, except bolt holes shall be enlarged as needed to accept bolt insulating sleeves.
Insulation Kits	As manufactured by Central Plastics or Pipeline Seal and Insulator, Inc.
Insulating Gaskets	Type E, NEMA G-10 glass reinforced epoxy, 1/8 inch [3 mm] thick, with Buna-N sealing element for water and air service. For wastewater service use Viton sealing element. Gaskets shall be furnished by the pipe manufacturer. Gaskets for potable water service shall be certified as suitable for chlorinated potable water; a certificate of gasket suitability shall be submitted.
Bolt Insulating Sleeves	Mylar, 1/32 inch [0.79 mm] thick.
Insulating Washers	Phenolic laminate, 1/8 inch [3 mm] thick, two for each flange bolt.
Backing Washers	Steel, 1/8 inch [3 mm] thick, two for each flange bolt.
Mechanical Joints	ANSI/AWWA C111/A21.11.
Restrained Mechanical Joints (factory prepared spigot), (4 inch through 48 inch) [100 mm through 1,200 mm]	American "MJ coupled Joints", or Griffin "Mech-Lok".

Restrained Mechanical Joints, (field cut spigot), (4 inch through 24 inch) [100 mm through 600 mm]	EBA Iron "Megalug" Series 1100, or Star Pipe Products "StarGrip 3000" without exception.
Wall Pipes or Castings	Mechanical joint with water stop and tapped holes; single casting or fabricated ductile iron pipe; holes sized in accordance with the details on the drawings and provided with removable plugs.
Mechanical Joints with Tie Rods	As indicated on the drawings.
Tie Rods	ASTM A307.
Steel Pipe	ASTM A53, Schedule 40 or 80 as indicated on the drawings.
Washers	ANSI/ASME B18.22.1, plain steel.
Threaded Connections	ANSI/ASME B1.20.1, NPT; with boss or tapping saddle wherever wall thickness minus the foundry tolerance at the tapped connection is less than that required for 4-thread engagement as set forth in Table A.1, Appendix A, of ANSI/AWWA C151/A21.51.
Mechanical Couplings	
Couplings	Dresser "Style 38"; Smith-Blair "r 411 Steel Coupling"; or Romac "Style 400" or "Style 501"; without pipe stop.
Gaskets	Oil-resistant synthetic rubber. Gaskets shall be furnished by the pipe manufacturer. Gaskets for potable water service shall be certified as suitable for chlorinated potable water; a certificate of gasket suitability shall be submitted.
Grooved-End Joints	AWWA C606.
Pipe Ends (rigid joints)	Grooved, with dimensions conforming to AWWA C606, Table 3.
Pipe Ends (flexible joints)	Shouldered, with dimensions conforming to AWWA C606, Table 4.
Couplings (non-shouldered pipe)	Tyco/Grinnell "Figure 772," or Victaulic "Style 31."
Couplings (shouldered pipe)	Victaulic "Style 41" or "Style 44".

Flanged Coupling Adapters

Restrained (4 inch through 12 inch) [100 mm through 300 mm]

Smith-Blair "Type 912" or Romac "Style FCA501", with anchor studs.

Dismantling Joints

Restrained (3 inch and larger [350 mm and larger] - Dismantling Joint)

Romac "DJ400"; Dresser "Style 131 Dismantling Joint" or Viking Johnson. For use in potable water systems, coating to be in accordance with NSF-61. Bolts, nuts, and tie rods shall be stainless steel ASTM A304 or A316.

Unrestrained (14 inch and larger) [350 mm and larger]

Smith-Blair "Type 913" or Romac "Style FC400", 14 inches [350 mm] and larger.

Unless otherwise indicated on the drawings, flanged coupling adapters shall be restrained.

Tapping Saddles

Ductile iron, with steel straps and rubber sealing gasket, 250 psi [1,700 kPa] pressure rating.

Watertight/Dusttight Pipe Sleeves

PSI "Thunderline Link-Seal", insulating type with modular rubber sealing elements, nonmetallic pressure plates, and stainless steel bolts and nuts.

Shop Coating and Lining

Cement Mortar Lining with Seal Coat

ANSI/AWWA C104/A21.4.

Ceramic Epoxy Lining

Induron "Protecto 401 Ceramic Epoxy".

Glass Lining

Two-coat system applied over blast-cleaned surface; ground and finish coats separately fired; finished lining thickness at least 8 mils [200 μm], Mohs' Hardness 5 to 6 density [2,500 to 3,000 kg/m^3] as determined by ASTM D792; Fast Fabricators, Inc. "MEH 32" or "SG-14".

Universal Primer

Manufacturer's standard. If in contact with treated or potable water, certify as being in compliance with ANSI/NSF 61.

Asphaltic Coating

Manufacturer's standard.

Coal Tar Epoxy

Manufacturer's standard.

Liquid Epoxy	ANSI/AWWA C210, non-coal tar modified, or when in contact with treated or potable water, certify as being in compliance with ANSI/NSF 61.
Medium Consistency Coal Tar	Carboline "Bitumastic 50" or Tnemec "46-465 H.B. Tnemecol."
Polyethylene Encasement	Seamless, ANSI/AWWA C105/A21.5; LLDPE - 8 mil [200 µm] or HDCLPE - 4 mil [100 µm].

2-3. SHOP COATING AND LINING. The interior of all pipe and fittings, unless noted otherwise, shall be cement mortar lined and seal coated.

The exterior surfaces of all pipe and fittings which will be exposed in interior locations shall be shop primed. Flange faces shall be coated with a suitable rust-preventive compound. Exterior surfaces of all other pipe and fittings shall be coated with asphaltic coating.

2-4. COLOR CODING. All buried and above ground pipe shall be color coded. The colors used shall be as listed in the Recommended Standards for Water Works (10 State Standard) and as approved by the County. For buried piping, tape or paint shall be applied in a continuous line that runs parallel to the axis of the pipe and that is located along the top of the pipe; for pipes with an internal diameter of 24 inches or greater, tape or paint shall be applied in continuous lines along each side of the pipe as well as along the top of the pipe.

PART 3 - EXECUTION

3-1. INSPECTION. Pipe and fittings shall be carefully examined for cracks and other defects immediately before installation; pipe ends shall be examined with particular care. All defective pipe and fittings shall be removed from the site.

3-2. PREPARATION. The interior of all pipe and fittings shall be thoroughly cleaned of all foreign matter prior to installation. Before jointing, all joint contact surfaces shall be wire brushed if necessary, wiped clean, and kept clean until jointing is completed.

Precautions shall be taken to prevent foreign material from entering the pipe during installation. Debris, tools, clothing, or other objects shall not be placed in or allowed to enter the pipe.

3-3. CUTTING PIPE. Cutting shall be done in a neat manner, without damage to the pipe or the lining. Cuts shall be smooth, straight, and at right angles to the pipe axis. After cutting, the ends of the pipe shall be dressed with a file or a power grinder to remove all roughness and sharp edges. The cut ends of push-on joint pipe shall be suitably beveled.

All field cutting of existing gray cast iron pipe shall be done with mechanical pipe cutters, except where the use of mechanical cutters would be difficult or impracticable.

Contractor shall use factory prepared pipe ends unless a field cut is required for connections.

Ends of ductile iron pipe shall be cut with a portable guillotine saw, abrasive wheel, saw, milling cutter, or oxyacetylene torch. The use of hydraulic squeeze type cutters will not be acceptable. Field-cut holes for saddles shall be cut with mechanical cutters; oxyacetylene cutting will not be acceptable.

3-4. ALIGNMENT. Piping shall be laid to the lines and grades indicated on the drawings. Pipelines or runs intended to be straight shall be laid straight. Deflections from a straight line or grade shall not exceed the values stipulated in Table 3 or Table 4 of AWWA C600, unless specially designed bells and spigots are provided.

Either shorter pipe sections or fittings shall be installed where needed to conform to the alignment or grade indicated on the drawings.

When pipelines must be closely controlled, laser beam equipment, surveying instruments, or other suitable means shall be used to maintain alignment and grade. At least one elevation reading shall be taken on each length of pipe. If laser beam equipment is used, periodic elevation measurements shall be made with surveying instruments to verify accuracy of grades. If such measurements indicate thermal deflection of the laser beam due to differences between the ground temperature and the air temperature within the pipe, precautions shall be taken to prevent or minimize further thermal deflections.

3-5. LAYING PIPE. Buried pipe shall be protected from lateral displacement by placing the specified pipe embedment material installed as specified in the Earthwork section. Under no circumstances shall pipe be laid in water, and no pipe shall be laid under unsuitable weather or trench conditions.

Whenever pipe laying is stopped, the open end of the pipe shall be sealed with a watertight plug, which will prevent trench water from entering the pipe.

Pipe shall be laid with the bell ends facing the direction of laying, except where reverse laying is specifically acceptable by Engineer.

3-6. FIELD JOINTS. Unless otherwise noted, all buried piping shall be restrained. Joints in buried and tunnel locations shall be mechanical or push-on type unless otherwise indicated on the drawings or where required to connect to existing piping or to valves. Bells on wall castings and wall sleeves shall be mechanical joint type, with tapped holes for tie rods or stud bolts. All other joints shall be flanged unless otherwise indicated on the drawings.

Certification of joint design shall be provided in accordance with ANSI/AWWA C111/A21.11, Section 4.5, Performance Requirements, as modified herein. The joint test pressure shall be not less than 2 times the working pressure or 1-1/2 times the test pressure of the pipeline, whichever is higher. The same certification and testing shall also be provided for restrained joints. For restrained joints, the piping shall not be blocked to prevent separation and the joint shall not leak or show evidence of failure. It is not necessary that such tests be made on pipe manufactured specifically for this project. Certified reports covering tests made on other pipe of the same size and design as specified herein and manufactured from materials of equivalent type and quality may be accepted as adequate proof of design.

Restrained joints shall be extended after they are assembled to minimize further takeup.

Field closure pieces shall be located away from the bends beyond the length over which joints are to be restrained.

Where acceptable to Engineer, grooved couplings may be used instead of flanges, provided that rigid grooving is used to preclude longitudinal pipe movement and angular deflection at joints. Fittings, valves, and equipment installed using grooved couplings shall be adequately supported and blocked or restrained to prevent rotation.

3-7. MECHANICAL JOINTS. Mechanical joints shall be carefully assembled in accordance with the manufacturer's recommendations. If effective sealing is not obtained, the joint shall be disassembled, thoroughly cleaned, and reassembled. Bolts shall be uniformly tightened to the torque values listed in Appendix A of ANSI/AWWA C111/A21.11. Overtightening of bolts to compensate for poor installation practice will not be acceptable.

The holes in mechanical joints with tie rods shall be carefully aligned to permit installation of the tie rods. In flange and mechanical joint pieces, holes in the mechanical joint bells and the flanges shall straddle the top (or side for vertical piping) centerline. The top (or side) centerline shall be marked on each flange and mechanical joint piece at the foundry.

3-8. PUSH-ON JOINTS. The pipe manufacturer's instructions and recommendations for proper jointing procedures shall be followed. All joint surfaces shall be lubricated with a soap solution provided by the pipe manufacturer immediately before the joint is completed. Lubricant shall be suitable for use in potable water, shall be stored in closed containers, and shall be kept clean. Each spigot end shall be suitably beveled to facilitate assembly.

Unless otherwise noted, all buried piping shall be restrained. Pipe ends for restrained joint pipe shall be prepared in accordance with the pipe manufacturer's recommendations.

3-9. FLANGED JOINTS. Pipe shall extend completely through screwed-on flanges. The pipe end and flange face shall be finish machined in a single operation. Flange faces shall be flat and perpendicular to the pipe centerline.

When bolting flanged joints, care shall be taken to avoid restraint on the opposite end of the pipe or fitting which would prevent uniform gasket compression or would cause unnecessary stress in the flanges. One flange shall be free to move in any direction while the flange bolts are being tightened. Bolts shall be tightened gradually and at a uniform rate, to ensure uniform compression of the gasket.

Special care shall be taken when connecting piping to any pumping equipment to ensure that piping stresses are not transmitted to the pump flanges. All connecting piping shall be permanently supported to obtain accurate matching of bolt holes and uniform contact over the entire surface of flanges before any bolts are installed in the flanges. Pump connection piping shall be free to move parallel to its longitudinal centerline while the bolts are being tightened. Each pump shall be leveled, aligned, and wedged into position which will fit the connecting piping, but shall not be grouted until the initial fitting and alignment of the pipe, so that the pump may be shifted on its foundation if necessary to properly install the connecting piping. Each pump shall, however, be grouted before final bolting of the connecting piping. After final

alignment and bolting, the pump connections shall be tested for applied piping stresses by loosening the flange bolts which, if the piping is properly installed, should result in no movement of the piping relative to the pump or opening of the pump connection joints. If any movement is observed, the piping shall be loosened and re-aligned as needed and then the flanges bolted back together. The flange bolts shall then be loosened and the process repeated until no movement is observed.

3-10. FLANGED COUPLING ADAPTERS. Flanged coupling adapters shall be installed in strict accordance with the coupling manufacturer's recommendations. After the pipe is in place and bolted tight, the proper locations of holes for the anchor studs shall be determined and the pipe shall be field-drilled. Holes for anchor studs shall be drilled completely through the pipe wall. Hole diameter shall be not more than 1/8 inch [3 mm] larger than the diameter of the stud projection. Unless indicated on the drawings, all flange coupling adapters shall be restrained.

The inner surfaces of couplings shall be prepared for coating in accordance with instructions of the coating manufacturer and shall then be coated with liquid epoxy in accordance with ANSI/AWWA C210. The remaining surfaces, except flange mating surfaces, shall be cleaned and shop primed with universal primer.

3-11. DISMANTLING JOINTS. Dismantling joints shall be provided for restrained coupling 14 inch and larger and where indicated on the drawings and as specified herein. Dismantling joints shall comply with AWWA C219 and shall be restrained flange by flange couplings manufactured as a single unit. Dismantling joints shall be installed in accordance with the manufacturer's recommendations.

3-12. MECHANICAL COUPLINGS. Mechanical couplings shall be carefully installed in accordance with the manufacturer's recommendations. A space of at least 1/4 inch [6 mm], but not more than 1 inch [25 mm], shall be left between the pipe ends. Pipe and coupling surfaces in contact with gaskets shall be clean and free from dirt and other foreign matter during assembly. All assembly bolts shall be uniformly tightened so that the coupling is free from leaks, and all parts of the coupling are square and symmetrical with the pipe. Following installation of the coupling, damaged areas of shop coatings on the pipe and coupling shall be repaired to the satisfaction of Engineer.

The interior surfaces of the middle rings shall be prepared for coating in accordance with instructions of the coating manufacturer and shall then be coated with liquid epoxy in accordance with ANSI/AWWA C210. The remaining components shall be cleaned and shop primed with universal primer.

3-13. GROOVED-END JOINTS. Grooved-end joints with rigid type grooving shall be installed in accordance with the coupling manufacturer's recommendations. Completed joints shall be rigid and shall allow no angular deflection or longitudinal movement. Except for closure pieces, field grooving of pipe will not be acceptable.

Special care shall be taken when connecting piping to pumping equipment to avoid transmitting pipe stresses to the pump flanges. Piping shall be permanently supported to obtain accurate matching with abutting pump flanges before bolts are installed in the flanges.

Grooved end couplings shall not be used in the following applications: chemical service, except lime slurry piping, flammable liquid or flammable gas piping, compressed air or compressed gas piping operating at pressures above 25 psig, toxic gas piping, hot liquid with operating temperatures above 120°F, or steam piping.

3-14. POLYETHYLENE ENCASEMENT. All buried ductile iron pipe, including all straight pipe, bends, tees, adapters, closure pieces, and other fittings or specials, and all valves, shall be provided with at least one wrap of polyethylene encasement. Locations where ductile iron pipe shall be double wrapped with polyethylene encasement are indicated on the drawings and/or as specified in the provisions for Corrosion Protection section. Polyethylene encasement shall be color coded in accordance with the type of pipe installed. Polyethylene encasement for finished water piping shall be dark blue.

Polyethylene tube protection shall be installed in accordance with ANSI/AWWA C105/A21.5, Method A. Preparation of the pipe shall include, but shall not be limited to, removal of lumps of clay, mud, cinders, etc., prior to installation.

Where ductile iron pipe is also embedded or encased in concrete, the polyethylene tube shall be installed over the pipe for 5 feet [1.5 m] either side of each end of the concrete encasement.

The terms "polyethylene tube protection" and "polyethylene encasement" are interchangeable and shall have the same meaning in these Contract Documents.

3-14.01. Inspection and Testing. Tests for preliminary acceptance of polyethylene encasement materials as required in the submittal paragraph shall be made at the expense of the Contractor.

The Owner may obtain samples from the material supplied in the field and have test conducted by an independent third-party laboratory, at the Owner's expense, of the requirements specified in ANSI/AWWA C105/A21.5.

3-15. OUTLETS. Where a 12 inch [300 mm] or smaller branch outlet is indicated and the diameter of the parent pipe is at least twice the diameter of the branch, a tee, a factory welded-on boss, or a tapping saddle will be acceptable.

Where a 4 inch [100 mm] or larger branch outlet is indicated on the drawings and the diameter of the branch pipe for a given diameter of parent pipe is less than equal to the maximum diameter listed herein, a factory welded-on outlet fabricated from centrifugally cast ductile iron pipe will be acceptable.

Parent Pipe Diameter Versus Maximum Branch Pipe
Diameter for Welded-On Outlets

<u>Parent Pipe Dia</u> inches [mm]	<u>Max Branch Pipe Dia</u> inches [mm]	<u>Parent Pipe Dia</u> inches [mm]	<u>Max Branch Pipe Dia</u> inches [mm]
8 [200]	4 [100]	30 [750]	20 [500]
10 [250]	6 [150]	36 [900]	24 [600]
12 [300]	8 [200]	42 [1050]	30 [750]
14 [350]	8 [200]	48 [1200]	30 [750]
16 [400]	10 [250]	54 [1350]	36 [900]
18 [450]	12 [300]	60 [1500]	36 [900]
20 [500]	14 [350]	64 [1600]	36 [900]
24 [600]	16 [400]		

All 30 inch [750 mm] and smaller branch pipe diameter welded-on outlets shall be rated for a working pressure of 250 psi [1,700 kPa], 36 inch [900 mm] branch diameter welded-on outlets shall be rated for a working pressure of 200 psi [5,000 kPa], and all outlets shall have a minimum factor of safety of 2.0. The pipe manufacturer shall provide test data and certification of proof of design. It is not necessary that these tests be performed on pipe manufactured specifically for this project. Certified reports covering tests made on other pipe of the same size and design as specified herein and manufactured from materials of equivalent type and quality may be accepted as adequate proof of design. Welded-on outlets may be provided as a radial (tee) outlet, a tangential outlet, or a lateral outlet fabricated at a specific angle to the parent pipe (in 15 degrees [0.262 rad] increments between 45 degrees and 90 degrees [0.785 to 1.570 rad] from the axis of the parent pipe), as indicated on the drawings. The fillet weld dimensions for welded-on outlets shall be as specified herein. Parent pipe and branch pipe shall meet hydrostatic test requirements in accordance with ANSI/AWWA C151/A21.51, Sec. 5.2, prior to fabrication.

Welded-on Outlet Fillet Weld Dimensions for Specified
Outlet Configurations

<u>Radial and Lateral Outlets</u>			<u>Tangential Outlets</u>		
<u>Parent Pipe Dia</u> inches [mm]	<u>Branch Pipe Dia</u> inches [mm]	<u>Weld Fillet Size</u> inches [mm]	<u>Parent Pipe Dia</u> inches [mm]	<u>Branch Pipe Dia</u> inches [mm]	<u>Weld Fillet Size</u> inches [mm]
24 [600] and smaller	24 [600] and smaller	1 x 1 [25 x 25]	8-30 [200-750]	24 [600] and smaller	1-1/4 x 1-1/4 [32 x 32]
30-48 [750-1200]	24 [600] and smaller	1-1/4 x 1-1/4 [32 x 32]	36-54 [900-1350]	24 [600] and smaller	1-1/2 x 1-1/2 [38 x 38]

Welded-on Outlet Fillet Weld Dimensions for Specified
Outlet Configurations

<u>Radial and Lateral Outlets</u>			<u>Tangential Outlets</u>		
<u>Parent Pipe Dia</u>	<u>Branch Pipe Dia</u>	<u>Weld Fillet Size</u>	<u>Parent Pipe Dia</u>	<u>Branch Pipe Dia</u>	<u>Weld Fillet Size</u>
inches [mm]	inches [mm]	inches [mm]	inches [mm]	inches [mm]	inches [mm]
54-64 [1350-1600]	24 [600] and smaller	2-1/4 x 2-1/2 [57 x 64]	60-64 [1500-1600]	24 [600] and smaller	2-1/2 x 2-1/2 [64 x 64]
42-64 [1050-1600]	30 [750]	2-1/2 x 2-1/2 [64 x 64]	42-54 [1050-1350]	30 [750]	2-1/2 x 2-1/2 [64 x 64]
54-64 [1350-1600]	36 [900]	2-3/4 x 2-3/4 [70 x 70]	60-64 [1500-1600]	30 [750]	2-3/4 x 2-3/4 [70 x 70]

All joints on welded-on branch outlets shall be made in accordance with the latest revision of ANSI/AWWA C111/A21.11 and/or ANSI/AWWA C115/A21.15, as applicable. All outlets shall be fabricated from centrifugally cast ductile iron pipe designed in accordance with ANSI/AWWA C150/A21.50 and manufactured and tested in accordance with ANSI/AWWA C151/A21.51. Ni-Rod FC 55[®] electrodes manufactured by International Nickel Corporation (or an electrode with equivalent properties) shall be used in the manufacture of the fillet welds. Carbon steel electrodes will not be acceptable. Special Thickness Class 53 pipe shall be used for all branch pipe and parent pipe in 4 to 54 inch [100 to 1350 mm] sizes. Pressure Class 350 pipe shall be used for 60 inch and 64 inch [1,500 and 1,600 mm] parent pipe. After welding, each fabricated outlet shall be subjected to a 15 psi [100 kPa] air test. A soap and water solution shall be applied during the testing procedure to inspect the weld for leakage. Any welds that show air seepage shall be refabricated and retested.

Welded-on outlets shall be fabricated by the pipe manufacturer at its production facilities. Manufacturers of welded-on outlets shall have at least 5 years of satisfactory experience in the manufacture and performance of these products. The manufacturer shall have a documented welding quality assurance system and shall maintain resident quality assurance records based on ANSI/AWS D11.2, the Guide for Welding Iron Castings. The manufacturer shall also maintain appropriate welding procedure specifications (WPS) and procedure qualification (PQR), and welder performance qualification test (WPQR) records.

The type of pipe end for the branch outlet shall be as specified or indicated on the drawings. The maximum size and laying length of the welded-on branch outlet shall be as recommended by the pipe manufacturer and shall be acceptable to Engineer for the field conditions and the connecting pipe or valve. Pipe embedment material and trench backfill shall be placed and compacted under and around each side of the outlet to hold the pipe in proper position and alignment during the subsequent pipe jointing, embedment, and backfilling.

At locations acceptable to Engineer, drilling and tapping of the pipe wall for 2 inch [50 mm] and smaller pipe connections will also be acceptable, provided that the wall thickness, minus the casting allowance, at the point of connection equals or exceeds the wall thickness required for 4-thread engagement in accordance with Table A.1, Appendix A of ANSI/AWWA C151/A21.51.

3-16. WALL PIPES OR CASTINGS. Wall pipes or castings shall be provided where ductile iron pipes pass through concrete walls, unless otherwise indicated on the drawings.

Where a flange and mechanical joint piece is to connect to a mechanical joint wall pipe or casting, the bolt holes in the bell of the wall pipe or casting shall straddle the top (or the side for vertical piping) centerline of the pipe or casting and shall align with the bolt holes in the flange and mechanical joint piece. The top centerline shall be marked on the wall pipe or casting at the foundry.

3-17. REDUCERS. Reducers shall be eccentric or concentric as indicated on the drawings. Reducers of eccentric pattern shall be installed with the straight side on top, so that no air traps are formed.

3-18. CONNECTIONS WITH EXISTING PIPING. Connections between new work and existing piping shall be made using fittings suitable for the conditions encountered. Each connection with an existing pipe shall be made at a time and under conditions which will least interfere with service to customers, and as authorized by Owner. Facilities shall be provided for proper dewatering and for disposal of all water removed from dewatered lines and excavations without damage to adjacent property.

Special care shall be taken to prevent contamination when dewatering, cutting into, and making connections with existing potable water piping. Trench water, mud, or other contaminating substances shall not be permitted to enter the lines. The interior of all pipe, fittings, and valves installed in such connections shall be thoroughly cleaned and then all potable water pipe, fittings, and valves shall be swabbed with, or dipped in, a 200 mg/L chlorine solution.

3-19. INSULATED FLANGED JOINTS. Insulated flanged joints shall be installed where indicated on the drawings. In addition to one full-faced insulated gasket, each flange insulating assembly shall consist of one full-length sleeve, two insulating washers, and two backing washers for each flange bolt. The insulating gasket ID shall be 1/8 inch [3 mm] less than the ID of the flange in which it is installed. The insulated flanged joint accessories shall be installed in accordance with the instructions and recommendations of the manufacturer.

3-20. CONCRETE ENCASEMENT. Concrete encasement shall be installed where indicated on the drawings. A pipe joint shall be provided within 12 inches [300 mm] of each end of the concrete encasement. Concrete and reinforcing steel shall be as specified in the Cast-in-Place Concrete section. All pipe to be encased shall be suitably supported and blocked in proper position, and shall be anchored to prevent flotation.

3-21. REACTION ANCHORAGE AND BLOCKING. Not used.

3-22. PRESSURE AND LEAKAGE TESTS. Pipe and fittings shall be subjected to a pressure test and a leakage test in accordance with the Pipeline Pressure and Leakage Testing section.

Pipe and fittings shall be subjected to a pressure test and a leakage test. The Contractor shall provide all necessary pumping equipment; piping connections between the piping and the nearest available source of test water; pressure gauges; and other equipment, materials, and facilities necessary for the tests.

All pipe, fittings, valves, pipe joints, and other materials which are found to be defective shall be removed and replaced with new and acceptable materials, and the affected portion of the piping shall be retested by and at the expense of Contractor.

All joints shall be watertight and free from visible leaks. Any visible leak which is discovered within the correction period stipulated in the General Conditions shall be repaired by and at the expense of Contractor.

3-23. CLEANING. The interior of all pipe and fittings shall be kept clean of any foreign matter until the work has been accepted.

End of Section

MISCELLANEOUS PLASTIC PIPE, TUBING, AND ACCESSORIES

PART 1 - GENERAL

1-1. SCOPE. This section covers the furnishing of miscellaneous plastic pipe, tubing, and accessories. Pipe and tubing shall be furnished complete with all fittings, flanges, unions, jointing materials and other necessary appurtenances.

1-2. SUBMITTALS.

1-2.01. Drawings and Data. Complete specifications, data and catalog cuts or drawings shall be submitted in accordance with the submittals section. Submittals are required for all piping, fittings, gaskets, sleeves, and accessories, and shall include the following data:

- Name of Manufacturer
- Type and model
- Construction materials, thickness, and finishes
- Pressure and temperature ratings

Contractor shall obtain and submit a written statement from the gasket material manufacturer certifying that the gasket materials are compatible with the joints specified herein and are recommended for the specified field test pressures and service conditions.

1-3. DELIVERY, STORAGE, AND HANDLING. Shipping shall be in accordance with the Shipping section. Handling and storage shall be in accordance with the Handling and Storage section. All materials shall be stored in a sheltered location above the ground, separated by type, and shall be supported to prevent sagging or bending.

Pipe, tubing, and fittings shall be stored between 40°F and 90°F [4°C and 32°C].

PART 2 - PRODUCTS

2-1. FRP PIPE. Not used.

2-2. PVC PIPE MATERIALS. PVC pipe materials and services shall be as specified herein.

2-2.01. Material Classification PVC-1. Not used.

2-2.02. Material Classification PVC-2.

PVC-2 – Schedule 80 PVC Pipe with Solvent Welded Joints.	Pipe	ASTM D1785, Cell Classification 12454, bearing NSF seal, Schedule 80. ASTM D2467, Cell Classification 12454, bearing NSF seal.
	Fittings	Flanges or unions shall be provided

<p>Sample lines, pre-lube lines, seal water drain, and ARV discharge lines. Sleeves for copper tubing. Buried potable lines 3 inch and smaller as shown on Drawings.</p>	<p>where needed to facilitate disassembly of equipment or valves. Flanges or unions shall be joined to the pipe by a solvent weld. When acceptable to Engineer, threaded joints may be used instead of solvent welded joints in exposed interior locations for the purpose of facilitating assembly. The use of threaded joints in this system shall be held to a minimum.</p>
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2-2.03. Material Classification PVC-3. Not used.

2-2.04. Material Classification PVC-4. Not used.

2-2.05. Material Classification PVC-5. Not used.

2-2.06. Material Classification PVC-6. Not used.

2-2.07. Material Classification PVC-7. Not used.

2-2.08. Material Classification PVC-8. Not used.

2-2.09. Accessory Materials. Accessory materials for the PVC Pipe systems shall be as indicated.

Flanges	<p>Diameter and drilling shall conform to ANSI/ASME B16.5, Class 150. Schedule 80 for DWV systems.</p>
Flange Bolts and Nuts	<p>ASTM A307, Grade B, length such that, after installation, the bolts will project 1/8 to 3/8 inch [3 to 10 mm] beyond outer face of the nut. Stainless steel for DWV and chemical feed systems, galvanized steel for all other systems.</p>
Flat Washers	ANSI B18.22.1, plain. Same material as bolts and nuts.
Flange Gaskets	Full face, 1/8 inch [3 mm] thick, chemical-resistant elastomeric material suitable for the specified service.
Expansion Joints	Edlon "Thermo-molded TFE" or Resistoflex "Style R6905" molded expansion joint.

2-3. CPVC PIPE. CPVC pipe materials and services shall be as specified herein.

2-3.01. Material Classification CPVC-1. Not used.

2-3.02. Accessory Materials. Accessory materials for the CPVC Pipe systems shall be as indicated.

Flanges	Diameter and drilling shall conform to ANSI/ASME B16.5, Class 150.
Flange Bolts and Nuts	ASTM A307, Grade B, length such that, after installation, the bolts will project 1/8 to 3/8 inch [3 to 10 mm] beyond outer face of the nut. Stainless steel for chemical feed systems, galvanized steel for all other systems.
Flat Washers	ANSI B18.22.1, plain. Same material as bolts and nuts.
Flange Gaskets	Full face, 1/8 inch [3 mm] thick, chemical-resistant elastomeric material suitable for the specified service.
Expansion Joints	Edlon "Thermo-molded TFE" or Resistoflex "Style R6905" molded expansion joint.

2-4. PE PIPE. Not used.

2-5. POLYPROPYLENE PIPE. Not used.

2-6. PVDF PIPE. Not used.

2-7. REINFORCED PLASTIC TUBING. Not used.

PART 3 - EXECUTION

3-1. INSTALLATION. Materials furnished under this section will be installed in accordance with the Miscellaneous Piping and Accessories Installation section.

End of Section

COPPER TUBING AND ACCESSORIES

PART 1 - GENERAL

1-1. SCOPE. This section covers the furnishing of copper tubing and accessories. Copper tubing shall be furnished complete with all fittings, flanges, unions, and other accessories specified herein.

1-2. SUBMITTALS.

1-2.01. Drawings and Data. Complete specifications, data, and catalog cuts or drawings shall be submitted in accordance with the Submittals Procedures section. Submittals are required for all piping, fittings, gaskets, sleeves, and accessories, and shall include the following data:

- Name of Manufacturer
- Type and model
- Construction materials, thickness, and finishes
- Pressure and temperature ratings

Contractor shall obtain and submit a written statement from the gasket material manufacturer certifying that the gasket materials are compatible with the joints specified herein and are recommended for the specified field test pressures and service conditions.

1-3. DELIVERY, STORAGE, AND HANDLING. Shipping shall be in accordance with the Product Delivery Requirements section. Handling and storage shall be in accordance with the Product Storage and Handling Requirements section. All materials shall be stored in a sheltered location above the ground, separated by type, and shall be supported to prevent sagging or bending.

PART 2 - PRODUCTS

2-1. MATERIALS. Copper tubing materials and service shall be as specified herein.

2-1.01. Material Classification CU-1.

CU-1 – Water Tubing with Flared Fittings Buried water supply, 2 inch [50 mm] and smaller.	Tubing	Soft annealed copper tubing, ASTM B88, Type K.
	Fittings	Flared, material to match tubing. Fittings shall conform to ANSI/ASME B16.26.

2-1.02. Material Classification CU-2. Not used.

2-1.03. Material Classification CU-3.

CU-3 – Water Tubing with Solder and Brazed Joints Potable water supply, 3 inch [75 mm] and smaller.	Tubing	Hard drawn copper tubing, ASTM B88, Type L.
	Fittings	Solder joint (smaller than 2 inch except compressed air piping), Brazed joint (2 inch and larger for piping other than compressed air and all sizes for compressed air piping), material to match tubing. Fittings shall conform to ANSI B16.18, or ANSI/ASME B16.22.
	Flanges	Where required for connection to equipment, valves, and accessories, ANSI B16.24, class 150, cast bronze, brazed joint.

2-1.04. Accessory Materials. Accessory materials for the copper tubing systems shall be as indicated.

Flange Bolts and Nuts	ASTM A307, Grade B, length such that, after installation, the bolts will project 1/8 to 3/8 inch [3 to 10 mm] beyond outer face of the nut.
Flange Gaskets	ASTM D1330, Grade I, red rubber, ring type, 1/8 inch [3 mm] thick.
Expansion Joints	Tempflex "Model HB Expansion Compensators" with copper tube ends.
Insulating Fittings	
Threaded	Dielectric steel pipe nipple, ASTM A53, Schedule 40, poly-propylene lined, zinc plated; Perfection Corp. "Clearflow Fittings".
Flanged	EpcO "Dielectric Flange Unions" or Central Plastics "Insulating Flange Unions".

PART 3 - EXECUTION

3-1. INSTALLATION. Materials furnished under this section will be installed in accordance with the Miscellaneous Piping and Accessories Installation section.

End of Section

RESILIENT-SEATED GATE VALVES

PART 1 - GENERAL

1-1. SCOPE. This section covers furnishing resilient-seated AWWA gate valves for clear water service. Resilient-seated gate valves shall be furnished complete with actuators and accessories as specified herein and as specified in the Valve and Gate Actuator section.

Shutoff valves 4 inches and larger indicated on the plumbing drawings shall be resilient-seated gate valves. For gate valves 3 inch and smaller, refer to Orange County Utilities Standards and Construction Specifications Manual for specification requirements and approved products.

1-2. GENERAL. Equipment provided under this section shall be fabricated and assembled in full conformity with drawings, specifications, engineering data, instructions, and recommendations of the equipment manufacturer, unless exceptions are noted by Engineer.

Valves shall be furnished with all necessary parts and accessories indicated on the drawings, specified, or otherwise required for a complete, properly operating installation and shall be the latest standard products of a manufacturer regularly engaged in the production of valves.

1-2.01. General Equipment Stipulations. The General Equipment Stipulations shall apply to all equipment furnished under this section. If requirements in this specification differ from those in the General Equipment Stipulations, the requirements specified herein shall take precedence.

1-2.02. Governing Standard. Except as modified or supplemented herein, all resilient-seated gate valves shall conform to the applicable requirements of ANSI/AWWA C509.

1-2.03. Temporary Number Plates. Each resilient-seat gate valve with the identifying number indicated on the drawings shall be tagged or marked in the factory with the identifying number .

1-2.04. Permanent Number Plates. All AWWA resilient-seated gate valves that have been assigned a number on the drawings shall be provided with a permanent number plate. The number plates shall be in accordance with section 01615.

1-3. SUBMITTALS. Complete drawings, details, and specifications covering the valves and their appurtenances shall be submitted in accordance with the Submittals section.

All valves shall be tested in accordance with Section 5 of the governing standard. Certified copies of the results of all tests, together with an affidavit of compliance as indicated in Section 6.3 of the governing standard, shall be submitted to Engineer before the valves are shipped.

PART 2 - PRODUCTS

2-1. MATERIALS. Except as modified or supplemented herein, materials used in the manufacture of resilient-seated gate valves shall conform to the requirements of the governing standard.

2-1.01. Bronze Components. All bronze valve components in contact with liquid shall contain less than 16 percent zinc. All aluminum bronze components in contact with liquid shall be inhibited against dealuminization in accordance with Section 4.2.2.4.3 of ANSI/AWWA C509.

2-1.02. Gaskets. Gaskets shall be free of asbestos and corrosive ingredients.

2-1.03. Shop Coatings.

Coal Tar Epoxy	High-build coal tar epoxy; Ameron "Amercoat 78HB Coal Tar Epoxy", Carboline "Bitumastic 300 M", Tnemec "46H-413 Hi-Build Tneme-Tar", or Sherwin-Williams "Hi-Mil Sher-Tar Epoxy".
Epoxy	Manufacturer's standard fusion-bonded or liquid epoxy.
Rust-Preventive Compound	As recommended by manufacturer.

2-2. VALVE CONSTRUCTION.

2-2.01. Valve Ends. Valve ends shall be compatible with connecting piping. Except as modified or supplemented herein, the ends shall conform to the applicable requirements of the governing standard. Unless indicated otherwise on the drawings, all buried valves shall have mechanical joint ends and all above grade valves shall have flanged ends.

Flanges shall be finished to true plane surfaces within a tolerance limit of 0.005 inch [125 µm]. The finished face shall be normal to the longitudinal valve axis within a maximum angular variation tolerance of 0.001 inch per inch [1 µm/mm] of flange diameter.

2-2.02. Stems. Gate valves shall be provided with non-rising stems and O-ring stem seals..

2-2.03. Rotation. The direction of rotation of the handwheel or the wrench nut to open the valve shall be to the left (counterclockwise).

2-2.04. Shop Coating. All interior and exterior ferrous metal surfaces of valves and accessories shall be shop coated for corrosion protection. Except as specified below, the valve manufacturer's standard coating will be acceptable, provided it is functionally equivalent to the specified coating and is compatible with the specified field coating.

Surfaces shall be coated as follows:

Interior surfaces	Epoxy.
Interior surfaces (potable water)	Epoxy (NSF certified).

Exterior surfaces of valves to buried, submerged, or installed in manholes or valve vaults	Epoxy or coal tar epoxy
Exterior surfaces of all other valves	Universal primer.
Polished or machined surfaces	Rust-preventive compound.

The protective epoxy coating on the interior surfaces of each valve shall be applied in three coats, with a minimum total dry film thickness of 13 mils [325 µm]. Alternatively, the manufacturer's standard coating may be used and the interior surfaces of each valve shall be subjected to a nondestructive holiday test in accordance with ASTM G62, Method A, and shall be electrically void-free.

Interior coatings shall comply with AWWA C550. The total dry film thickness of shop-applied coatings shall be not less than:

<u>Type of Coating</u>	<u>Minimum Dry Film Thickness</u>
Epoxy	10 mils [250 µm] or 13 mils [325 µm] where specified herein.
Universal Primer	3 mils [75 µm].

2-3. VALVE ACTUATORS. Requirements for valve actuators shall be as specified in the Valve and Gate Actuator section. .

2-4. ACCESSORIES. Refer to the Valve and Gate Actuator section for extension stems, stem guides, position indicators, floor boxes, valve boxes, or operating stands.

PART 3 - EXECUTION

3-1. INSTALLATION. Valves will be installed in accordance with Valve Installation section.

3-1.01. Installation Check. An experienced, competent, and authorized representative of the manufacturer shall visit the site of the Work and inspect, check, adjust if necessary, and approve the equipment installation. The representative shall be present when the equipment is placed in operation in accordance with the Startup Requirements section, and shall revisit the jobsite as often as necessary until all trouble is corrected and the equipment installation and operation are satisfactory in the opinion of Engineer.

The manufacturer's representative shall furnish a written report certifying that the equipment has been properly installed and lubricated; is in accurate alignment; is free from any undue stress imposed by connecting piping or anchor bolts; and has been operated under full load conditions and that it operated satisfactorily.

All costs for these services shall be included in the contract price.

End of Section

**Schedule 15104-S01
Resilient Seated Gate Valves Schedule**

1.010	1.020	1.030	1.040	1.050	1.060	2.010	2.020	2.030	3.010	3.020	3.030	3.040		
Tag Number	Size	Type of Service (5)	Type of Installation(1)	Ends(2)	Stem(3)	Type of Manual Actuator(4)	Type of Electric Actuator(6)	Voltage/Phase	Extension Stems	Floor Boxes	Cast Iron Operating Stands	Fabricated Steel Operating Stands	P and IDWG No.	Global ID
	(in)													
RW_10_701	12	RW	B4	MJ	NRS	WN	N/A	N/A	Yes	No	No	No	I-04	
RW_10_801	12	RW	B4	MJ	NRS	WN	N/A	N/A	Yes	No	No	No	I-04	
VG-11	12	RCW	B20	MJ	NRS	N/A	STD*	460/3	Yes	No	No	No	I-06	
VG-13	12	RCW	B20	MJ	NRS	N/A	STD*	460/3	Yes	No	No	No	I-06	
VG-14	12	RCW	B20	MJ	NRS	N/A	STD*	460/3	Yes	No	No	No	I-06	

*The valve is a buried valve with an extension stem and the electric actuator shall be located 3' above grade.

Notes:

(1) Abbreviations for installation types are as follows:

B4	Buried, depth of 4 feet or less
B20	Buried, depth greater than 4 feet but 20 feet or less
B	Buried, depth greater than 20 feet, actual depth of xx feet
SV20	Submerged or vaulted, depth 20 feet or less
SV	Submerged or vaulted, depth greater than 20 feet, actual depth of xx feet
IP	In plant

(2) Abbreviations for types of ends:

F	Flanged
MJ	Mechanical joint
P	Push-on joint

(3) Abbreviations for types of stems:

NRS	Non-rising stem
OS&Y	Outside screw-and-yoke

(4) Abbreviations for types of manual actuators:

WN	Wrench nut
HW	Handwheel

(5) Abbreviations for types of service

RW	Raw Water
PW	Potable Water
RCW	Reclaimed Water
WW	Waste Water

(6) Abbreviations for types of electric actuators:

STD	Standard
INT	Intelligent

END OF SCHEDULE

AIR RELEASE AND COMBINATION AIR VALVES

PART 1 - GENERAL

1-1. SCOPE. This section covers furnishing air release valves, combination air valves, and air release and vacuum relief valves as required by the Work, and as indicated in the Air Release and Combination Air Valve Schedule.

1-2. GENERAL. Equipment provided under this section shall be fabricated and assembled in full conformity with drawings, specifications, engineering data, instructions, and recommendations of the equipment manufacturer, unless exceptions are noted by Engineer.

Valves shall be furnished with all necessary parts and accessories indicated on the drawings, specified, or otherwise required for a complete, properly operating installation and shall be the latest standard products of a manufacturer regularly engaged in the production of valves.

1-2.01. General Equipment Stipulations. The General Equipment Stipulations shall apply to all equipment furnished under this section. If requirements in this specification differ from those in the General Equipment Stipulations, the requirements specified herein shall take precedence.

1-2.02. Governing Standard. Except as modified or supplemented herein, all valves furnished under this section shall conform to the applicable requirements of AWWA C512.

1-2.03. Permanent Number Plates. All valves that have been assigned a number on the drawings shall be provided with a permanent number plate. The location of number plates and the method of fastening shall be acceptable to Engineer. Permanent number plates shall be as specified in the Equipment, Valve, and Piping Identification section.

1-3. SUBMITTALS. Complete assembly drawings, together with detailed specifications and data covering materials used and accessories forming a part of the valves furnished, shall be submitted in accordance with the Submittals section.

1-4. DELIVERY, STORAGE, AND HANDLING. Shipping shall be in accordance with the Shipping section. Handling and storage shall be in accordance with the Handling and Storage section.

PART 2 - PRODUCTS

2-1. CONSTRUCTION. Air release valves with operating pressures of 150 psi [1000 kPa] or less shall be Apco/Valve and Primer "No. 200", GA Industries "Figure 920m", Multiplex "Crispin Type PL", or Val-Matic "No. 38".

Three inch [75 mm] and smaller air/vacuum valves to be installed at well pump discharges shall be of the integral type that functions as both an air release and vacuum relief valve. Well service air/vacuum valves shall be provided with a throttling device to allow the air discharge rate to be

adjusted. The valves shall be Apco/Valve and Primer "Series 140DAT Air/Vacuum Valves" with "Double Acting Throttling Device and Water Diffuser" or Val-Matic "Well Service Air Valves" with "Dual Port Throttling Device". The discharge from the valve shall be provided with a threaded NPT connection

2-2. MATERIALS. Except as modified or supplemented herein, materials of construction shall comply with the governing standard. The use of stressed thermoplastic components will not be acceptable.

Valve Trim	Bronze or austenitic stainless steel.
Float	Austenitic stainless steel.
Shop Coatings	
Medium Consistency Coal Tar	Carboline "Bitumastic 50" or Tnemec "46-465 H.B. Tnemecol".
Epoxy	Carboline "Carboguard 891" or Tnemec "Series N140 Pota-Pox Plus."
Rust-Preventive Compound	As recommended by manufacturer.

2-3. SHOP PAINTING. All interior and exterior ferrous metal surfaces, except stainless steel components, shall be shop painted for corrosion protection. The valve manufacturer's standard coating will be acceptable, provided it is functionally equivalent to the specified coating and is compatible with the specified field coating. Field painting is covered in the Protective Coatings section.

Surfaces shall be painted as indicated:

Interior Surfaces	Epoxy.
Exterior Surfaces of Valves To Be Installed in Manholes or Valve Vaults	Coal tar epoxy.
Exterior Surfaces of All Other Valves	Universal primer.
Polished or Machined Surfaces	Rust-preventive compound.

Interior epoxy coatings shall comply with AWWA C550 and shall be free of holidays. The total dry film thickness of shop-applied coatings shall be not less than:

<u>Type of Coating</u>	<u>Minimum Dry Film Thickness</u>
Medium Consistency Coal Tar	15 mils [380 µm]
Epoxy	10 mils [250 µm]
Universal Primer	3 mils [75 µm]

2-4. SHUTOFF VALVES. A shutoff valve shall be provided in the piping leading to each air release valve and combination air valve.

PART 3 - EXECUTION

3-1. INSTALLATION. Air release and combination air valves will be installed in accordance with the Valve Installation section.

End of Section

GLOBE PATTERN WELL PUMP CONTROL VALVES

PART 1 - GENERAL

1-1. SCOPE. This section includes materials and installation of globe pattern diaphragm-actuated control valves acting as pressure-sustaining valves for well pump flow control.

1-2. SUBMITTALS. Submit shop drawings in accordance with the General Conditions, Section 01300 and the following.

Submit dimensional drawings for the size and type of valve provided.

Provide listing of materials of construction, with ASTM reference and grade. Show valve lining and paint primer coating with coating manufacturer and coating system number or designation.

Submit electrical drawings, showing wire and terminal connections, for valves that are electrically controlled.

Submit manufacturer's recommended maximum operating pressure and maximum recommended flow.

1-3. QUALITY ASSURANCE

1-3.01 Warranty. The manufacturer shall warranty the valve to be free of defects for a period of three years from date of shipment.

1-3.02 Cavitation Analysis. The manufacturer shall be able to provide a cavitation analysis to prove that the valve will operate cavitation damage free throughout the entire flow range.

1-4. MANUFACTURERS' SERVICES. Provide equipment manufacturers' services at the jobsite for minimum three man-days to check the installation, supervise start-up, supervise testing and adjustment of the valves, and instruct the Owner's personnel in the operation and maintenance of the valves. Travel time excluded.

PART 2 - PRODUCTS

2-1. MANUFACTURERS. Diaphragm-actuated control valves shall be manufactured by Claval Co., Newport Beach, CA; Watts Automatic Control Valve, Houston, TX; Bermad, Anaheim, CA; Singer Valve Inc., Charlotte, NC or equal.

2-2. VALVE DESIGN. The valves shall be designed to open when the pressure at the inlet is higher than the set point of the sustaining pilot control. It shall be designed to modulate open and limit the flow by maintaining a back pressure as indicated herein. This back pressure shall be field adjustable to limit the well pump flow as indicated herein.

Valve location.	Well Pump Discharges
Number of valves.	2
Valve tag numbers.	WL_P7_VPC1 and WL_P8_VPC1
Valve Size	10"
Design Inlet Pressure	60 psig
Maximum Inlet Pressure	65 psig
Minimum Inlet Pressure	55 psig
Downstream Pressure	25 to50 psig
Design Flow	1,750 gpm

Valves shall be hydraulically actuated diaphragm type. The body shall contain a removable seat insert. A resilient rubber disc shall form a drip-tight seal with the valve seat when pressure is applied above the diaphragm. The diaphragm assembly shall form a sealed chamber in the upper portion of the valve, separating operating pressure from line pressure.

All major components of the pilot control system shall be manufactured by the same company that manufactures the main valve. The main valve diaphragm shall either be vulcanized at the stem hole to ensure against wicking of the product within the diaphragm or the diaphragm shall utilize an FDA-approved nonwicking material and an elastomeric insert seal at the stem hole. The diaphragm shall not be used as a seating surface.

Provide guides at both ends of the stem or provide a center-guided stem. For design utilizing guides at both ends of the stem, provide a bearing in the valve cover and an integral bearing in the valve seat. Provide valve position indicator. Repairs and modifications other than the replacement of the main valve body shall be possible without removing the main valve from the line.

2-3. MATERIALS.

<u>Item</u>	<u>Material</u>
Main valve body and cover	Ductile iron, ASTM A 536
Main valve trim, seat, disc guide, and cover bearings	Type 316 stainless steel ASTM A 276, A 351, or A 743
Diaphragm washer and disc retainer	Bronze
Pilot control system	Bronze
Piping and tubing	Copper (ASTM B 75 and B 88) and brass (ASTM B 43)
Stem sleeves	Type 303 stainless steel

Elastomers

Buna-N

Cover screws, caps, and nuts and bolts

Type 316 stainless steel

2-4. VALVE END CONNECTIONS. Valves shall have flanged ends. Flanges for ductile-iron valves shall be ductile iron. Class 150 flanges shall comply with ANSI B16.42, Class 150. Flanges shall be flat face.

Do not provide raised-face mating flanges on the connecting piping.

2-5. LINING. The valves shall be lined with NSF 61 certified fusion-bonded epoxy.

Do not coat seating areas and bronze or stainless-steel pieces.

2-6. COATING. Coat valves the same as the adjacent piping. Apply prime coat at factory. Color of finish coat shall match the color of the connecting piping.

2-7. VALVES. The valves shall be globe pattern Class 150 Pressure-Sustaining Valves. The valve shall maintain a constant upstream pressure regardless of fluctuations in flow. When the upstream pressure equals the spring setting on the pressure-sustaining control, the valve shall throttle to maintain a constant upstream pressure. The valve shall close tightly on flow reversal. The pressure-sustaining pilot shall be a direct-acting, adjustable, spring-loaded, normally closed diaphragm valve which opens when upstream pressure exceeds the spring setting. Adjustment range of the upstream spring setting shall be 20-75 psi. Provide closing speed control, opening speed control, pilot piping isolation valves, and large control canister style strainer in the pilot control piping. Valves shall be provided with stainless steel stem position indicator and stainless steel seat. Valve body shall be provided with fusion bonded coating inside and outside. Flange diameter and drilling shall conform to Class 150, ANSI B16.42.

2-8. BOLTS AND NUTS FOR FLANGED VALVES. Bolts and nuts for flanged valves shall be as specified for the piping to which the valves are connected. Provide washers for each nut. Washers shall be of the same material as the nuts.

2-9. GASKETS. Gaskets for flanged end valves shall be as specified for the piping to which the valve is connected.

2-10. SPARE PARTS. Provide the following spare parts for each valve:

<u>Quantity</u>	<u>Description</u>
1	Diaphragm (for diaphragm-actuated valves).
1	Strainer.
2	Isolation valves for each valve pilot system.
1	Throttling valve for opening/closing speed control.

Pack spare parts in a wooden box and label with parts description and vendor name, address, and telephone number.

PART 3 - EXECUTION

3-1. VALVE INSTALLATION. Bolt holes of flanged valves shall straddle the horizontal and vertical centerlines of the pipe run to which the valves are attached. Clean flanges by wire brushing before installing flanged valves. Clean flange bolts and nuts by wire brushing, lubricate threads as specified in the piping specifications, and tighten nuts uniformly and progressively. If flanges leak under pressure testing, loosen or remove the nuts and bolts, reseal or replace the gasket, reinstall or retighten the bolts and nuts, and retest the joints. Joints shall be watertight.

Clean threaded joints by wire brushing or swabbing. Apply Teflon joint compound or Teflon tape to pipe threads before installing threaded valves. Joints shall be watertight.

3-2. VALVE PRESSURE TESTING. Test valves at the same time that the connecting pipelines are pressure tested. See Section 02704 for pressure testing requirements. Protect or isolate any parts of valves, operators, or control and instrumentation systems whose pressure rating is less than the test pressure.

End of Section

GLOBE PATTERN FILL CONTROL VALVE

PART 1 - GENERAL

1-1. SCOPE This section includes materials and installation of globe pattern pilot operated diaphragm valve designed to be electrically positioned, as commanded through SCADA, by a position indicator and two 2-way solenoid pilots for filling the ground storage tanks.

1-2. SUBMITTALS Submit shop drawings in accordance with the General Conditions, Section 01300 and the following.

Submit dimensional drawings for the size and type of valve provided.

Provide listing of materials of construction, with ASTM reference and grade. Show valve lining and paint primer coating with coating manufacturer and coating system number or designation.

Submit electrical drawings, showing wire and terminal connections, for valves that are electrically controlled.

Submit manufacturer's recommended maximum operating pressure and maximum recommended flow.

1-3. QUALITY ASSURANCE

1-3.01 Warranty The manufacturer shall warranty the valve to be free of defects for a period of three years from date of shipment.

1-3.02 Cavitation Analysis The manufacturer shall be able to provide a cavitation analysis to prove that the valve will operate cavitation damage free throughout the entire flow range.

1-4. MANUFACTURERS' SERVICES Provide equipment manufacturers' services at the jobsite for minimum three man-days to check the installation, supervise start-up, supervise testing and adjustment of the valves, and instruct the Owner's personnel in the operation and maintenance of the valves. Travel time excluded.

PART 2 - PRODUCTS

2-1. MANUFACTURERS Diaphragm-actuated control valves shall be manufactured by Cla-Val Co., Newport Beach, CA; Ames Fire and Waterworks, Houston, TX; Bermad Control Valves, Anaheim, CA; or Singer Valve Inc., Charlotte, NC.

2-2. VALVE DESIGN The valves shall be designed to open when the pressure at the inlet is higher than the deadband set point for a set period of time. The valve will actuate to set point position as entered through SCADA. The valve shall be designed to close when the pressure at the inlet is lower than the deadband set point for a set period of time.

Valves location.	Tank Fill Line
Number of valves.	1
Valvetag numbers.	VPC-12
Valve Size	12"
Design Inlet Pressure	72 psig
Maximum Inlet Pressure	90 psig
Minimum Inlet Pressure	40 psig
Downstream Pressure	2 to 10 psig

Valves shall be hydraulically actuated diaphragm type. The body shall contain a removable seat insert. A resilient rubber disc shall form a drip-tight seal with the valve seat when pressure is applied above the diaphragm. The diaphragm assembly shall form a sealed chamber in the upper portion of the valve, separating operating pressure from line pressure.

All major components of the pilot control system shall be manufactured by the same company that manufactures the main valve. The main valve diaphragm shall either be vulcanized at the stem hole to ensure against wicking of the product within the diaphragm or the diaphragm shall utilize an FDA-approved nonwicking material and an elastomeric insert seal at the stem hole. The diaphragm shall not be used as a seating surface.

Provide guides at both ends of the stem or provide a center-guided stem. For design utilizing guides at both ends of the stem, provide a bearing in the valve cover and an integral bearing in the valve seat. Provide valve position indicator. Repairs and modifications other than the replacement of the main valve body shall be possible without removing the main valve from the line.

Cavitation Control Trim (CCT) shall be provided as required, and if necessary an additional Downstream Orifice Plate shall be provided along with the CCT.

2-3. MATERIALS

<u>Item</u>	<u>Material</u>
Main valve body and cover	Ductile iron, ASTM A 536
Main valve trim, seat, disc guide, and cover bearings	Type 316 stainless steel ASTM A 276, A 351, or A 743
Diaphragm washer and disc retainer	Bronze
Pilot control system	Bronze
Piping and tubing	Copper (ASTM B 75 and B 88) and brass (ASTM B 43)
Stem sleeves	Type 303 stainless steel

Elastomers

Buna-N

Cover screws, caps, and nuts and bolts

Type 316 stainless steel

2-4. VALVE END CONNECTIONS Valves shall have flanged ends. Flanges for ductile-iron valves shall be ductile iron. Class 150 flanges shall comply with ANSI B16.42, Class 150. Flanges shall be flat face.

Do not provide raised-face mating flanges on the connecting piping.

2-5. LINING The valves shall be lined with fusion-bonded epoxy.

Do not coat seating areas and bronze or stainless-steel pieces.

2-6. COATING Coat valves the same as the adjacent piping. Apply prime coat at factory. Color of finish coat shall match the color of the connecting piping.

2-7. VALVES The Fill Control Valve shall be a pilot operated diaphragm valve designed to be electrically positioned, as commanded by two 2-Way Solenoid Pilots. The valve shall have provisions for manual operation in the event of power outage. Solenoid voltage shall be 110-120 VAC and enclosures shall be NEMA 4 General Purpose.

The main valve shall be a hydraulically operated, single diaphragm actuated, globe pattern valve. Y-pattern valves shall not be permitted. The valve shall contain a disc and diaphragm assembly that forms a sealed chamber below the valve cover, separating operating pressure from line pressure. The diaphragm shall be constructed of nylon reinforced Buna-N, and shall not seal directly against the valve seat and shall be fully supported by the valve body and cover. Rolling diaphragm construction will not be allowed and there shall be no pistons operating the main valve or any pilot controls.

The main valve body and cover shall be Ductile Iron ASTM A536, and all internal cast components shall be Ductile Iron. All Ductile Iron components, including the body and cover, shall be lined and coated with an epoxy coating applied by the electrostatic heat fusion process. All main valve trim and throttling components (cover bearing, valve seat and disc guide) shall be Stainless Steel. The valve body and cover must be machined with a 360-degree locating lip to assure proper alignment.

The disc and diaphragm assembly shall contain a Buna-N synthetic rubber disc with a rectangular crosssection that is securely retained on 3-1/2 sides by a disc retainer and disc guide. Diaphragm assemblies utilizing bolts or cap screws for component retention will not be permitted. The exposed portion of the seat disc shall contact the valve seat and seal drip-tight. The disc and diaphragm assembly must be guided by two separate bearings, one installed in the valve cover and one concentrically located within the valve seat, to avoid deflection and assure positive disc-to-seat contact. Center guided valves will not be permitted. All necessary repairs shall be made from the top of the valve while the body remains in line.

A valve position indicator with a 4-20mA output shall be provided to allow the position of the valve to be controlled as a control variable through SCADA.

The pilot control system shall contain two 2-Way Solenoid Pilots, each with a by-pass valve to allow manual opening or closing, separate Adjustable Opening and Closing Speed Controls, an external Y-Strainer and Isolation Ball Valves on all body connections. The pilot control system shall utilize copper tubing and brass fittings.

2-8. BOLTS AND NUTS FOR FLANGED VALVES Bolts and nuts for flanged valves shall be as specified for the piping to which the valves are connected. Provide washers for each nut. Washers shall be of the same material as the nuts.

2-9. GASKETS Gaskets for flanged end valves shall be as specified for the piping to which the valve is connected.

2-10. SPARE PARTS Provide the following spare parts for each valve:

<u>Quantity</u>	<u>Description</u>
1	Diaphragm (for diaphragm-actuated valves).
1	Strainer.
2	Solenoid valves for valve pilot system.
2	Isolation valves for valve pilot system.
1	Throttling valve for opening/closing speed control.

Pack spare parts in a wooden box and label with parts description and vendor name, address, and telephone number.

PART 3 - EXECUTION

3-1. VALVE INSTALLATION Bolt holes of flanged valves shall straddle the horizontal and vertical centerlines of the pipe run to which the valves are attached. Clean flanges by wire brushing before installing flanged valves. Clean flange bolts and nuts by wire brushing, lubricate threads as specified in the piping specifications, and tighten nuts uniformly and progressively. If flanges leak under pressure testing, loosen or remove the nuts and bolts, reseal or replace the gasket, reinstall or retighten the bolts and nuts, and retest the joints. Joints shall be watertight.

Clean threaded joints by wire brushing or swabbing. Apply Teflon joint compound or Teflon tape to pipe threads before installing threaded valves. Joints shall be watertight.

3-2. VALVE PRESSURE TESTING Test valves at the same time that the connecting pipelines are pressure tested. See Section 02704 for pressure testing requirements. Protect or isolate any parts of valves, operators, or control and instrumentation systems whose pressure rating is less than the test pressure.

End of Section

PIPE SUPPORTS

PART 1 - GENERAL

1-1. SCOPE. This section covers the furnishing and installation of pipe hangers, brackets, and supports. Pipe supports shall be furnished complete with all necessary inserts, bolts, nuts, rods, washers, and other accessories. This section also covers the spacing of expansion joints in piping systems. Expansion joint products and materials are covered in the respective piping sections.

Concrete and fabricated steel supports shall be as indicated on the drawings, as specified in other sections, or, in the absence of such requirements, as permitted by Engineer.

This section covers pipe supports for the following pipe materials:

- Cast or ductile iron
- Stainless Steel
- Hot-dip galvanized steel
- Steel (hot water)
- Steel (other)
- Copper (hot water)
- Copper (other)
- PVC/CPVC Schedule 80 (chemical service)
- PVC/CPVC Schedule 80 (other)
- PVC Schedule 40
- FRP (pressure)
- FRP (LP)
- Polypropylene DWV
- PVDF DWV
- Cast iron soil pipe

1-2. GENERAL. Pipe supports, anchors, and expansion joints have been indicated on the drawings in certain locations, but no attempt has been made to indicate every pipe support, anchor, and expansion joint. It shall be Contractor's responsibility to provide a complete system of pipe supports, to provide expansion joints, and to anchor all piping, in accordance with the requirements specified herein. Additional pipe supports may be required adjacent to expansion joints, couplings, or valves. When supports are shown on the drawings, Contractor shall not relocate supports without Engineer's approval.

All piping shall be rigidly supported and anchored so that there is no movement or visible sagging between supports.

Pipe supports and expansion joints are not required in buried piping, but concrete blocking or other suitable anchorage shall be provided as indicated on the drawings or specified in other sections.

Piping support system components shall comply with specified piping code requirements.

1-2.01. General Equipment Stipulations. The General Equipment Stipulations shall apply to all equipment furnished under this section. If requirements in this specification differ from those in the General Equipment Stipulations, the requirements specified herein shall take precedence.

1-3. SUBMITTALS. Complete data and catalog cuts or drawings covering fabricated pipe supports, fabricated inserts, and stainless steel, galvanized, and copper- and plastic-coated pipe supports shall be submitted in accordance with the Submittals section.

Data shall include a listing of the intended use and general location of each item submitted.

PART 2 - PRODUCTS

2-1. MATERIALS. Unless otherwise indicated, all pipe supports shall comply with ANSI/MSS SP-58 and MSS SP-69. Materials of construction for fabricated steel supports are covered in the Structural and Miscellaneous Metals section. All pipe support materials shall be packaged as necessary to ensure delivery in satisfactory condition.

Design loads for inserts, brackets, clamps, and other support items shall not exceed the manufacturer's recommended loads.

Pipe supports shall be manufactured for the sizes and types of pipe to which they are applied. Strap hangers will not be acceptable. Threaded rods shall have sufficient threading to permit the maximum adjustment available in the support item. Continuously threaded rod is not acceptable for hanger rods over 12 inches in length.

Unless otherwise acceptable to Engineer, the use of supports which rely on stressed thermoplastic components to support the pipe will not be acceptable.

Contact between dissimilar metals, including contact between stainless steel and carbon steel, shall be prevented. Supports for brass or copper pipe or tubing shall be copper plated. Portions of pipe supports which come into contact with other metals that are dissimilar shall be rubber or vinyl coated.

Stainless steel supports shall be furnished, and shall be AISI Type 304 or 316 stainless steel. Stainless steel supports fabricated by welding shall be AISI Type 304L or 316L. Stainless steel support shall be provided as shown on the drawings.

Hot-dip galvanized supports shall be furnished and shall be in accordance with ASTM A153 and A385. Unless otherwise indicated all supports provided shall be galvanized.

Pipe support types and application shall comply with Table 1.

2-2. WIND LOADS. For pipe supports that are designed by the Contractor, wind loads shall be considered in the design. The applicable building code and design criteria are included in the structural general notes on the drawings.

PART 3 - EXECUTION

3-1. APPLICATION. Concrete inserts or anchor bolts shall be used to support piping from new cast-in-place concrete. Expansion anchors shall be used to fasten supports to existing concrete and masonry.

Anchorage shall be provided to resist thrust due to temperature changes, changes in diameter or direction, or dead-ending. Anchors shall be located as specified to force expansion and contraction movement to occur at expansion joints, loops, or elbows, and as needed to prevent excessive bending stresses and opening of mechanical couplings. Anchorage for temperature changes shall be centered between elbows and mechanical joints used as expansion joints. Anchorage for bellows type expansion joints may be located adjacent to the joint.

When expansion joints are required, pipe guides shall be provided adjacent to bellows type expansion joints. Guides will not be required where mechanical couplings are permitted as expansion joints. Guides shall be located on both sides of expansion joints, except where anchors are adjacent to the joint. Unless otherwise indicated on the drawings, one guide shall be within four pipe diameters from the joint and a second guide within 14 pipe diameters from the first guide. Pipe supports shall allow adequate movement; pipe guides shall not be used for support. Pipe guides shall be provided at locations as recommended by the manufacturer.

Pipe supports for insulated cold piping systems shall be sized for the outside diameter of the insulated pipe, and an insulation protection shield shall be installed between the support and the insulation. Rigid insulation inserts shall be installed between the pipe and the insulation shields for piping larger than 2 inches or when needed to prevent crushing of the insulation. Inserts shall be of the same thickness as the adjacent insulation and shall be vapor sealed.

Insulated hot piping systems shall be supported by clevises, clamps, support saddles, or rollers. Pipe clamps shall be attached directly to the pipe. Support saddles and rollers shall be sized for the outside diameter of the insulated pipe, and an insulation protection saddle shall be installed at the support.

When supports for the FRP piping systems are in contact with less than 180 degrees of the pipe surface or when the width of the support is less than one-third the nominal pipe diameter (4 inches minimum), an FRP or steel saddle, shaped to the outside diameter of the pipe, shall be bonded to at least the bottom 120 degrees of the pipe.

3-2. TYPES OF SUPPORTS. The specific products for pipe supports shall be as indicated in Table 1 for the specified type and size of support.

TABLE 1 - TYPES OF SUPPORTS

Description and Service	Type	
	MSS SP 69 (Note 1)	Other
(Orange County Utilities) (Meadow Woods WSF Modifications)	15140-3	

TABLE 1 - TYPES OF SUPPORTS

Description and Service	MSS SP 69 (Note 1)	Type	
			Other
Hangers			
2-1/2 inch and smaller pipe			
For hot and cold insulated piping			
Clevis	1	B-Line "B3100" or Anvil "260".	
Other services			
J-style	5	B-Line "B3690", Anvil "67", or Unistrut "J Hanger".	
Clevis	1	B-Line "B3104" or Anvil "65".	
3 Through 10 inch pipe			
For hot insulated piping			
Double bolt	3	B-Line "B3144" or Anvil "295".	
For cold insulated piping			
Clevis	1	B-Line "B3100" or Anvil "260".	
For uninsulated cold piping			
Clamp	4	B-Line "3140" or Anvil "212".	
Clevis	1	B-Line "B3100" or Anvil "260".	
Other services			
Clevis	1	B-Line "B3100" or Anvil "260" for steel pipe; B-Line "B3102" or Anvil "590" for cast iron pipe.	
12 inch pipe			
Clevis or saddle	1	See drawings.	
14 inch and larger pipe			
Saddle	--	See drawings.	
Concrete Inserts, Steel			
12 inch and smaller pipe	18	Channel 12 ga , galv, 1-5/8 by 1-3/8 inches , min. 8 inches long, anchor lugs on 4 inch centers, at least three lugs, end caps, and filler strip.	
14 inch and larger pipe, fabricated insert, except as noted	--	See drawings.	
Beam Clamps, Malleable Iron or Steel, 12 inch and smaller pipe	21	B-Line "3050" and "3055" or Anvil "133" and "134".	
	28, 29	Anvil "292".	
	30	B-Line "3054" or Anvil "228".	
Side Beam Bracket	34	B-Line "B3062" or Anvil "202".	
Wall Supports and Frames, Steel, 12 inch and smaller pipe (Note 2)			
Brackets	32	B-Line "B3066" or Anvil "195".	

TABLE 1 - TYPES OF SUPPORTS

Description and Service	MSS SP 69 (Note 1)	Type
		Other
Prefabricated channels	33	B-Line "B3067" or Anvil "199". 12 ga , galv, 1-5/8 inches , with suitable brackets and pipe clamps.
Offset pipe clamp, 1-1/2 inch and smaller pipe	--	Galv, 1-1/4 by 3/16 inch steel, with 3/8 inch bolts.
Offset pipe clamp, 2 to 3-1/2 inch pipe	--	Galv, 1-1/4 by 1/4 inch steel, with 3/8 inch bolts.
Floor Supports, Steel or Cast Iron		
6 inch and smaller pipe	37 (with base)	B-Line "B3090" or Anvil "259".
8 through 24 inch pipe	38	B-Line "B3093" or Anvil "264".
Pipe Alignment Guides	--	B-Line "B3281" through "B3287" or Anvil "255".
Turnbuckles Steel	13	B-Line "B3202" or Anvil "230".
Hanger Rods, Carbon Steel, Threaded Both Ends, 3/8 inch minimum size	--	B-Line "B3205" or Anvil "140".
Weldless Eye Nut, steel	17	B-Line "B3200" or Anvil "290".
Insulation Protection Saddle	39	B-Line "B3160 Series" or Anvil "160 Series".
Insulation Protection Shield	40	B-Line "B3151" or Anvil "167".

Table 1 Notes:

1. MSS SP-69 supports and hangers are illustrated on Figure 1-15140.
2. Pipe clamps or other devices which rely on the application of a clamping force to the supported pipe in order to maintain the clamp position or location in a prefabricated channel or track will not be acceptable for use with nonmetallic pipe or tubing.

3-3. **SUPPORT SPACINGS.** Pipe supports and expansion joints shall be spaced in accordance with Tables 2, 3, 4, and 5. The types of pipes to be supported are as specified herein. Table 2 covers spacings for the standard operating conditions specified for each pipe material. Tables 3 and 4 cover PVC and FRP pipe spacings where operating conditions are in excess of the temperature and specific gravity requirements covered in Table 2. Table 5 covers PVC and FRP pipe which carries air or liquids with a specific gravity other than 1.0.

TABLE 2 – MAXIMUM PIPE SUPPORT SPACINGS AT STANDARD TEMPERATURES AND SERVICES

Type of Pipe	Pipe Support Max Spacing	Max Run Without Expansion Joint, Loop, or Bend (Note 1)	Expansion Joint Max Spacing (Note 2)	Type of Expansion Joints
	feet	feet	feet	
Cast iron or Ductile iron	15	80	80	Note 6
Cast iron or Ductile iron, glass-lined	12	80	80	Note 6
Steel, for hot water heating				
1-1/4 inch and smaller	7	30	100	Note 3
1-1/2 to 4 inch	10	30	100	Note 3
Over 4 inch	15	30	100	Note 3
Steel, for other services				
1-1/4 inch and smaller	7	30	100	Note 3
1-1/2 to 4 inch	10	30	100	Note 3
Over 4 inch	15	80	80	Note 6
Stainless steel				
1-1/4 inch and smaller	7	30	100	Note 3
1-1/2 to 4 inch	10	30	100	Note 3
Over 4 inch	15	80	80	Note 3
Copper, for hot water				
1 inch and smaller	5	20	100	Note 3
Over 1 inch	7	20	100	Note 3
Copper, for services other than hot water				
1 inch and smaller	5	--	--	Note 7
Over 1 inch	7	50	100	Note 3
PVC, Schedule 80, for alum solution, caustic soda solution, ferric chloride solution, and hypochlorite solution at a maximum temperature of 100°F .				
1/8 and 1/4 inch	Continuous Support	20	60	Note 3
1/2 inch	3-1/2	20	60	Note 3
3/4 inch	4	20	60	Note 3
1 and 1-1/4 inch	4-1/2	20	60	Note 3
1-1/2 and 2 inch	5	20	60	Note 3
2-1/2 inch	5-1/2	20	60	Note 3
3 inch	6-1/2	20	60	Note 3
4 inch	7	20	60	Note 3
6 inch	8	20	60	Note 3
8 inch	9	20	60	Note 3

TABLE 2 – MAXIMUM PIPE SUPPORT SPACINGS AT STANDARD TEMPERATURES AND SERVICES

Type of Pipe	Pipe Support Max Spacing	Max Run Without Expansion Joint, Loop, or Bend (Note 1)	Expansion Joint Max Spacing (Note 2)	Type of Expansion Joints
	feet	feet	feet	
10 inch	9-1/2	20	60	Note 3
12 inch	10	20	60	Note 3
PVC, Schedule 80, for other services at a maximum temperature of 100°F and a maximum specific gravity of 1.0.				
1/8 and 1/4 inch	Continuous Support	20	60	Note 3
1/2 inch	4	20	60	Note 3
3/4 inch	4-1/2	20	60	Note 3
1 and 1-1/4 inch	5	20	60	Note 3
1-1/2 and 2 inch	5-1/2	20	60	Note 3
2-1/2 inch	6	20	60	Note 3
3 inch	7	20	60	Note 3
4 inch	7-1/2	20	60	Note 3
6 inch	8-1/2	20	60	Note 3
8 inch	9-1/2	20	60	Note 3
10 inch	10	20	60	Note 3
12 inch	11	20	60	Note 3
FRP, for double containment and single wall pressure pipe at a temperature of 150°F .				
1 inch	3-1/2	60	100	Note 3
1-1/2 inch	4	60	100	Note 3
2 inch	5	60	100	Note 3
3 inch	5-1/2	60	100	Note 3
4 inch	6	40	100	Note 3
6 inch	7	40	100	Note 3
8 inch	8	40	100	Note 3
10 inch	8-1/2	40	100	Note 3
12 inch and larger	9	40	100	Note 3
FRP, for low pressure and odor control pipe at a maximum temperature of 150°F and a maximum specific gravity of 1.0.				
1 inch	4	60	100	Note 3
1-1/2 inch	4-1/2	60	100	Note 3
2 inch	5-1/2	60	100	Note 3
3 inch	6	60	100	Note 3
4 inch	6-1/2	40	100	Note 3
6 inch	7-1/2	40	100	Note 3
8 inch	8-1/2	40	100	Note 3

TABLE 2 – MAXIMUM PIPE SUPPORT SPACINGS AT STANDARD TEMPERATURES AND SERVICES

Type of Pipe	Pipe Support Max Spacing	Max Run Without Expansion Joint, Loop, or Bend (Note 1)	Expansion Joint Max Spacing (Note 2)	Type of Expansion Joints
	feet	feet	feet	
10 inch	9-1/2	40	100	Note 3
12 inch and larger	10	40	100	Note 3
Tempered glass (Note 4)	8	--	--	Note 7
High silicon iron (Note 5)	15	--	--	Note 7
Polypropylene DWV	6	--	--	Note 7
PVDF DWV	6	--	--	Note 7
Cast iron soil pipe	10	--	--	Notes 7, 8
PVC, Schedule 40, for services at a maximum temperature of 100°F , and a maximum specific gravity of 1.0.				
1/8 and 1/4 inch	Continuous Support	20	60	Note 3
1/2 inch	3-1/2	20	60	Note 3
3/4 and 1 inch	4	20	60	Note 3
1-1/4 and 1-1/2 inch	4-1/2	20	60	Note 3
2 inch	5	20	60	Note 3
2-1/2 inch	5-1/2	20	60	Note 3
3 inch	6	20	60	Note 3
4 inch	6-1/2	20	60	Note 3
6 inch	7-1/2	20	60	Note 3
8 inch	8	20	60	Note 3
10 inch	8-1/2	20	60	Note 3
12 inch	9-1/2	20	60	Note 3

Table 2 Notes:

1. Unless otherwise acceptable to Engineer, an expansion joint shall be provided in each straight run of pipe having an overall length between loops or bends exceeding the maximum run specified herein.
2. Unless otherwise acceptable to Engineer, the spacing between expansion joints in any straight pipe run shall not exceed the maximum spacing specified herein.
3. Expansion joint fittings are specified in the respective piping procurement sections.
4. At least two properly padded supports for each pipe section.
5. At least one support for each pipe section.

6. Expansion joints shall be mechanical couplings.
7. No expansion joints are required.
8. Supports for 5 and 10 foot long pipe sections shall be located within 18 inches of each joint. Supports shall be positioned to maintain the piping alignment and to prevent the piping from sagging.

3-3.01. Temperature Adjustments for PVC Pipe. Not Used.

3-3.02. Temperature Adjustments for FRP Pipe. Not Used.

3-3.03. Specific Gravity Adjustments for PVC and FRP Pipe. PVC and FRP pipe shall have the maximum spacing indicated in Tables 2, 3, and 4 adjusted in accordance with the following table when the specific gravity of the liquid is greater than 1.0. Table 5 shall not apply to PVC pipe containing alum solution, caustic soda solution, ferric chloride solution, and hypochlorite solution, as these services are specifically covered in Table 2.

TABLE 5 – MAXIMUM SUPPORT SPACING CORRECTION FACTORS FOR PVC AND FRP PIPE	
Specific Gravity	Correction Factor
1.0	1.00
1.1	0.98
1.2	0.96
1.4	0.93
1.6	0.90
2.0	0.85
2.5	0.80
Air	1.40

3-4. INSTALLATION.

3-4.01. General. All piping shall be supported in a manner which will prevent undue stress 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. Pipe supports and hangers shall not be installed in equipment access areas.

Where horizontal piping is arranged with two or more parallel lines, trapeze hangers may be used in lieu of individual hangers. Trapeze assembly shall consist of structure attachments as previously specified with rod size dependent upon total weight supported. Spacing of assemblies shall be determined by the minimum pipe size included in the group supported. Trapeze horizontal assemblies shall be structural angle or channel section of sufficient size to prevent measurable sag between rods. All lines shall be attached to the horizontal with intermediate pipe guides and U-bolts or one-hole clamps. Pre-engineered support equipment may be used when selected and installed in accordance with the manufacturer's recommendations.

No copper pipe shall contact a pipe support or hanger of dissimilar metal. Hangers and supports for copper pipe shall be copper-plated, plastic coated, or copper pipe shall be galvanically isolated using Neoprene strips or other material as approved.

No piping shall be supported from the pipe above.

Horizontal piping hanger support rods shall attach to steel beams with center-loading I-clamps, or welded beam clips. Hanger support rods shall attach to concrete slabs or beams with inserts.

Anchorage shall be provided to resist both lateral and longitudinal seismic forces. Seismic forces shall be calculated assuming the pipes are full.

3-4.02. Inserts. Reference building structural concrete drawings for concrete inserts. When not provided as part of the building concrete structure, provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.

Where concrete slabs form finished ceilings, provide inserts flush with the slab surface.

Where inserts are omitted, drill through concrete slab from below and provide thru-bolt with recessed square steel plate and nut recessed into and grouted flush with slab. X-ray locate existing reinforcing rods before drilling.

3-4.03. Pipe Hangers and Supports. Hanger rod sizing for copper pipe and plastic pipe shall be same as for steel pipe. Install hangers to provide a minimum 1/2 inch space between finished covering and adjacent work.

A hanger shall be placed with 18 inches of each horizontal elbow, and on both sides of all piping accessories and valves weighing 20 lbs or more.

Hangers shall have 1-1/2 inches minimum vertical adjustment.

Support horizontal cast iron, ductile iron and no-hub piping systems adjacent to each joint.

Support vertical piping at every floor using riser clamps.

Support riser piping independently of connected horizontal piping.

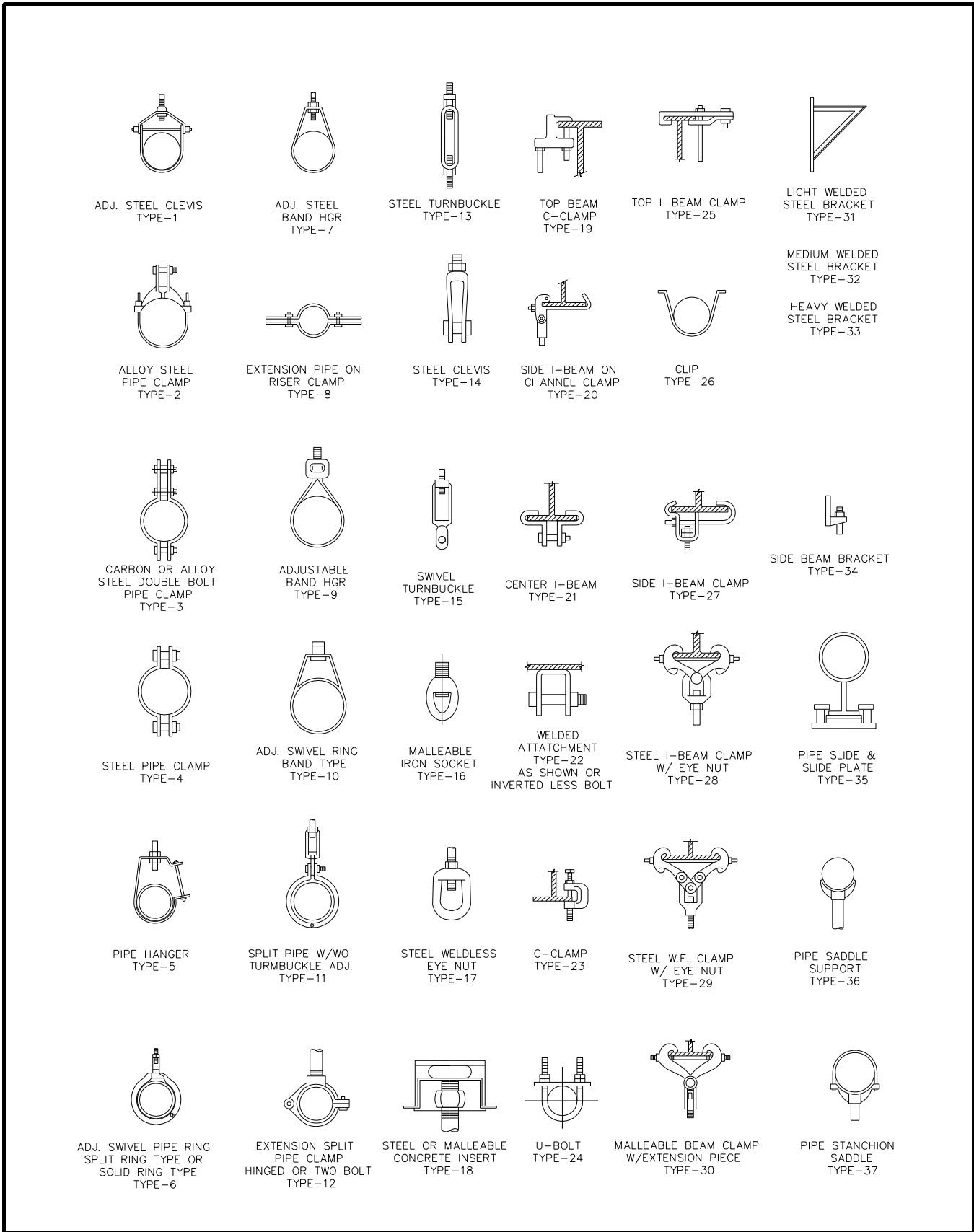
Hanger and hanger components shall be sized specifically for the pipe size it is to be used on.

3-5. PLACEMENT. Unless closer spacing is indicated on the drawings, the maximum spacing for pipe supports and expansion joints shall be as indicated in Tables 2, 3, 4, and 5.

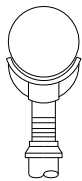
Rubber hose and flexible tubing shall be provided with continuous angle or channel support.

Unless otherwise indicated on the drawings or acceptable to Engineer, piping shall be supported approximately 1-1/2 inches out from the face of walls and at least 3 inches below ceilings.

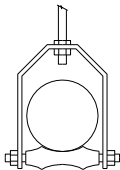
End of Section



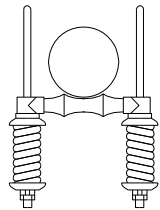
HANGERS AND SUPPORTS



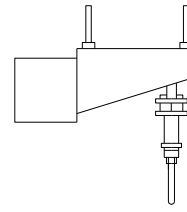
ADJUSTABLE PIPE SADDLE SUPPORT
TYPE-38



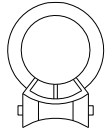
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TYPE-43



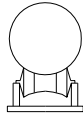
SPRING CUSHION ROLL
TYPE-49



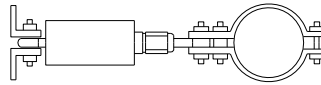
CONSTANT SUPPORT HORIZONTAL TYPE
TYPE-54



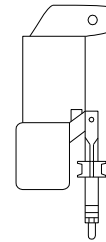
STEEL PIPE COVER PROTECTION SADDLE
TYPE-39



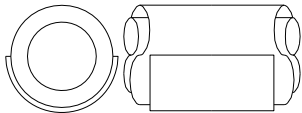
PIPE ROLL COMPLETE
TYPE-44



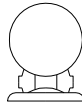
SPRING SWAY BRACE
TYPE-50



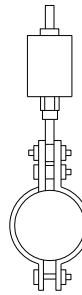
CONSTANT SUPPORT VERTICAL TYPE
TYPE-55



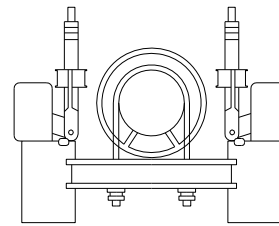
PROTECTION SHIELD
TYPE-40



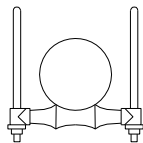
PIPE ROLL & PLATE
TYPE-45



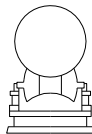
VARIABLE SPRING HANGER
TYPE-51



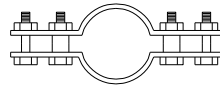
CONSTANT SUPPORT TRAPEZE TYPE
TYPE-56



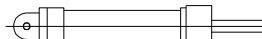
SINGLE PIPE ROLL
TYPE-41



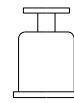
ADJUSTABLE PIPE ROLL & BASE
TYPE-46



CARBON OR ALLOY STEEL RISER CLAMP
TYPE-42



RESTRAINT CONTROL DEVICE
TYPE-47



VARIABLE SPRING BASE SUPPORT
TYPE-52

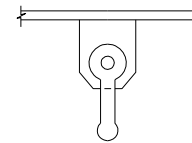
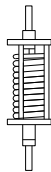
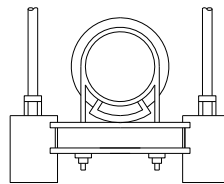


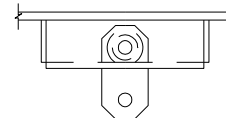
PLATE LUG
TYPE-57



SPRING CUSHION
TYPE-48



VARIABLE SPRING TRAPEZE HANGER
TYPE-53



HORIZONTAL TRAVELER
TYPE-58

HANGERS AND SUPPORTS

VALVE AND GATE ACTUATORS

PART 1 - GENERAL

1-1. SCOPE. This section covers furnishing manual and powered valve and gate actuators and accessories as specified herein.

1-2. GENERAL. Equipment provided under this section shall be fabricated and assembled in full conformity with Drawings, specifications, engineering data, instructions, and recommendations of the equipment manufacturer, unless exceptions are noted by Engineer.

Actuators shall be furnished with all necessary parts and accessories indicated on the Drawings, specified, or otherwise required for a complete, properly operating installation and shall be the latest standard products of a manufacturer regularly engaged in the production of actuators.

1-2.01. General Equipment Stipulations. The General Equipment Stipulations shall apply to all equipment furnished under this section. If requirements in this specification differ from those in the General Equipment Stipulations, the requirements specified herein shall take precedence.

1-2.02. Governing Standards. Except as modified or supplemented herein, cylinder and vane type actuators shall conform to applicable requirements of ANSI/AWWA C541.

Except as modified or supplemented herein, electric motor actuators shall conform to applicable requirements of ANSI/AWWA C542.

Except as modified or supplemented herein, actuators for butterfly and eccentric plug valves shall conform to the applicable requirements of ANSI/AWWA C504.

Except as modified or supplemented herein, manual actuators for ball valves shall conform to the applicable requirements of ANSI/AWWA C507.

Except as modified or supplemented herein, actuators for cast-iron slide gates shall conform to the applicable requirements of ANSI/AWWA C560.

Except as modified or supplemented herein, actuators for open channel slide gates and weir gates shall conform to the applicable requirements of ANSI/AWWA C513.

Except as modified or supplemented herein, actuators for stainless steel slide gates shall conform to the applicable requirements of ANSI/AWWA C561.

Except as modified or supplemented herein, actuators for composite slide gates shall conform to the applicable requirements of ANSI/AWWA C563.

1-2.03. Power Supply. Power supply to electric actuators will be as indicated on the electrical drawings.

1-2.04. Marking. Each actuator shall be marked with the manufacturer's name, model number, and the country of origin. An identifying serial number shall be stamped on a corrosion-resistant plate attached to the actuator.

1-2.05. Temporary Number Plates. Each actuator shall be factory tagged or marked to identify the actuator and the applicable valve or gate by number or service as indicated in the valve or gate schedule.

1-3. SUBMITTALS. Complete drawings, details, and specifications covering the actuators and their appurtenances shall be submitted in accordance with the Submittal Procedures section. Submittal drawings shall clearly indicate the country of origin of each actuator and its components.

Submittal drawings shall include separate wiring diagrams for each electrically operated or controlled actuator and the electrical control equipment. Each actuator drawing shall be identified with the respective valve number or name.

For networked valve actuators, information on the available input and output assemblies shall be submitted for the protocol(s) specified to be provided. The submittal shall identify the version of the selected network protocol for which the device has been tested and certified.

For electric or cylinder actuators, certified copies of reports covering proof-of-design testing of the actuators as set forth in Section 5 of ANSI/AWWA C541 or ANSI/AWWA C542 respectively, together with an affidavit of compliance as indicated in Section 6.3 of ANSI/AWWA C541 or ANSI/AWWA C542 respectively, shall be submitted to Engineer before the actuators are shipped.

PART 2 - PRODUCTS

2-1. PERFORMANCE AND DESIGN REQUIREMENTS.

2-1.01. General. Actuators and appurtenances shall be designed for the conditions and requirements as indicated in the respective valve and gate sections.

Liberal factors of safety shall be used throughout the design, especially in the design of parts subject to intermittent or alternating stresses. In general, working stresses shall not exceed one-third of the yield point or one-fifth of the ultimate strength of each material.

2-1.02. Valve Actuators. Each actuator shall be designed to open or close the valve under all operating conditions. Actuators shall be designed for the maximum pressure differential across the valve and maximum velocities through the valve where indicated in the respective valve schedules.

Valve actuators shall be provided and adjusted by the valve manufacturer. Actuator mounting arrangements and positions shall facilitate operation and maintenance and shall be determined by the valve manufacturer unless indicated otherwise on the Drawings or directed by Engineer.

When valves are to be buried, submerged, or installed in vaults; the actuators and accessories shall be sealed to prevent the entrance of water. The design water depth shall be as indicated in the respective valve schedules but not less than 20 feet.

2-1.03. Gate Actuators. Actuators shall be sized to produce the torque or thrust required to operate the gate when subject to the seating and unseating operating heads as indicated in the respective gate schedules.

Both the design head and the operating head shall be measured from the surface of the liquid to the center line of the gate.

2-1.04. Limit Switches. Limit switches shall be provided as indicated on the Drawings or in the valve and gate schedules.

For manual or cylinder type actuators, each limit switch shall be heavy duty type, with a cast NEMA Type 4 enclosure, a spring return roller lever, and four isolated contacts (two normally open and two normally closed) rated 10 amperes at 120 to 480 volts ac and 5 amperes at 125 volts dc. The switches shall be Allen Bradley "802T" or Square D "9007 Type C".

Limit switches for intelligent and standard electric actuators shall be as indicated in their respective paragraphs.

2-2. MATERIALS. Except as modified or supplemented herein, materials used in the manufacture of actuators shall conform to the requirements of the applicable governing standard(s).

2-3. VALVE MANUAL ACTUATORS.

2-3.01. General. Manual actuators of the types listed in the valve specifications or schedules shall be provided by the valve manufacturer.

Unless otherwise indicated or specified, each geared manual actuator shall be equipped with an operating handwheel.

The direction of rotation of the wheel, wrench nut, or lever to open the valve shall be to the left (counterclockwise). Each valve body or actuator shall have cast thereon the word "Open" and an arrow indicating the direction to open.

The housing of traveling-nut type actuators shall be fitted with a removable cover which shall permit inspection and maintenance of the operating mechanism without removing the actuator from the valve. Travel limiting devices shall be provided inside the actuator for the open and closed positions. Travel limiting stop nuts or collars installed on the reach rod of traveling-nut type operating mechanisms shall be field adjustable and shall be locked in position by means of a removable roll pin, cotter pin, or other positive locking device. The use of stop nuts or adjustable shaft collars which rely on clamping force or setscrews to prevent rotation of the nut or collar on the reach rod will not be acceptable.

Each actuator shall be designed so that shaft seal leakage cannot enter the actuator housing.

Valves for throttling service shall be equipped with an infinitely variable locking device or a totally enclosed gear actuator.

Actuators shall produce the required torque with a maximum pull of 80 lbs on the lever, handwheel, or chain. Actuator components shall withstand, without damage, a pull of 200 lbs on the handwheel or chainwheel or an input of 300 foot-lbs on the operating nut.

2-3.02. Handwheels. Handwheel diameters shall be at least 8 inches but not more than 24 inches for 30 inch and smaller valves and not more than 30 inches for 36 inch and larger valves.

2-3.03. Chainwheels. Unless otherwise specified in the valve schedules, all valves with center lines more than 7'-6" above the floor shall be provided with chainwheels and operating chains. Each chainwheel operated valve shall be equipped with a chain guide which will permit rapid handling of the operating chain without "gagging" of the wheel and will also permit reasonable side pull on the chain. Suitable extensions shall be provided, if necessary, to prevent interference of the chain with adjacent piping or equipment. Operating chains shall be hot-dip galvanized or zinc plated carbon steel and shall be looped to extend to within 4 feet of the floor below the valve.

2-3.04. Levers. Levers shall be capable of being locked in at least five intermediate positions between fully open and fully closed. In any building or structure containing lever operated valves, at least two operating levers shall be provided for each size and type of lever operated valve.

2-3.05. Chain Levers. Suitable actuator extensions shall be provided, if necessary, to prevent interference of the chain with adjacent piping or equipment. Operating chains shall be hot-dip galvanized carbon steel and shall be looped to extend to within 4 feet of the floor below the valve.

2-3.06. Wrench Nuts. Unless otherwise specified in the valve schedules or on the Drawings, wrench nuts shall be provided on all buried valves and on all valves that are to be operated through floor boxes. Unless otherwise directed by Owner, all wrench nuts shall comply with Section 4.4.13 of ANSI/AWWA C500. At least two operating keys shall be furnished for operation of the wrench nut operated valves.

2-3.07. Operating Stands. Operating stands shall be provided in the locations indicated on the Drawings or as indicated in the valve and gate schedules. Operating stands shall support the handwheel approximately 36 inches above the floor. A sleeve made from standard weight galvanized steel pipe shall be provided for the opening in the floor beneath each operating stand. When stems are 10 feet or longer, a suitable thrust bearing shall be provided in each operating stand to carry the weight of the extension stem.

2-3.08. Wall Brackets. Wall brackets shall be provided to support manual actuators in the locations indicated on the Drawings or in the respective valve schedules. The horizontal face of the bracket shall be predrilled to accept the actuator and the stem without modification. The top of the bracket shall extend sufficiently to bear on and transfer thrust loads to the top of the supporting structure.

2-4. GATE MANUAL ACTUATORS. Not used.

2-5. INTELLIGENT ELECTRIC ACTUATORS. Not used.

2-6. STANDARD ELECTRIC ACTUATORS.

2-6.01. General. Standard electric actuators as listed in the valve and gate schedules shall be provided by the valve or gate manufacturer.

Electric actuators with torque output requirements of 750 ft-lbs and less for butterfly valves and eccentric plug valves shall be quarter-turn type and shall be Auma "SGBV 05.1 through SGBV 12.1", EIM "Series P, Q, or R" or Limitorque "LY" without exception.

All other electric actuators for open-close service shall be multi-turn type and shall be Auma "SABV 07.1 through SABV 48.1", EIM "Series 2000", Limitorque "L120", or Rotork "AWT Series" without exception.

All other electric actuators for modulating service shall be multiturn type and shall be Auma "SARBV 07.1 through SARBV 16.1", EIM "Series 2000", Limitorque "L120", or Rotork "AWT Series" without exception.

All other electric actuators for Explosion-proof service shall be multiturn type and shall be Auma "SAExBV/SARExBV 07.1 through SAExBV/SARExBV 16.1", EIM "Series 2000", Limitorque "L120", or Rotork "AWT Series" without exception.

Electric actuators produced by other manufacturers are not acceptable.

Each standard electric actuator shall be furnished complete with a motor, gearing, handwheel, limit switches and torque sensors, lubricants, heating elements, wiring, and terminals. Each actuator shall be constructed as a self-contained unit with a cast iron or aluminum alloy housing, of a type as indicated in the valve and gate schedules, and shall be integrally assembled on the applicable valve or gate by the valve or gate manufacturer.

Actuators shall be designed to cycle the valve or gate from the fully open to the fully closed position or the reverse in approximately 60 seconds or as indicated in the valve and gate schedules.

Actuator motors may be mounted horizontally adjacent to or vertically above the reduction gearing. All gearing shall be oil or grease lubricated.

2-6.02. Motors. Motors shall be totally enclosed, high torque design made expressly for valve and gate actuator service, capable of operating the valve or gate under full differential pressure for two complete strokes or one complete cycle of travel without overheating. Motors shall be designed in accordance with NEMA standards and shall operate successfully at any voltage within 10 percent above or below rated voltage. Motor bearings shall be permanently lubricated.

2-6.03. Power Gearing. Power gearing shall consist of hardened steel spur or helical gears and alloy bronze or hardened steel worm gear, all suitably lubricated, designed for 100 percent overload, and effectively sealed against entrance of foreign matter. Steel gears shall be hardened to at least 350 Brinell. Planetary or cycloidal gearing or aluminum, mild steel, or nonmetallic gears will not be acceptable. Gearing shall be designed to be self-locking so that actuation of a

torque switch or electronic torque protection device by a torque overload condition will not allow the actuator to restart until the torque overload has been eliminated. If a secondary gear box is required, it shall be designed to withstand the locked rotor torque of the actuator.

2-6.04. Handwheel Mechanism. The handwheel shall not rotate during motor operation. During handwheel operation the motor shall not affect the actuator operation. The actuator shall be responsive to electrical power and control at all times and, when under electrical control, shall instantly disengage the handwheel. The handwheel shall rotate counterclockwise to open the valve. An arrow indicating the opening direction and the word "Open" shall be cast on the handwheel. The force required to operate the handwheel shall not exceed 80 lbs. The handwheel shall have a padlockable declutch lever.

2-6.05. Torque Sensing. Torque and thrust loads in both closing and opening directions shall be limited by a torque sensing device. Each torque sensing device shall be provided with an adjustment setting indicator. The adjustment shall permit a variation of approximately 40 percent in torque setting. Switches shall have a rating of not less than 6 amperes at 120 volts ac and 0.5 ampere at 115 volts dc.

2-6.06. Limit Switches. Each standard electric actuator shall have a minimum of four internal limit switch assemblies which are field adjustable. Each switch assembly shall consist of at least three separate limit switches, shall be operated by the driving mechanism, and shall be independently adjustable to trip at any point at and between the fully open and fully closed valve positions. All switches shall have an inductive contact rating of not less than 15 amperes at 250 volts ac and 10 amperes at 30 volts dc with a switching load limited to 5 amperes maximum for both AC and DC.

2-6.07. Position Transmitter. When indicated in the valve and gate schedules, actuators shall be provided with an electronic type position transmitter. The transmitter output shall be an isolated 4-20 mA dc capable of driving an external load of 0 to 400 ohms. Accuracy of the transmitted signal shall be ± 2 percent of span. Repeatability and hysteresis shall be within 1 percent. The transmitter shall transmit to a remote position indicator which is specified in the Instrumentation section.

2-6.08. Heating Elements. Space heating elements shall be provided to prevent condensation in the motor and limit switch housing. Space heating elements shall not be required for actuators which are of a sealed design utilizing double O-ring seals in the motor and controls housing. Heating elements shall be rated 120 volts ac. Heaters shall be continuously energized.

2-6.09. Terminal Facilities. Terminal facilities for connection to motor leads, switches, position transmitter, and heating elements shall be provided in readily accessible terminal compartments. Each terminal compartment shall have at least two openings for external electrical conduits, one sized at least 3/4 inch and the other at least 1-1/4 inches. Each terminal compartment shall be large enough to allow easy routing and termination of fifteen 12 AWG conductors.

2-6.10. Controller. Each valve or gate shall be furnished with a reversing controller located inside the actuator enclosure and shall have controller devices as indicated in the valve and gate schedules. The controller shall be equipped with:

- a. A motor overload protective device in each phase or solid state motor protection.
- b. A space heater element, rated 120 volts ac, sized to be continuously energized for prevention of condensation within the controller enclosure.
- c. A fused control power circuit taken from one power lead on the load side of the breaker and line side of the reversing starter to ground. If power supply is greater than 120 volts ac, a control power transformer with fused secondary, with volt-ampere capacity suitable for starter control plus continuous service to space heater elements in motor housing, limit switch compartment, and controller enclosure.
- d. A terminal block with connectors for all external controls. All leads from the actuator motor and limit switch assembly shall be routed to terminal connections in the controller for external connections to all other control devices.
- e. Auxiliary control contacts as indicated in the electrical schematics.

Reversing controllers shall be both mechanically and electrically interlocked and shall be provided with the necessary direct-operated auxiliary contacts for required interlocking and control.

Valve controllers shall be expressly selected for long life and reliable, low maintenance service under rugged service conditions.

2-6.11. Control Module. Valves or gates indicated for modulating service in the valve and gate schedules shall be provided with a control module for position modulating type service. The control module shall be mounted within the valve actuator limit switch housing. The module shall accept a standard 4-20 mA dc analog input signal with a load impedance of not greater than 400 ohms. The control module shall contain adjustments for span, zero, gain, and deadband.

The actuator shall have a slide-wire type position feedback potentiometer or electronic current position transmitter which provides a position feedback signal to the control module.

2-6.11.01. Control Performance. For any operating torque within the specified range of the valve actuator, the valve and actuator shall perform within these specified limits:

Linearity	Linearity of actual valve position as compared to demand signal shall be within ± 4 percent of span over the entire operating range.
Repeatability	For any repeated demand signal to the valve actuator, the actual valve position shall be repeated.
Deadband	Deadband of the valve actuator shall be adjustable from 1 to 10 percent of span.
Hysteresis	For any repeated demand signal to the valve actuator, from either an increasing or a decreasing direction, the actual valve position shall be repeated within 1 degree of valve shaft rotation.

- 2-7. HYDRAULIC CYLINDER ACTUATORS. Not used.
- 2-8. AIR CYLINDER ACTUATORS. Not used.
- 2-9. VANE TYPE PNEUMATIC ACTUATORS. Not used.
- 2-10. AIR-OIL CYLINDER ACTUATORS. Not used.
- 2-11. PORTABLE ELECTRIC ACTUATORS. Not used.
- 2-12. PORTABLE HYDRAULIC ACTUATORS. Not used.
- 2-13. ACTUATOR ACCESSORIES.

2-13.01. Extension Stems. Extension stems and stem guides shall be furnished when indicated in the respective valve schedules, indicated on the Drawings, or otherwise required for proper valve operation. Extension stems shall be of solid steel and shall be not smaller in diameter than the stem of the actuator shaft. Extension stems shall be connected to the actuator with a single Lovejoy "Type D" universal joint with grease-filled protective boot. All stem connections shall be pinned.

At least two stem guides shall be furnished with each extension stem, except for buried valves. Stem guides shall be of cast iron, bronze bushed, and adjustable in two directions. Stem guide spacing shall not exceed 100 times the stem diameter or 10 feet, whichever is smaller. The top stem guide shall be designed to carry the weight of the extension stem. The extension stem shall be provided with a collar pinned to the stem and bearing against the stem thrust guide.

Extension stems for chemical resistant butterfly valves located in drainage sumps shall be the two-piece type with stainless steel stem, PVC housing, wall support, and collar. Unless otherwise indicated on the Drawings, the length of the stem extension shall be as necessary to position the valve operator 12 inches above the maximum liquid level in the immediate area.

Extension stems for buried valve actuators shall extend to within 6 inches of the ground surface, shall be centered in the valve box using spacers, and shall be equipped with a wrench nut.

Extension stems for buried valve actuators shall be provided with position indicators as specified in the valve schedules.

2-13.02. Position Indicators. Unless otherwise specified, each valve actuator shall be provided with a position indicator to display the position of the plug or disc relative to the body seat opening.

For quarter turn plug, ball, or cone type valves installed in interior locations, the indicating pointer shall be mounted on the outer end of the valve operating shaft extension and shall operate over an indicating scale on the operating mechanism cover. Where the shaft passes through the cover, a suitable stuffing box or other seal shall be provided to prevent the entrance of water.

Each actuator for butterfly valves, except where located in manholes, buried, or submerged, shall have a valve disc position indicator mounted on the end of the valve shaft. A disc position indicator shall also be provided on each operating stand or the actuator mounted thereon.

2-13.02.01. Position Indicators for Buried Actuators. Not used.

2-13.03. Floor Boxes. Openings through concrete slabs provided for key operation of valves shall be provided with a cast iron floor box complete with cover. The floor box shall be of the depth indicated on the Drawings. Where the operating nut is in the slab, the stem shall have a guide to maintain the nut in the center of the box; where the nut is below the slab, the opening in the bottom of the box shall accommodate the operating key.

Each floor box and cover shall be shop coated with manufacturer's standard coating.

2-13.04. Torque Tubes. Torque tube shall utilize pipe rather than solid shafting between the valve input shaft and the output shaft of the valve floorstand operator. An adjustment of 2 inches shall be provided in the torque tube installation. Torque tube shall be coated with the same material as the submerged valve.

2-13.05. Valve Boxes. Each valve buried to a depth of 4 feet or less shall be provided with a slide type valve box. Valve boxes shall be cast iron, extension sleeve type, suitable for the depth of cover indicated on the Drawings. Only one extension will be allowed with each slide type valve box. Valve boxes shall be at least 5 inches in inside diameter, shall be at least 3/16 inch thick, and shall be provided with suitable cast iron bases and covers.

Each valve buried deeper than 4 feet shall be provided with a valve box consisting of a cast iron cover and a 6 inch Cast Iron Pipe section. The cover shall be Clay & Bailey "No. 2193". The pipe shaft shall extend from the valve to 5 inches inside the valve box cover.

All parts of valve boxes, bases, and covers shall be shop coated with manufacturer's standard coating.

Valve boxes which are to be provided with position indicators shall have top sections and covers designed for proper installation of the position indicator and accessories.

2-14. SHOP PAINTING. All ferrous metal surfaces, except bearing and finished surfaces and stainless steel components of valve actuators and accessories, shall be shop painted for corrosion protection. The valve manufacturer's standard coating will be acceptable, provided it is functionally equivalent to the specified coating and is compatible with the specified field painting.

The following surfaces shall be painted:

Polished or Machined Surfaces	Rust-preventive compound.
Other Surfaces	Epoxy.
Actuators and Accessories	Universal primer.

PART 3 - EXECUTION

3-1. INSTALLATION. Actuators will be installed on the valves in accordance with the Valve Installation section and on gates in accordance with the Gate Installation section.

End of Section

PLUMBING

PART 1 - GENERAL

1-1. SCOPE. This section covers the furnishing and installation of materials, appliances, fixtures, equipment, and appurtenances associated with the plumbing systems as specified herein and as indicated on the Drawings. Additional requirements for plumbing systems shall be as indicated in the schedules on the Drawings. Suitable connections shall be provided for each fixture, piece of equipment, and appurtenance.

Pipe materials, valves, thermal insulation, and pipe supports which are not an integral part of the fixture or piece of equipment and are not specified herein are covered in other sections.

1-2. GENERAL. Materials furnished and installed under this section shall be fabricated, assembled, erected, and placed in proper operating condition in full conformity with the Drawings, Specifications, engineering data, instructions, and recommendations of the manufacturer unless exceptions are noted by Engineer.

1-2.01. Coordination. Contractor shall verify that each component of the plumbing system is compatible with all other parts of the system; that all piping, fixtures, and appurtenances are appropriate; and that all devices necessary for a properly functioning system have been provided.

Where two or more units of the same class of equipment are required, they shall be the product of a single manufacturer; however, all the component parts of the system need not be the products of one manufacturer.

Where several manufacturers' names have been listed in this section as possible suppliers, only the products of the first manufacturer listed have been checked for size, functions, and features.

1-2.02. General Equipment Stipulations. The General Equipment Stipulations shall apply to all equipment and materials provided under this section. If requirements in this specification differ from those in the General Equipment Stipulations, the requirements specified herein shall take precedence.

1-2.03. Governing Standards. Except as modified or supplemented herein, all work covered by this section shall be performed in accordance with all applicable municipal codes and ordinances, laws, and regulations. In case of a conflict between this section and any state law or local ordinance, the latter shall govern.

All work shall conform to the requirements of AGA, ASTM, NFPA, and UL safety requirements.

1-2.04. Power Supply. Unless otherwise specified, power supply to equipment with motors shall be as indicated on the Drawings. Power supply for controls shall be 120 volts, 60 Hz, single phase unless otherwise required for a properly operating system.

1-2.05. Metal Thickness. Metal thicknesses and gages specified herein are minimum requirements. Gages refer to US Standard gage.

1-2.06. Mechanical Identification. Mechanical identification shall conform to the requirements of the Basic Mechanical Building Systems Materials and Methods section.

1-3. SUBMITTALS.

1-3.01. Drawings and Data. Complete assembly and installation drawings, and wiring and schematic diagrams, together with detailed specifications and data covering materials, parts, devices, and accessories forming a part of the equipment furnished, shall be submitted in accordance with the Submittals Procedures section. Device tag numbers indicated on the Drawings shall be referenced on the wiring and schematic diagrams where applicable. The data and specifications to be submitted for each unit shall include, but shall not be limited to, the following:

Equipment, Piping Accessories, and Appurtenances

- Name of manufacturer.
- Type and model.
- Construction materials, thicknesses, and finishes.
- Capacities.
- Pressure and temperature ratings.
- Overall dimensions.
- Piping connection sizes and locations.
- Net weight.
- Horsepower [kW].
- Power requirements.
- Wiring diagrams.

Plumbing Fixtures

- Name of manufacturer.
- Type and model.
- Construction materials, thicknesses, and finishes.
- Water consumption data.
- Overall dimensions.
- Rough-in dimensions.
- Piping connection sizes and locations.
- Net weight.

1-3.02. Operations and Maintenance Data and Manuals. Adequate operation and maintenance information shall be supplied as required in the Submittals Procedures section. Operation and maintenance manuals shall be submitted in accordance with the Submittals Procedures section.

Operation and maintenance manuals are required for emergency fixtures, .

1-4. QUALITY ASSURANCE.

1-4.01. Welding Qualifications. All welding procedures and welding operators shall be qualified by an independent testing laboratory in accordance with the applicable provisions of AWS Standard Qualification Procedures. All procedure and operator qualifications shall be in

written form and subject to Engineer's review. Accurate records of operator and procedure qualifications shall be maintained by Contractor and made available to Engineer upon request.

1-4.02. Qualification. The plumbing system installer shall be licensed as stipulated by the authority having jurisdiction.

1-4.03. Manufacturer's Experience. Unless the equipment manufacturer is specifically named in this section, the manufacturer shall have furnished equipment of the type and size specified which has been in successful operation for not less than the past 5 years.

1-4.04. Construction. Plumbing fixtures shall be constructed in accordance with the following standards:

Emergency/Safety Fixtures ANSI Z358.1

1-5. DELIVERY, STORAGE, AND HANDLING. Shipping shall be in accordance with the Product Delivery Requirements section. Handling and storage shall be in accordance with the Product Storage and Handling Requirements section.

1-6. EXTRA MATERIALS. Not used.

PART 2 - PRODUCTS

2-1. SERVICE CONDITIONS. All plumbing fixtures and equipment shall be designed and selected to meet the specified conditions.

2-2. PERFORMANCE AND DESIGN REQUIREMENTS. All fixtures and equipment shall be designed to meet the performance and design conditions specified herein and indicated on the Drawings.

2-2.01. Dimensional Restrictions. Layout dimensions will vary between manufacturers and the layout area indicated on the Drawings is based on typical values. Contractor shall review the contract Drawings, the manufacturer's layout drawings, and installation requirements and shall make any modifications required for proper installation subject to acceptance by Engineer.

2-3. ACCEPTABLE MANUFACTURERS. Acceptable manufacturers shall be as listed in the respective product description paragraphs.

2-4. MANUFACTURE AND FABRICATION.

2-4.01. Anchor Bolts and Expansion Anchors. Anchor bolts, expansion anchors, nuts, and washers shall be as indicated in the Anchorage In Concrete and Masonry section unless otherwise indicated on the Drawings.

2-4.02. Surface Preparation. All iron and steel surfaces, except motors and speed reducers, shall be shop cleaned by sandblasting or equivalent, in strict conformance with the paint manufacturer's recommendations. All mill scale, rust, and contaminants shall be removed before shop primer is applied.

2-4.03. Shop Painting. All steel and iron surfaces shall be protected by suitable coatings applied in the shop. Surfaces which will be inaccessible after assembly shall be protected for the life of the equipment. Coatings shall be suitable for the environment where the equipment is installed. Exposed surfaces shall be finished, thoroughly cleaned, and filled as necessary to provide a smooth, uniform base for painting. Electric motors, speed reducers, starters, and other self-contained or enclosed components shall be shop primed or finished with an oil-resistant enamel or universal type primer suitable for top coating in the field with a universal primer and aliphatic polyurethane system.

Surfaces to be coated after installation shall be prepared for painting as recommended by the paint manufacturer for the intended service, and then shop painted with one or more coats of the specified primer.

Surface finish damaged during installation shall be repaired to the satisfaction of Engineer. Field painting shall conform to the requirements of the Protective Coatings section.

2-4.04. Equipment Bases. Not used.

2-4.05. Special Tools and Accessories. Not used.

2-4.06. Piping Systems. Unless otherwise specified herein, piping system materials shall be as specified in other sections.

2-4.07. Valves. Unless otherwise specified herein, valves indicated to be a part of the plumbing systems shall be as specified in other sections.

2-5. WATER SUPPLY PIPING ACCESSORIES.

2-5.01. Shut-off Valves. Ball Valves VB-1.

VB-1 ball valves indicated on the plumbing drawings for water service in metallic piping systems. 2 inch and smaller	Rating	500 psi [3.4 MPa] nonshock cold WOG
	Code	MSS SP-110
	Type	In-line, two piece, end entry, full port ASTM B584-C84400 bronze
	Body/Bonnet	
	Trim	Reinforced Teflon
	Seat	Brass, or chrome plated brass
	Ball	Brass or bronze
	Stem	Reinforced Teflon
	Thrust Washer	Teflon or Viton
	Stem Seal	Threaded End
	End Connection	-20 to 400°F [-29 to 204°C]
	Temp. Limitations	Lever
	Valve Operator	Conbraco Industries "Apollo 77-100 Series"; Powell "Fig 4210T"
Manufacturers		

2-5.02. Water Hammer Arresters. Water hammer arresters shall be either bellows or piston type. Bellows type arresters shall consist of a stainless steel shell, a factory charged and sealed

compression chamber, a stainless steel or elastomer bellows, and a stainless steel threaded adapter. Piston type arresters shall consist of a seamless Type L copper shell, a seamlessly spun and factory charged air chamber, a factory lubricated double or triple O-ring sealed piston, and a threaded copper adapter. Water hammer arresters shall be tested and certified in accordance with American Society of Sanitary Engineering (ASSE) Standard 1010. Arresters shall be rated for a maximum working pressure of 350 psig [2400 kPa gauge] and a temperature range of 33°F to 250°F [1°C to 120°C]. Water hammer arresters shall be Smith "Hydrotrol", Josam "75000 Series Absorbotron", Wade "Shokstop", or Sioux Chief "Hydra-Rester".

2-5.03. Wall Hydrants. Wall hydrants shall be freezeproof type with bronze body, polished bronze or chrome plated face, integral vacuum breaker, and removable handle key. Wall hydrants shall be provided with ¾ inch pipe thread inlet and ¾ inch male hose thread outlet. Wall hydrants shall be ASSE 1019-B approved. Wall hydrants shall be Smith "Model 5619", Zurn "Z1321-C", or Prier "Model C-634".

2-5.04. Pressure Gauges.

Pressure gauges shall be Ashcroft "Duragauge 1279", Weksler, or Weiss Instruments, Inc.

Except as modified or supplemented herein, all gauges shall conform to the requirements of ANSI B40.1. Accuracy shall be ANSI Grade A or better. Gauges shall be indicating dial type with C-type phosphor bronze Bourdon tube, stainless steel rotary geared movement, phenolic open-front turret, stainless steel or phenolic ring, case, adjustable pointer, and acrylic or shatterproof glass window.

The dial shall be 4-1/2 inch [114 mm] in diameter with black markings on a white background. The units of measurement shall be psi and shall be indicated on the dial face. The pointer shall span not less than 200 degrees nor more than 270 degrees. The range shall be selected so that the normal operating reading is near the midpoint of the scale.

Each gauge shall be provided with a threaded end ball-type shutoff valve as specified in the Ball Valves section.

All stem-mounted gauges shall be provided with 1/2 inch [13 mm] NPT connections.

2-6. PLUMBING FIXTURES AND ACCESSORIES.

2-6.01. General. Plumbing fixtures shall be provided with all required supports, fasteners, supply and drain fittings, gaskets, and escutcheons required for a complete installation.

2-6.02. Water Closets. Not used.

2-6.03. Urinals. Not used.

2-6.04. Lavatories. Not used.

2-6.05. Showers. Not used.

2-6.06. Stainless Steel Sinks. Not used.

2-6.07. Janitors Sinks. Not used.

2-6.08. Emergency Fixtures. Emergency fixtures, including showers, eye/face washes, and combination shower/eye/face wash units shall be furnished and installed as indicated on the Drawings. Emergency fixtures shall be manufactured by Haws, Guardian, or Bradley.

2-6.08.01. Indoor Emergency Eyewash Fixtures. Not used.

2-6.08.02. Indoor Emergency Shower Fixtures. Not used.

2-6.08.03. Indoor Combination Units. Not used.

2-6.08.04. Corrosion Resistant Combination Units. Not used.

2-6.08.05. Freezeproof Emergency Eyewash Fixtures. Freezeproof emergency eye wash fixtures shall be wall mounted with a wall bracket, a stainless steel receptor, ABS plastic heads, a stay-open ball valve, a push plate actuator, and a universal emergency sign. The ball valve shall be located indoors, with an extension stem extending through the exterior wall to the push plate actuator. All necessary drain and bleed piping, wall sleeves, and accessories required for a complete installation shall be provided.

2-6.08.06. Freezeproof Emergency Shower Fixtures. Freezeproof emergency shower fixtures shall be wall mounted, suitable for a horizontal supply pipe, with a pipe support bracket, a stainless steel or ABS shower head, a stay-open ball valve, and a universal emergency sign. The ball valve shall be located indoors, with an actuator extending through the exterior wall. All drain and bleed piping, wall sleeves, and accessories required for a complete installation shall be provided.

2-6.08.07. Freezeproof Combination Units. Not used.

2-6.08.08. Alarm Systems. A visual alarm system shall be provided when indicated on the Drawings. The alarm system shall activate based on water flow when either the emergency shower or eyewash fixture is operated. The alarm system shall provide local and remote alarm indication as indicated on the Drawings. The water flow switch shall be provided with double-pole double-throw contacts rated 5 amperes at 125 volts, suitable for remote alarm annunciation. The alarm light shall be amber, flashing type. The alarm system shall be pre-wired and shall be furnished with all necessary junction boxes, conduit, wire, and accessories for a complete installation. The alarm system shall be suitable for a 120 volt power supply. Alarm systems for emergency fixtures shall be Haws Model 9001.5, Guardian, or Bradley.

2-7. PLUMBING EQUIPMENT.

2-7.01. General. Plumbing equipment shall be provided with all supports, fasteners, fittings, and escutcheons required for a complete installation.

2-8. COLOR. Plumbing equipment shall have the manufacturer's standard color and finish unless otherwise indicated in the schedules.

2-9. ELECTRICAL. Electrical controls and disconnects shall be furnished and installed under the Electrical section, except where specified herein. All electrical controls shall have enclosures suitable for the environment and NEMA rating as indicated on the electrical Drawings.

PART 3 - EXECUTION

3-1. INSPECTION. Equipment installed in existing facilities with limited access shall be suitable for being installed through available openings. Contractor shall field verify existing opening dimensions and other provisions for installation prior to submittal of bids.

3-2. PREPARATION.

3-2.01. Surface Preparation. All surfaces to be field painted shall be dry and free of dirt, dust, sand, grit mud, oil, grease, rust, loose mill scale, or other objectionable substances, and shall meet the recommendations of the paint manufacturer for surface preparation. Cleaning and painting operations shall be performed in a manner which will prevent dust or other contaminants from getting on freshly painted surfaces. Oil and grease shall be completely removed by use of solvents or detergents before mechanical cleaning is started. The gloss of previously painted surfaces shall be dulled if necessary for proper adhesion of top coats.

3-3. INSTALLATION. Materials furnished under this section shall be installed in proper operating condition in full conformity with the drawings, specifications, engineering data, instructions, and recommendations of the equipment manufacturer, unless exceptions are noted by Engineer.

Unless otherwise indicated, sleeves shall be provided for all pipe penetrations through concrete and masonry walls. Sleeves and sealing requirements shall be as indicated in the Miscellaneous Piping and Accessories Installation section and as indicated on the Drawings.

Not all required reducing fittings and unions are indicated. Additional fittings and unions shall be provided as needed to connect all equipment and appurtenances.

Insulating fittings shall be provided to prevent the contact of dissimilar metals in piping systems.

When located indoors, fuel gas pressure regulator vents and fuel train vent valves shall be piped to the exterior of the building in accordance with the applicable codes and standards.

Piping shall not be routed over or in front of electrical switchboards or panels unless acceptable to Engineer.

3-3.01. Water Supply Piping and Accessories. Water hammer arresters shall be provided in the cold water supply piping at all quick closing valves, at solenoid valves, and at plumbing fixtures. When not indicated on the Drawings, arresters shall be located and sized by Contractor in accordance with PDI Standard No. WH201. Contractor shall submit arrester location and sizing plans to Engineer for approval prior to installation. Where possible, water hammer arresters shall be installed in an accessible location.

Water supply piping to hose faucets and hose valves shall be secured with a pipe support within 6 inches [150 mm] of the fixture.

3-3.02. Drainage and Vent Piping and Accessories. Unless otherwise indicated or required by code, horizontal sanitary drainage piping 3 inches [75 mm] in diameter or smaller shall be installed at a uniform slope of 1/4 inch per foot [2 percent]; horizontal sanitary drainage piping larger than 3 inches [75 mm] in diameter shall be installed at a uniform slope of 1/8 inch per foot [3 mm/300 mm]; horizontal storm drainage piping shall be installed at a uniform slope of 1/8 inch per foot [3 mm/300 mm].

Drainage fittings shall be installed to convey flow in the piping in the intended direction. To the extent possible, changes in direction shall be made by sweep type fittings. Quarter-bends and sanitary tee fittings shall not be installed for vertical to horizontal or horizontal to horizontal changes of direction.

3-3.03. Plumbing Fixtures and Accessories. Plumbing fixtures shall be set level and plumb, and shall be securely attached to the floor or wall. Unless otherwise indicated on the Drawings, each fixture shall be mounted at the height recommended by the manufacturer. Where required to be in compliance with ADA, fixtures shall be mounted at the heights established by the Federal Government.

Fixtures shall be sealed to the floor or wall with a sealant as specified in the Joint Sealants section. The color of sealant shall match the color of the fixture.

Fixture traps shall be easily removable for servicing and cleaning. Escutcheons shall be placed at all locations where fixture supply or drain piping penetrates walls, floors, or ceilings.

Water piping at stop valves, shower heads, and flush valves shall be rigidly secured to blocking. Drop-ear elbows shall be used whenever possible. All water supply piping shall be cleaned and flushed before the plumbing fixtures are installed.

3-4. FIELD QUALITY CONTROL.

3-4.01. Installation Check. An installation check by an authorized representative of the manufacturer of equipment specified herein is not required.

3-4.02. Startup and Testing. Field performance tests shall be conducted to demonstrate that each system is functioning as specified and to the satisfaction of Engineer.

If inspection or tests indicate defects, the defective work or material shall be replaced, and inspection and tests repeated. All repairs to piping shall be made with new materials. Caulking of threaded joints or holes will not be acceptable.

3-5. ADJUSTING. All devices shall be adjusted for proper flow and quiet operation. All drains shall be checked for proper operation.

3-6. PROTECTION. Plumbing fixtures, equipment and appurtenances shall be protected from damage immediately after installation.

3-7. CLEANING. After completion of testing and immediately before the final inspection, plumbing fixtures, equipment, piping, and appurtenances shall be thoroughly cleaned. Cleaning

materials and methods shall be as recommended by the manufacturer. All faucet aerators shall be removed, cleaned, and reinserted.

Any stoppage, discoloration, or other damage to parts of the building, its finish, or furnishings shall be repaired at no additional cost to Owner.

3-8. DISINFECTION. Before the potable water system is placed in operation, it shall be disinfected in accordance with the requirements of the local authority having jurisdiction. In the absence of local requirements, the following disinfection method shall be used:

1. The system shall be purged with clean potable water until all dirt and other substances are flushed from the system.
2. The system shall be filled with a water/chlorine solution containing at least 50 parts per million [50 mg/L] of available chlorine and allowed to stand for 24 hours; or the system shall be filled with a water/chlorine solution containing at least 200 parts per million [200 mg/L] of available chlorine and allowed to stand for 3 hours.
3. The system shall be purged with clean potable water until the chlorine is flushed from the system.
4. The procedure shall be repeated if a bacterial examination indicates that contamination remains present in the system.

3-9. OPERATOR INSTRUCTION AND TRAINING. Not used.

End of Section

HEATING, VENTILATING, AND AIR CONDITIONING

PART 1 - GENERAL

1-1. SCOPE. This section covers the furnishing and installation of heating, ventilating, and air conditioning (HVAC) equipment, devices, and appurtenances associated with the HVAC systems.

Piping, pipe supports, valves, and accessories which are not an integral part of the equipment or are not specified herein are covered in other sections.

1-2. GENERAL. Equipment furnished and installed under this section shall be fabricated, assembled, erected, and placed in proper operating condition in full conformity with the Drawings, Specifications, engineering data, instructions, and recommendations of the equipment manufacturer unless exceptions are noted by Engineer.

1-2.01. Coordination. Contractor shall verify that each component of the system is compatible with all other parts of the system; that all piping, ductwork, materials, fans, and motor sizes are appropriate; and that all devices necessary for a properly functioning system have been provided.

Where two or more units of the same class of equipment are needed, they shall be the product of a single manufacturer; however, all the component parts of the system need not be the products of one manufacturer.

Where individual equipment paragraphs specify the requirement for local service, each manufacturer shall have a local service center, or with written consent of Engineer, shall be able to provide service from other locations within 24 hours. The service center shall be equipped and staffed to service the system and shall maintain a local parts supply. Information on equipment manufacturers' representatives shall be included with the submittals.

Where several manufacturers' names have been listed in this section as possible suppliers, only the products of the first manufacturer listed have been checked for size, functions, and features.

1-2.02. General Equipment Stipulations. The General Equipment Stipulations shall apply to all equipment and materials furnished under this section. If requirements in this specification differ from those in the General Equipment Stipulations, the requirements specified herein shall take precedence.

1-2.03. Governing Standards. Except as modified or supplemented herein, all work covered by this section shall be performed in accordance with all applicable municipal codes and ordinances, laws, and regulations. In case of a conflict between this section and any state law or local ordinance, the latter shall govern.

All work shall comply with UL safety requirements.

1-2.04. Power Supply. Power supply to equipment with motors shall be as indicated in

schedules on the Drawings. Power supply for controls shall be 120 volts, 60 Hz, single phase unless otherwise required for a properly operating system.

1-2.05. Metal Thickness. Metal thickness and gages specified herein are minimum requirements. Gages refer to US Standard gage.

1-2.06. Mechanical Identification. Mechanical identification shall conform to the requirements of the Basic Mechanical Building Systems Materials and Methods section.

1-3. SUBMITTALS.

1-3.01. Drawings and Data. Complete assembly and installation drawings, and wiring and schematic diagrams, together with detailed specifications and data covering materials, parts, devices, and accessories forming a part of the equipment furnished, shall be submitted in accordance with the Submittals Procedures section. Device tag numbers indicated on the Drawings shall be referenced on the wiring and schematic diagrams where applicable. The data and specifications for each unit shall include, but shall not be limited to, the following:

Packaged Air Conditioning Units

Name of manufacturer.

Type and model.

Construction materials, thickness, and finishes.

Capacities.

Filter velocities.

Overall dimensions and required clearances.

Net weight and load distribution.

Performance tables with the specified operating point clearly identified for each unit, type, and model, with capacity in cubic feet per minute[m³/s], speed or rpm, brake horsepower, and static pressure listed.

Multiline wiring diagrams clearly indicating factory installed and field installed wiring with all terminals identified.

Electrical requirements including voltage, number of phases, and amperage.

Where specified, information on equipment manufacturers' representatives.

Fans

Name of manufacturer.

Type and model.

Construction materials, thickness, and finishes.

Overall dimensions and required clearances.

Net weight and load distribution.

Performance curves with the specified operating point clearly identified for each unit, type, and model, with capacity in cubic feet per minute [m³/s] as the abscissa and brake horsepower, static pressure, and efficiency as the ordinate. The fan curves shall include a family of curves for at least 3 different rotative speeds on a single chart.

Certified AMCA standard test code sound power output data for the fan outlet and casing when operating at the specified volume flow rate. Sound data shall list dB re 10-12 watts in each octave band, with midrange frequencies starting at 63 Hz and ending at 8,000 Hz.

Where specified, information on equipment manufacturers' representatives.

Sheet Metal Ductwork

- Pressure and seal classifications.
- Reinforcement types and spacing.
- Joint and seam types.
- Hanger and support types, spacing, and attachment methods.
- Access panel and door construction, sizes, and locations.
- Duct sealant, adhesive, gasket, and tape information.
- Product data for adhesives and sealants shall include VOC content.
- Coatings.
- Ductwork materials and thicknesses.
- Product data demonstrating compliance with ASHRAE 62.1
- Ductwork leakage test report.

Temperature Controls

- Published descriptive data on each item of equipment and accessories, indicating all specific characteristics and options and identified with the designation used herein and on the Drawings.
- Schematic control diagrams giving specific data on all settings, ranges, actions, adjustments, and normal positions. Although schematic, these diagrams shall, as closely as possible, represent the actual system with all significant equipment and devices identified and located relative to each other. These diagrams shall also show detailed multiline wiring with all terminals accurately identified. The wiring diagrams shall show the internal connections of the temperature control panels and all field wiring to equipment remote from the control panels, including wiring to Owner-furnished equipment. The wiring diagrams shall be complete, showing all connections necessary to place the temperature control systems in operation. Wiring diagrams shall be detailed to the degree necessary for field construction and shall include all related wiring.
- Sequence of operation for each system corresponding to the control schematics.
- Space thermostat schedule indicating the types of covers and means of adjustment for each space.
- Conduit and wire types.
- Where specified, information on equipment manufacturers' representatives.

1-3.02. Operation and Maintenance Data and Manuals. Adequate operation and maintenance information shall be supplied as required in the Submittals Procedures section. Operation and maintenance manuals shall be submitted in accordance with the Submittals Procedures section. The operation and maintenance manuals shall be in addition to any instructions or parts lists packed with or attached to the equipment when delivered.

In addition to the requirements of the Submittals Procedures section, the operation and maintenance manuals shall include a listing of all filter locations, types, sizes, and quantities associated with each piece of equipment.

1-4. QUALITY ASSURANCE. Quality assurance shall comply with the requirements of the Basic Mechanical Building Systems Materials and Methods section.

1-5. DELIVERY, STORAGE, AND HANDLING. Shipping shall be in accordance with the

Product Delivery Requirements section. Handling and Storage shall be in accordance with the Product Storage and Handling Requirements section.

1-6. EXTRA MATERIALS. Extra materials shall be furnished for the equipment as specified in the individual equipment paragraphs.

Extra materials shall be packaged in accordance with the Product Delivery Requirements section, with labels indicating the contents of each package. Each label shall indicate manufacturer's name, equipment name, equipment designation, part nomenclature, part number, address of nearest distributor, and current list price. Extra materials shall be delivered to Owner as directed.

Extra materials subject to deterioration such as ferrous metal items and electrical components shall be properly protected by lubricants or desiccants and encapsulated in hermetically sealed plastic wrapping.

PART 2 - PRODUCTS

2-1. SERVICE CONDITIONS. All equipment shall be designed and selected to meet the specified conditions.

2-2. PERFORMANCE AND DESIGN REQUIREMENTS. Equipment and coil capacities shall be as indicated on the schedules. Where equipment is provided with special coatings, unit capacities shall be corrected to account for any efficiency losses from the selected special coating.

Each fan's operating selection point on the fan curves shall be selected to the right of the peak pressure/efficiency point and below the lowest point along the fan curve to the left of the peak pressure/efficiency point.

2-2.01. Dimensional Restrictions. Layout dimensions will vary between manufacturers and the layout area indicated on the Drawings is based on typical values of the first manufacturer listed. Contractor shall review the contract Drawings, the manufacturer's layout drawings, and installation requirements and shall make any modifications required for proper installation subject to acceptance by Engineer. At least 3 feet [0.9 m] of clear access space shall be provided on all sides of the unit unless otherwise indicated.

2-2.02. Elevation. Equipment shall be designed to operate at the elevation indicated in the Meteorological and Seismic Design Criteria section. All equipment furnished for sites above 2000 feet [610 m] above sea level shall be properly derated to operate and meet the specified capacities at the site conditions.

2-3. ACCEPTABLE MANUFACTURERS. Acceptable manufacturers shall be as listed in the respective product description paragraphs.

2-4. MATERIALS.

2-4.01. Gas Vent Systems. Not used.

2-4.02. Packaged Air Conditioning Units---Wall Mounted. Wall mounted packaged air conditioning cooling only units, denoted by the symbol “PAC” and an identifying number, Each unit shall be a self-contained wall mount air conditioner suitable for outdoor use. The unit shall be manufactured by Marvair™, division of Airxcel®, Inc., Bard Manufacturing Company, or equal.

2-4.02.01. Performance and Design Requirements. The units shall be completely factory assembled and tested, and shall include compressor, indoor and outdoor coils, fans and motors as required, prewired controls, interconnecting refrigerant tubing, wiring, disconnects, and other necessary components mounted in a corrosion resistant cabinet. Unit shall be shipped from the factory with a full operating refrigerant and oil charge. All field wiring shall be in accordance with the National Electric code and all local codes. The complete package shall be UL Listed or tested to UL Standards. The unit shall be certified to Air Conditioning and Refrigeration Institute (ARI) Standard 210-94 (Single Package Vertical Units).

2-4.02.02. Cabinet. The cabinet shall be constructed of 20 gauge zinc-coated, galvanized G60 steel with satin beige polyester finish. The finish shall be highly resistant to abrasion, metal marking, staining, and require minimal maintenance. The cabinet shall include a sloped top and built-in mounting flanges. The conditioned air section shall be insulated with 1/2 inch, 2 pound dual density fiberglass.

2-4.02.03. Heating Sections. Not used.

2-4.02.04. Filters. Two inch filament spun glass type filter shall be mounted internally, factory supplied, and accessible through an external panel.

2-4.02.05. Compressor and Refrigerant Circuit. The compressor shall be a hermetic type, and shall be equipped with an immersion type self regulating crankcase heater (a scroll compressor may be used as an option and does not require a crankcase heater). Refrigerant type shall be 410A. The refrigeration circuit shall contain a liquid filter dryer, suction and liquid access valves. The refrigeration circuit shall include a high pressure switch with a lockout relay and an automatic reset low pressure switch. The compressor motor shall be protected by an internal line break thermostat. Electrical wiring connections at the compressor shall be protected by receptacle housing.

2-4.02.06. Outdoor Section. The condenser coil shall be constructed of aluminum plate fins mechanically bonded to seamless copper tubes. Outdoor fan shall be direct driven, slow speed propeller type for quiet operation. The outdoor motor shall be equipped with a thermal protector.

2-4.02.07. Indoor Section. The evaporator coil shall be constructed of aluminum plate fins mechanically bonded to seamless copper tubes. Two direct driven indoor blowers shall be of centrifugal type, forward curved. The indoor motor shall be equipped with a thermal protector.

2-4.02.08. Accessories. The supply grille shall be an adjustable aluminum, double deflection grille, factory provided. The return grille shall be an aluminum grille, factory provided. Galvanized metal ductwork extensions shall be used to connect the unit through the wall to the supply and return grilles.

Where an economizer package is not specified, an outside air damper shall be furnished to

provide the indicated outside air volume.

Where indicated on the drawings, hot gas bypass shall be installed to provide reduced capacity control.

Where indicated on the drawings for operation in coastal environments, a coastal environmental package shall be installed. The unit shall have a factory applied polyurethane or phenolic coating on the condenser coil (fins and copper tubing), stainless steel fasteners, a sealed control panel, and coating on the copper tubing in the condenser compartment.

2-4.02.09. Controls. Controls shall be factory wired and located in a readily accessible location. Control circuit transformer shall be factory installed. A main circuit breaker or fused disconnect switch with lockable cover and operating handle shall be supplied on each unit. If a circuit breaker or fused disconnect is not available as a standard option on the unit the equipment manufacturer shall provide a separately enclosed circuit breaker or fused disconnect for field mounting next to the unit by the CONTRACTOR. The enclosure for the main disconnect shall be suitable for the location where it will be mounted.

A programmable thermostat shall be provided to control the cooling stages where single units are provided.

2-4.03. Furnaces. Not used.

2-4.04. Makeup Air Units. Not used.

2-4.05. Fans. Fans shall be rated in accordance with AMCA standards, shall be licensed to bear the AMCA Certified Rating Label unless otherwise indicated in the Fan Schedule on the Drawings, and shall be UL listed. Surfaces in contact with the airstream shall comply with the requirements of ASHRAE 62.1.

The manufacturer of the equipment provided shall have a local service center.

Each fan shall be complete with an electric motor, factory mounted safety disconnect switch with wiring to the motor, drive, and accessories required for satisfactory operation. Belt-driven fans shall be complete with a V-belt drive designed for 50 percent overload capacity, sheaves, adjustable base or rails for belt tightening, and a belt guard. Adjustable pitch sheaves shall be furnished for fans with less than 10 horsepower [7.5 kW] motors and fixed sheaves for 10 horsepower [7.5 kW] and larger motors. Adjustable sheaves shall be selected so that the fan speed at the specified conditions is at the mid-position of the sheave range. Sheaves shall be replaced with sheaves of the proper size after the air system balancing if necessary, to provide the required fan speed for the specified airflow.

Fan drive motors shall be as specified in the Electrical paragraph, unless otherwise indicated. Fans shall be suitable for use with the power supply indicated on the Drawings.

Where indicated in the schedules on the Drawings, fans shall be given a special coating resistant to the corrosive atmosphere indicated.

2-4.05.01. Extra Materials.

Extra Materials

Quantity

Sets of matched belts per fan

1

2-4.05.02. Cabinet Fans. Not used.

2-4.05.03. Duct Fans. Not used.

2-4.05.04. Power Roof Ventilators. Not used.

2-4.05.05. Propeller Fans. Propeller fans, denoted by the symbol "PF" and an identifying number, shall be Greenheck "Model S/SC" for direct drive and "Model SB/SBC" for belt drive, PennBarry, or Loren Cook.

Propeller fans shall consist of a panel frame, wire guard, motor, fan blades, and a disconnect switch. Fan blades shall be constructed of aluminum as scheduled on the Drawings. Propeller fans shall be statically and dynamically balanced to ensure quiet, vibration-free operation, and be suitable for mounting as indicated.

2-4.05.06. Utility Fans. Not used.

2-4.05.07. Wall Fans. Not used.

2-4.06. Roof Hoods. Not used.

2-4.07. Dampers. Not used.

2-4.08. Damper Operators. Not used.

2-4.09. Air Outlet and Inlet Devices. Not used.

2-4.10. Flexible Connections. Not used.

2-4.11. Air Filtration Equipment. Not used.

2-4.12. Draft Gauges. Not used.

2-4.13. Sheet Metal Ductwork. Ductwork, accessories, bracing, and supports shall be constructed of aluminum . Where more than one material is indicated, ductwork, accessories, bracing, and supports shall be constructed of galvanized steel unless otherwise indicated on the Drawings. Ductwork, turning vanes, and other accessories shall be fabricated in accordance with the latest SMACNA HVAC Duct Construction Standards unless otherwise indicated. Accessories, bracing, and supports shall be constructed of similar materials as the ductwork.

Aluminum ductwork shall be constructed of aluminum alloy 3003-H14 or better in accordance with ASTM B209.

Sheet metal fan boxes shall be fabricated with 0.125 inch [3.175 mm] thickness aluminum sheet

metal skin and structural framing of sufficient strength to support the fan box and the fan mounted on the box. Drawings of the fan boxes shall be submitted in accordance with the Submittals Procedures section.

Sealants shall be suitable for the duct service and shall maintain leakage integrity at pressures in excess of the ductwork pressure classification.

2-4.14. Duct Insulation. Not used.

2-4.15. Flexible Duct and Takeoffs. Not used.

2-4.16. Access Doors. Not used.

2-4.17. Temperature Controls. The temperature control components and systems shall be manufactured by Honeywell; Johnson Controls; or Siemens Building Technologies, Landis Division. Where manufacturers are not specified, materials and equipment furnished shall meet the performance and design requirements indicated.

The manufacturer of the equipment provided shall have a local service center.

2-4.17.01. Performance and Design Requirements. Contractor shall coordinate with the Work to make certain that the field wiring associated with the work of this section is completed in accordance with the requirements of the heating, ventilating, and air conditioning equipment furnished and their interconnection. Where cable and conduit is not indicated on the Drawings but is needed for a complete and functional control system in accordance with the sequence of operation it shall be provided as specified herein. The control wiring shall be installed so that all HVAC equipment will function as described in the HVAC sequence of operation.

Conduit and control wiring for all control circuits needed between all field mounted HVAC controlling and indicating devices, such as, but not limited to, damper actuators, thermostats, temperature control panels, pressure differential switches, control switches, motor starters, and the HVAC equipment, shall be furnished and installed as specified in the Electrical Wiring paragraph. Cable and conduit for all HVAC power circuits shall be as specified in the Electrical section.

2-4.17.02. Tolerances. Unless otherwise indicated, the controls shall maintain space temperatures within $\pm 2^{\circ}\text{F}$, and the relative humidity within ± 5 percent of the setpoint.

2-4.17.03. Thermostats. Where indicated on the Drawings, thermostats shall be constructed of materials resistant to or shall be protected from the corrosive atmosphere indicated. Thermostats specified in the individual equipment paragraphs shall be provided with the respective equipment.

- a. Two Position Wall Mounted Thermostats. Two position wall mounted thermostats shall be Honeywell "T631A Airswitch", Penn Controls "A19BAC-1", or Siemens Building Technologies.

Two position wall mounted thermostats shall be line voltage type. The thermostats shall have a range of approximately 35°F to 100°F with a

nonadjustable differential of 3.5°F. The thermostats shall have a spdt switch rated for 1 horsepower.

- b. Low Limit Thermostats. Not used.
- c. Modulating Duct Mounted Thermostats. Not used.
- d. Explosion-proof Thermostats. Not used.

2-4.17.04. Temperature Control Panels. Not used.

2-4.17.05. Dial Thermometers. Not used.

2-4.17.06. Smoke Detectors. Not used.

2-4.17.07. Pressure Differential Airflow Switches. Not used.

2-4.17.08. Control Stations. Not used.

2-4.17.09. Emergency Ventilation Shutoff Switches. Not used.

2-4.17.10. Accessory Components. All additional control components, including, but not limited to, electric relays, temperature sensors and transmitters, humidity sensors and transmitters, controllers, and position switches, shall be furnished where necessary to ensure a complete, properly operating installation. All components shall be products of the temperature control manufacturer. Accessory components not mounted inside the temperature control panels shall be furnished with equipment enclosures. Relays shall be provided with 120 volt coils and at least 10 ampere contacts.

2-4.17.11. Electrical Wiring. Detailed wiring diagrams shall be submitted in accordance with the Submittals Procedures section. The wiring diagrams shall show the internal connections of the control panels and all field wiring to equipment remote from the control panels including wiring to Owner-furnished equipment. The wiring diagrams shall be complete, showing all connections necessary to place the temperature control systems in operation.

Control wiring shall be in accordance with the National Electric Code (NEC). Cable shall be multi-conductor, at least 18 AWG size, specifically designed for industrial systems and UL listed for indoor/outdoor installations.

Conduit for all HVAC control circuits in exposed indoor locations shall be rigid steel or intermediate metal, except in areas designated on the electrical Drawings as Area Type 1A. Exposed conduit shall be rigidly supported by hot-dip galvanized hardware and framing materials, including nuts and bolts. In areas designated Type 1A, exposed conduit shall be rigid Schedule 40 PVC non-metallic conduit with PVC fittings, boxes, and accessories. Conduit installed in floor slabs and walls in non-hazardous (classified) locations shall be rigid Schedule 40 PVC. All conduit and conduit installation shall be in accordance with the requirements of the Electrical section and NEC.

2-5. ELECTRICAL. Electric motors and motor controls shall conform to the Basic Mechanical Building Systems Materials and Methods section. Motor starters and controls shall be furnished

and installed under the Electrical section, except for equipment specified or furnished with prewired integral starters. Disconnects for equipment shall be furnished and installed under the Electrical section, except where specified with integral disconnects. All electrical controls shall have enclosures suitable for the environment and NEMA rating as indicated on the electrical Drawings. Equipment installed outdoors shall have NEMA Type 4 enclosures.

2-6. DRIVE UNITS. Electric motors, V-belt drives, and safety guards shall be in accordance with the requirements of the Basic Mechanical Building Systems Materials and Methods section.

2-7. MANUFACTURE AND FABRICATION. Manufacture and fabrication shall comply with the requirements of the Basic Mechanical Systems Materials and Methods section.

2-8. SHOP TESTING. The equipment furnished under this section shall be tested at the factory according to the standard practice of the manufacturer. Ratings shall be based on tests made in accordance with applicable AMCA, ASHRAE, AHRI, NBS, NFPA, and UL Standards.

2-9. BALANCE. All rotating parts shall be accurately machined and shall be in as nearly perfect rotational balance as practicable. Excessive vibration shall be sufficient cause for rejection of the equipment. The mass of the unit and its distribution shall be such that the resonance at normal operating speeds is avoided. In any case, the maximum measured root-mean-square (rms) value as measured at any point on the equipment shall not exceed those listed in the latest ASHRAE Applications Handbook.

At any operating speed, the ratio of rotative speed to the critical speed of a unit or components thereof shall be less than 0.8 or more than 1.3.

PART 3 - EXECUTION

3-1. INSPECTION. Equipment installed in facilities with limited access shall be suitable for being installed through available openings. Contractor shall field verify existing opening dimensions and other provisions for installation prior to submittal of bids.

Where penetrations through existing concrete slabs are made, the Contractor shall locate and avoid damage to all rebar, embedded conduit, etc. when making new openings.

3-2. PREPARATION.

3-2.01. Field Measurement. Contractor shall be responsible for verifying all field dimensions, and for verifying location of all equipment relative to any existing equipment or structures.

3-2.02. Surface Preparation. All surfaces to be field painted shall be dry and free of dirt, dust, sand, grit, mud, oil, grease, rust, loose mill scale, or other objectionable substances, and shall meet the recommendations of the paint manufacturer for surface preparation. Cleaning and painting operations shall be performed in a manner which will protect freshly painted surfaces from dust or other contaminants. Oil and grease shall be completely removed by use of solvents or detergents before mechanical cleaning is started. The gloss of previously painted surfaces shall be dulled if necessary for proper adhesion of top coats.

Surface finish damaged during installation shall be repaired to the satisfaction of Engineer. Field painting shall be as specified in the Architectural Painting and Protective Coatings sections.

3-3. INSTALLATION. Equipment and materials furnished under this section shall be installed in proper operating condition in full conformity with the drawings, specifications, engineering data, instructions, and recommendations of the equipment manufacturer, unless exceptions are noted by Engineer.

All adhesives used on the interior of the building defined as inside the weatherproofing system shall have a VOC content not greater than 80 g/L.

3-3.01. Gas Vents. Not used.

3-3.02. Packaged Air Conditioning Units. Units shall be installed level and with vibration isolators types where indicated on the Drawings. Flexible connections shall not be in tension when the fans are operating. Ductwork and piping installed adjacent to each unit shall not interfere with unit servicing or panel removal.

The installation shall be checked by the manufacturer in accordance with the installation check paragraph.

3-3.03. Furnaces. Not used.

3-3.04. Makeup Air Units. Not used.

3-3.05. Heaters. Not used.

3-3.06. Fans. Where indicated on the Drawings, flexible connections shall be installed between fan inlet and outlet sheet metal connections. Flexible connections shall not be in tension when the fans are operating. Where fan inlets and outlets are exposed, safety screens shall be installed over the opening. Scroll drains for equipment installed indoors shall be piped to the nearest floor drain.

3-3.07. Roof Hoods. Not used.

3-3.08. Damper Operators. Not used.

3-3.09. Air Outlet and Inlet Devices. Not used.

3-3.10. Draft Gauges. Not used.

3-3.11. Sheet Metal Ductwork. Ductwork, turning vanes, and other accessories shall be installed and supported in accordance with the latest SMACNA Duct Construction Standards unless otherwise indicated. The locations, arrangement, and sizes of ductwork shall be as indicated on the Drawings. The duct sizes indicated are clear dimensions inside the duct or duct lining. Sheet metal sizes are larger for ductwork with interior linings.

Ductwork shall be fabricated, reinforced, supported, and sealed for the operating pressures indicated in the schedules for the connected equipment. All ductwork shall have a pressure

classification of at least 1 inch [0.25 kPa].

Sheet metal ductwork shall be sealed according to the classifications described in the SMACNA HVAC Duct Construction Standards in accordance with the following:

Duct Location	Duct Type			
	Supply		Exhaust	Return
	≤ 2 inches wc	> 2 inches wc		
Outdoors	A	A	A	A
Unconditioned Areas	B	A	B	B
Conditioned Spaces				
(concealed ductwork)	C	B	B	C
(exposed ductwork)	A	A	B	B

Sealing Levels

A - All transverse joints, longitudinal seams, and duct wall penetrations

B - All transverse joints and longitudinal seams

C - Transverse joints only

All joints, seams, connections, and penetrations in ductwork located outdoors shall be sealed watertight and weatherproof. Transverse joints shall be flanged and shall be provided with a continuous gasket and flange cap.

Ductwork shall be supported as required by SMACNA. Where ductwork is connected to equipment, it shall be independently supported with no weight bearing on the equipment and in such a manner that the equipment maybe removed for service without temporary support of the ductwork. Ductwork shall be supported within 24 inches [of each elbow and within 48 inches of each branch intersection. Strap or wire hangers shall not be used where the hanger length exceeds 5 feet

Ductwork shall be constructed and installed in accordance with the Drawings. When acceptable to Owner, modifications in the size and location of ductwork may be made where required to avoid interference with the building structure, piping systems, or electrical work. The installation shall be coordinated with other phases of work to establish space and clearance requirements. Unless otherwise indicated by a bottom of duct elevation, all ductwork shall be routed as high as possible, with a minimum height of 8 feet above the finished floor. Ductwork installed above suspended ceilings shall be installed with at least 8 inch lighting allowance between the ceiling and the bottom of the ductwork.

3-3.12. Duct Insulation. Not used.

3-3.13. Flexible Duct and Takeoffs. Not used.

3-3.14. Access Doors. Not used.

3-3.15. Temperature Controls. Automatic temperature controls shall be furnished and installed as indicated on the Drawings and as specified herein.

Contractor shall be responsible for determining that all equipment supplied is suitable for installation in the space indicated on the Drawings. Control equipment shall be installed with adequate space for operating and maintenance access.

3-3.15.01. Temperature Control Panels. Not used.

3-3.15.02. Thermostats. Wall-mounted thermostats shall be mounted above the finished floors as indicated in the Electrical section. Insulating spacers shall be provided for thermostats mounted on exterior building walls. The spacers shall be installed between the thermostat and its mounting surface, so that the thermostat will not be affected by surface temperatures.

Wall-mounted thermostats in non air-conditioned areas shall be furnished and installed with a cast aluminum or wire guard.

3-4. FIELD QUALITY CONTROL.

3-4.01. Installation Check. Not used.

3-4.02. Startup and Testing. After the equipment and systems have been installed, adjusted, and balanced, tests shall be conducted to demonstrate that each system is functioning as specified and to the satisfaction of Engineer. Tests shall be as indicated in the Startup Requirements section.

If inspection or tests indicate defects, the defective work or material shall be replaced, and inspection and tests repeated. All repairs to piping shall be made with new materials. Caulking of threaded joints or holes will not be acceptable.

3-5. CLEANING. At the completion of the testing, all equipment, pipes, ductwork, valves, and fittings shall be cleaned of grease, debris, metal cuttings, and sludge. Any stoppage, discoloration, or other damage to parts of the building, its finish, or furnishings shall be repaired by Contractor at no additional cost to Owner.

Upon completion of the duct system cleaning, the duct system shall be visually inspected for cleanliness to verify no visible contaminants are present to the satisfaction of Engineer. If the visual inspection is inconclusive, then additional tests in accordance with the National Air Duct Cleaners Association shall be performed. Any ducts that are considered not to be clean by the ENGINEER shall be re-cleaned and re-tested. Any damaged materials or surfaces shall be repaired or replaced. A report shall be provided indicating the successful cleaning of the ductwork, method used to determine the cleanliness, and results of any tests.

End of Section

TESTING, ADJUSTING, AND BALANCING

PART 1 - GENERAL

1-1. SCOPE. This section covers the cleaning, testing, adjusting, and balancing of the air systems associated with the heating, ventilating, and air conditioning (HVAC) systems.

1-2. GENERAL. Equipment and systems shall be cleaned, tested, adjusted, and balanced in full conformity with the drawings, specifications, engineering data, instructions, and recommendations of the equipment manufacturer unless exceptions are noted by Engineer.

1-2.01. Coordination. Contractor shall verify that all components and devices necessary for a properly functioning system have been provided. Prior to cleaning, testing, adjusting, and balancing, Contractor shall verify that each system has been installed properly and is operating as specified. Equipment bearings shall be lubricated in accordance with the manufacturer's recommendations.

Air systems shall be complete and operating, with ductwork, duct mounted equipment, and control components.

1-2.02. Governing Standards. Except as modified or supplemented herein, all work covered by this section shall be performed in accordance with all applicable municipal codes and ordinances, laws, and regulations. In case of a conflict between this section and any state law or local ordinance, the latter shall govern.

All work shall comply with the latest edition of AABC, NEBB, or SMACNA standard manuals for testing, adjusting, and balancing of air systems.

1-3. SUBMITTALS.

1-3.01. Drawings and Data. Complete apparatus report sheets for all air systems shall be accurately and completely filled out in accordance with the Standard's manual. The testing and balancing results shall be submitted on the TAB report forms of the applicable standard. Copies of the final test readings and report sheets shall be submitted in accordance with the Submittals Procedures section. A description of the standard procedures used during testing, adjusting, and balancing shall be included in the submittal. The submittal shall include a reduced set of drawings, with the air outlet devices, air inlet devices, and equipment identified to correspond with the report sheets. Test dates shall be recorded on the individual TAB report forms indicating when the actual testing was performed.

The apparatus report sheets shall include the following information:

1. Title Page:
 - a. Company name
 - b. Company address
 - c. Company telephone number

- d. Project name
 - e. Project location
 - f. Project Engineer
 - g. Project Contractor
 - h. Project altitude
 - i. Date
2. Instrument List:
- a. Instrument
 - b. Manufacturer
 - c. Model
 - d. Serial number
 - e. Range
 - f. Calibration date
3. Air Moving Equipment:
- a. Unit number
 - b. Location
 - c. Manufacturer
 - d. Model and serial number
 - e. Airflow, design and actual
 - f. Total static pressure (total external), design and actual
 - g. Static pressure, inlet and discharge
 - h. Total pressure
 - i. Fan RPM, design and actual
4. Electric Motors:
- a. Manufacturer
 - b. Motor type and frame
 - c. HP/BHP
 - d. Phase, voltage, amperage, nameplate, actual, no load.
 - e. RPM
 - f. Service factor
 - g. Starter size, rating, heater elements
5. V-Belt Drive:
- a. Required driven RPM
 - b. Driven sheave make, diameter, and RPM
 - c. Belt make, size, and quantity
 - d. Motor sheave make, diameter, and RPM
 - e. Center to center distance, maximum, minimum, and actual
6. Duct Traverse: Not used.
7. Outlet and Inlet Devices: Not used.
8. Sound Level Report: Not used.
- a. Location
 - b. Octave bands - equipment off
 - c. Octave bands - equipment on
9. Wall Mounted Package Air Conditioning Unit.
- a. Unit number
 - b. Location
 - c. Manufacturer and model
 - d. Refrigerant type and capacity
 - e. Airflow, design and actual

- f. Return airflow, design and actual
 - g. Outside airflow, design and actual
 - h. Dry bulb temperature, entering and leaving
 - i. Wet bulb temperature, entering and leaving
 - j. Outside air temperature, dry and wet bulb
10. Air Terminal Unit Data: Not used.
 11. Electric Duct Heater: Not used.
 12. Air Cooled Condenser/Heat Pump: Not used.
 13. Chillers: Not used.
 14. Pump Data: Not used.
 15. Heat Exchanger: Not used.
 16. Combustion Test: Not used.
 17. Odor Control Vessels: Not used.
 18. Mist Eliminators: Not used.

Product data indicating cleaning materials and treatment, chemicals, and reports on the analysis of system water after cleaning and after treatment, shall be submitted in accordance with the Submittals Procedures section.

1-4. QUALITY ASSURANCE. Contractor shall provide the services of a licensed independent contractor, certified by AABC, NEBB, or TABB and with proven experience on at least three similar projects, to perform operational testing, adjusting, and balancing of the air systems. The work shall be performed in accordance with the latest edition of the procedural standards as published by the National Organization associated with the testing, adjusting, and balancing contractor.

1-5. MAINTENANCE. Contractor shall provide the services of a company specializing in water analysis and chemical treatment with at least 3 years of documented experience. The company shall have local representation with water analysis laboratories and full-time service personnel.

The water treatment company shall provide laboratory services and technical assistance for one year from the date of substantial completion of the project. At the completion of the service period, the water treatment company shall conduct a 4 hour training course to instruct facility operating personnel in system maintenance, testing methods, and chemical water treatment procedures.

PART 2 - PRODUCTS

2-1. SERVICE CONDITIONS. All equipment shall be adjusted or balanced to meet the specified conditions and to operate at the elevation indicated in the equipment sections.

2-2. CONSTRUCTION.

2-2.01. Painting. Surface finish damaged during cleaning, testing, adjusting, and balancing of equipment shall be repaired to the satisfaction of Engineer. Field painting shall be as specified in the Architectural Painting and Protective Coatings sections.

PART 3 - EXECUTION

3-1. INSPECTION. Before testing and balancing the air system, doors and windows surrounding the area served by the system shall be closed. Fans shall be checked for correct rotation and rotative speed. Dampers shall be open and access doors and panels shall be closed during the testing and balancing period.

A resistance shall be placed at all filter locations to simulate dirty filter conditions. The filter resistance shall be as follows:

<u>Filter Type</u>	<u>Simulated Loss</u>
Provided with PAC	0.15 inch water column [37 Pa]

3-2. STARTUP REQUIREMENTS. System equipment shall be subject to preliminary field tests as indicated in Startup Requirements section.

3-3. FIELD PERFORMANCE TESTING. Field performance tests shall be conducted for each system to demonstrate each is functioning as specified and to the satisfaction of Engineer. All tests shall be conducted in a manner acceptable to Engineer and shall be repeated as many times as necessary to secure Engineer's acceptance of each system. If inspection or tests indicate defects, the defective item or material shall be replaced, and the inspection and tests shall be repeated. All repairs to piping shall be made with new materials. Caulking of threaded joints or holes will not be acceptable.

3-3.01. Hydronic Piping. Not used.

3-3.02. Refrigerant Piping. Not used.

3-4. CLEANING. At the completion of the testing, all parts of the installation shall be thoroughly cleaned. All equipment, ductwork, pipes, valves, and fittings shall be cleaned of grease, debris, metal cuttings, and sludge. Any stoppage, discoloration, or other damage to parts of the building, its finish, or furnishings shall be repaired by Contractor at no additional cost to Owner.

3-4.01. Chemical Pipe Cleaning. Not used.

3-5. ADJUSTING & BALANCING. The air system shall be adjusted and balanced.

All instrumentation shall be calibrated in accordance with the governing standard manual and shall be checked for accuracy before testing, adjusting, and balancing the systems. The accuracy of the instrumentation shall be not less than specified by the testing, adjusting, and balancing standard manual or the instrument manufacturer.

All data, including system deficiencies encountered and corrective measures taken, shall be recorded. If a system cannot be adjusted to meet the design requirements, Contractor shall notify Engineer in writing as soon as practicable.

Following final acceptance of the certified balancing reports, the testing and balancing contractor shall permanently mark the settings of all adjustment devices, including valves and dampers, and shall lock the memory stops.

All ceiling tiles, belt guards, panels, and doors removed during testing, adjusting, and balancing shall be reinstalled.

3-5.01. Air Systems. Air systems shall be adjusted to the design airflows indicated on the Drawings. Airflows shall be adjusted to maintain a net positive (supply airflow greater than exhaust airflow) or negative (exhaust airflow greater than supply airflow) pressure as indicated on the Drawings.

End of Section

Section 16050

ELECTRICAL - GENERAL PROVISIONS

PART 1 - GENERAL

1-1 Scope of Work. Furnish all labor, materials, equipment and incidentals required for a complete electrical system at the Meadow Woods Water Supply Facility, Orange County, Florida, hereinafter specified and shown on the Drawings.

The work, apparatus and materials which shall be furnished under these Specifications and accompanying Drawings shall include all items listed hereinafter and/or shown on the Drawings. Certain equipment will be furnished as specified in other sections of these Specifications which will require wiring thereto and/or complete installation as indicated. All materials necessary for the complete installation shall be furnished and installed by the CONTRACTOR to provide complete power, lighting, communication systems, instrumentation, wiring and control systems as indicated on the Drawings and/or as specified herein.

The CONTRACTOR shall furnish and install the necessary cables, transformers, protective devices, conductors, exterior electrical system, etc., to serve motor loads, lighting loads and miscellaneous electrical loads as indicated on the Drawings and/or as specified hereinafter or other divisions of the specifications including all conduit, wire and terminations of all field instruments furnished under other divisions of specifications.

The work shall include testing of all equipment and wiring at the completion of the work and making any minor connection changes or adjustments necessary for the proper functioning of the system and equipment. All workmanship shall be of the highest quality; sub-standard work will be rejected.

Mount and wire instruments furnished under other Divisions of these Specifications.

Make all field connections to instrument panels and other control panels furnished under other Divisions of these Specifications.

For instrumentation furnish and install all conduit, wire and interconnections between primary elements, transmitters, local indicators and receivers.

Furnish necessary devices and make connections to provide power to equipment. This will require appropriate receptacles in some cases and direct wiring in other cases, depending upon equipment furnished.

Install and wire all thermostats and other devices furnished under other Divisions of this Specification.

Install complete raceway system for data highway.

All panelboards, wireways, pullboxes, light switches, receptacles, enclosures, etc., shall be labeled with voltage, service location and circuit designation. All nameplates to be red with

white letters.

Hazardous Areas – all equipment, materials and installation in areas designated as Hazardous on the drawings or by the code shall comply with NEC articles 500, 501, 502, 503, 504 and 510.

Equipment and materials installed in hazardous areas shall be UL listed for the appropriate hazardous area classification. Enclosure types:

NEMA 1	Indoor, dry, non-process areas
NEMA 12	Dust locations
NEMA 4X	Outdoor, Rooms below vaults, etc., SS
NEMA 4X	Corrosive locations, SS or Plastic
NEMA 7	Class I Div I Group D
NEMA 7	Class I Div II Group D
NEMA 7	Class II Div I Group D

Each bidder or his authorized representatives shall, before preparing his proposal, visit all areas of structures in which work under this division is to be performed and inspect carefully the present installation. The submission of the proposal by this bidder shall be considered evidence that he or his representative has visited the area and noted the locations and conditions under which the work will be performed and that he takes full responsibility for a complete knowledge of all factors governing his work.

CONTRACTOR shall utilize a ground sensing radar or other acceptable methods, along all proposed ductbank routes, and confirm presence of existing utilities and /or conflicts. Ductbank routing is based on information found in the record drawings provided by OCU and with discussions and coordination with the Plant staff.

All planned power interruptions shall be at the OWNER's convenience. Each interruption shall have prior approval.

It is the intent of these Specifications that the electrical system shall be suitable in every way for the service required. All material and all work, which may be reasonably implied as being incidental to the work of this Section, shall be furnished at no extra cost.

1-2 QUALIFICATIONS. The CONTRACTOR shall be experienced in this type of work; "experienced" means having successfully completed a minimum of the following:

Seven (7) verifiable years in the performance of work on projects with similar skill set requirements including but not limited to Medium Voltage Distribution Apparatus and cable systems.

Minimum of two (2) which have taken place within the past sixty (60) months.

A minimum of five (5) projects similar in size and scope to this Project.

1-3 SERVICE AND METERING. The CONTRACTOR is responsible for the coordination with Progress Energy of Florida. The CONTRACTOR to extend the customer owned feeders and associated conduit from the existing PEF pad mounted transformer to the electrical Main at Well

House No. 8.

All terminations at PEF gear are to be completed by PEF; all terminations at the customer owned gear will be completed by the contractor.

CONTRACTOR to coordinate with the Progress Energy representative:

Mr. Robert "Bobby" Burns III
Distribution Design Specialist
SouthEast Orlando Operations
Progress Energy Florida, Inc.
Office: (407) 850-2736

OWNER shall be responsible for all PEF costs for providing new PEF service.

1-4 CODES, INSPECTION AND FEES. All material and installation shall be in accordance with the latest edition of the National Electrical Code and all applicable national, local and state codes.

Pay all fees required for permits and inspections including any charges associated with the service modifications.

1-5 TESTS. Test all systems and repair or replace all defective work. Make all necessary adjustments to the systems and instruct the OWNER's personnel in the proper operation of the systems.

The following minimum tests and checks shall be made prior to the energizing of electrical equipment and cabling. Test shall be by an independent NETA certified testing firm, and a certified test report shall be submitted stating that the equipment meets and operates in accordance with the Manufacturer's and job specifications, and that equipment and installation conforms to all applicable Standards and Specifications:

- Testing and setting of protective relays for calibration and proper operation.
- Mechanical inspection of all 480 Volt circuit breakers 100 amps and larger to assure proper operation.
- Motors: Megger to ground each motor winding. Record date, motor temperature, terminal, reading and operator and have OWNER representative sign off on each reading.
- 480V Conductors: Megger to ground prior to termination all conductors not used for service conductors. Record the date, conductor, reading and operator and have OWNER representative sign off on each reading. Submit report in both hard copy and electronic format (PDF) for final approval.
- Service Conductors: Megger to ground prior to termination in the presence of the ENGINEER or his representative all 600 volt service conductors. Record date, conductor, reading, operator, and have the OWNER representative sign off on

each reading. Submit report in both hard copy and electronic format (PDF) for final approval.

- 480 Volt Power Panel/Switchboards: After installing, with circuit breakers closed, but prior to terminating any conductors, megger each phase to phase and phase to ground. Record the date, test (i.e. A/B or A/G), reading and operator and have OWNER representative sign off on each reading. Submit report in both hard copy and electronic format (PDF) for final approval.
- Connections & Terminations:
 - Torque to Manufacturer's values in the presence of the ENGINEER or his representative. Record the date, conductor, torque, and operator and have the ENGINEER sign off on each reading. Submit report in both hard copy and electronic format (PDF) for final approval.
 - Hot Spot Testing: Perform infrared hot spot inspection of all 480 volt, and associated equipment as soon as determined by the ENGINEER that representative loads are present. Record the date, gear conditions found, operator and have the OWNER's representative who must be present for the inspection sign off in each instance. Submit report in both hard copy and electronic format (PDF) for final approval. Test shall be completed on new and existing equipments, wherever terminations are made.
- Miscellaneous:
 - Meggering must be done at 1000 VDC for one minute. The ground plane used must be the one established at the main source of energy for conductors. The motor frame may be used for the ground plane for motors.
 - In the course of construction, it will become necessary to temporarily energize some systems for testing. Confirm that any motor has been meggered prior to connection and testing. Do not leave any motor or system unattended and energized without written authorization.
 - An unsuccessful test will be one in which any one of the three megger readings differs from another by more than 25%. ENGINEER shall determine if cables and/or equipment bussing shall be replaced.

CONTRACTOR shall notify and schedule the testing with the OWNER, in writing, with a minimum of 7 days' notice. All reports shall be submitted to the OWNER and the ENGINEER for review and comment.

1-6 SLEEVES AND FORMS FOR OPENING. Provide and place all sleeves for conduits penetrating floors, walls, partitions, etc. Locate all necessary slots for electrical work and form before concrete is poured.

1-7 CUTTING AND PATCHING. All cutting and patching shall be done in a thoroughly

workmanlike manner.

1-8 INTERPRETATION OF DRAWINGS.

1-8.01. The Drawings are not intended to show exact locations of conduit runs.

1-8.02. All three-phase circuits shall be run in separate conduits unless otherwise shown on the Drawings.

1-8.03. Unless otherwise approved by the ENGINEER conduit shown exposed shall be installed exposed; conduit shown concealed shall be installed concealed.

1-8.04. Where circuits are shown as "home-runs" all necessary fittings and boxes shall be provided for a complete raceway installation.

1-8.05. The CONTRACTOR shall harmonize the work of the different trades so that interferences between conduits, piping, equipment, architectural and structural work will be avoided. All necessary offsets shall be furnished so as to take up a minimum space and all such offsets, fittings, etc., required to accomplish this shall be furnished and installed by the CONTRACTOR without additional expense to the OWNER. In case interference develops, the OWNER's authorized representative is to decide which equipment, piping, etc., must be relocated, regardless which was installed first.

1-8.06. Verify with the ENGINEER the exact locations and mounting heights of lighting fixtures, switches and receptacles prior to installation.

1-8.07. The locations of equipment, fixtures, outlets, and similar devices shown on the Drawings are approximate only. Exact locations shall be as approved by the ENGINEER during construction. Obtain in the field all information relevant to the placing of electrical work and in case of any interference with other work, proceed as directed by the ENGINEER and furnish all labor and materials necessary to complete the work in an approved manner.

1-8.08. Surface mounted panel boxes, junction boxes, conduit, etc., shall be supported by spacers to provide a clearance between wall and equipment.

1-8.09. Circuit layouts shown are not intended to show the number of fittings, or other installation details. Furnish all labor and materials necessary to install and place in satisfactory operation all power, lighting, and other electrical systems shown. Additional circuits shall be installed wherever needed to conform to the specific requirements of the equipment.

1-8.10. The ratings of motors and other electrically operated devices together with the size shown for their branch circuit conductors and conduits are approximate only and are indicative of the probable power requirements insofar as they can determine in advance of the purchase of equipment.

1-8.11. All connections to equipment shall be made as shown, specified, and directed and in accordance with the Manufacturer's approved shop drawings, regardless of the number of conductors shown on the Drawings.

1-9. SIZE OF EQUIPMENT. Investigate each space in the building where equipment must pass to reach its final location. If necessary, the Manufacturer shall be required to ship his material in sections, sized to permit passing through such restricted areas in the building.

The equipment shall be kept upright at all times. When equipment has to be tilted for ease of passage through restricted areas during transportation, the Manufacturer shall be required to brace the equipment suitably, to insure that the tilting does not impair the functional integrity of the equipment.

1-10. RECORD DRAWING. Requirements for record drawings are specified in Section 01720.

1-11. OPERATIONAL AND MAINTENANCE MANUALS. Requirements for O&M manuals are specified in Section 01300.

1-12. COMPONENT INTERCONNECTIONS. Component equipment furnished under this Specification will not be furnished as integrated systems. CONTRACTOR shall field install and wire completely all components.

CONTRACTOR shall analyze all systems components and their shop drawings, identify all terminals and prepare drawings and wiring tables necessary for component interconnection. CONTRACTOR shall provide crimp on wire numbers on both ends of all control wiring installed between all panels furnished under this contract. These numbers shall directly relate to the interconnect wiring drawing furnished by the CONTRACTOR and be reflected in the record drawings submitted.

1-13. SHOP DRAWINGS. As specified under other sections shop drawings shall be submitted for approval of all materials, equipment, apparatus, and other items as required by the ENGINEER.

Shop drawings shall be submitted for the following equipment:

- Dry Type Transformer
- Panelboards
- Lighting Fixtures
- Disconnect Switches
- Emergency Battery Units
- Wire and Cable
- Tagging Conventions of cable and wires
- Conduit Drawings, building and site layouts
- Lightning Protection and Grounding System
- 480V Motors
- Variable Frequency Drives
- Motor Control Centers
- Starters
- Manholes
- Pull boxes

The Manufacturer name and product designation and catalog data sheet shall be submitted for the

following material:

- Conduit
- Receptacles
- Boxes and fittings
- Wiring Devices
- Lamps

Prior to submittal by the CONTRACTOR, all shop drawings shall be checked for accuracy and contract requirements. Shop drawings shall bear the date checked and shall be accompanied by a statement that the shop drawings have been examined for conformity to Specifications and Drawings. This statement shall also list all discrepancies with the Specifications and Drawings. Shop drawings not so checked and noted shall be returned.

The ENGINEER's check shall be only for conformance with the design concept of the project and compliance with the Specifications and Drawings. The responsibility of, or the necessity of, furnishing materials and workmanship required by the Specifications and Drawings which may not be indicated on the shop drawings is included under the work of this Section.

The responsibility for all dimensions to be confirmed and correlated at the job site and for coordination of this work with the work of all other trades is also included under the work of this Section.

No material shall be ordered or shop work started until the ENGINEER's approval of shop drawings has been given.

1-14. MATERIALS. The materials used in all systems shall be new, unused and as hereinafter specified. All materials where not specified shall be of the very best of their respective kinds. Samples of materials or Manufacturer's specifications shall be submitted for approval as required by the ENGINEER.

Materials and equipment used shall be Underwriters Laboratories, Inc. listed.

Electrical equipment shall at all times during construction be adequately protected against mechanical injury or damage by water. Electrical equipment shall not be stored out-of-doors. Electrical equipment shall be stored in dry permanent shelters. If any apparatus has been damaged, such damage shall be repaired by the CONTRACTOR at his own cost and expense. If any apparatus has been subject to possible injury by water, it shall be thoroughly dried out and put through such special tests as directed by the ENGINEER, at the expense of the CONTRACTOR, or shall be replaced by the CONTRACTOR at his own expense.

1-15. DEMOLITION. Remove all electrical work associated with equipment scheduled for demolition except those portions indicated to remain or be reused. Remove all unused exposed conduit and wiring back to point of concealment. Remove unused wiring in concealed conduits back to source (or nearest point of usage). Electrical work to be removed corresponds to the associated mechanical equipment to be removed.

Where electrical systems pass through the demolition areas to serve other portions of the premises, they shall remain or shall be suitably relocated and the system restored to normal

operation. Coordinate outages in systems with the OWNER. Where duration of proposed outage cannot be allowed by the OWNER, provide temporary connections as required to maintain service.

All removals and relocations of existing installations cannot be completely detailed on the Drawings. CONTRACTOR is responsible for determining the exact requirements for the project based upon site investigation.

Continuous service is required on all circuits and outlets affected by these changes, except where the OWNER will permit outage for a specific time. Obtain OWNER's written consent before removing any circuit from continuous service.

Where required to disconnect and/or remove any part of an existing circuit, reconnect that circuit to reestablish service in the remaining portion.

Remove exposed conduits, wire ways, outlet boxes, pull boxes and hangers made obsolete by the alternations, unless specifically designated to remain. Exposed conduits shall be removed back to point of concealment, where they shall be cut and threaded for a cap. A threaded cap shall then be installed. Conduits may be removed back to first coupling if within 3-inches of point of concealment. Cut back in traffic areas to the floor level and patch.

1-16. DISPOSITION OF REMOVED MATERIALS AND EQUIPMENT. In general, it is intended that all materials and equipment indicated to be removed and disposed of by the CONTRACTOR shall, upon removal, become the CONTRACTOR's property and shall be disposed of off the site by the CONTRACTOR at their expense, unless otherwise directed by the OWNER.

Reuse of wire will not be permitted. An exception is the reuse or relocation when wire is part of an existing lighting branch circuit and reuse or relocation is specifically designated and can be accomplished without removing and re-pulling the wire.

All electrical equipment to be salvaged shall be removed and shall be moved by the CONTRACTOR to a location on the site for storage as directed by the OWNER.

1-17. COORDINATION, SHORT CIRCUIT AND ARC FLASH HAZARD STUDY

1-17.01. General. The CONTRACTOR shall provide a Power System Study and Flash Arc Study for the electrical power distribution and motor control equipment. The studies shall be a totally independent effort to verify adequacy of all of the existing equipment as well as new additions being implemented under these Specifications. The studies shall be prepared by a professional ENGINEER, registered in the State of Florida, with demonstrated experience in the performance of industrial power system and fault arc hazard analysis. The ENGINEER may be an employee of an equipment manufacturer or supplier.

The CONTRACTOR shall provide data necessary to perform the study. This includes feeder cable sizes, approximate feeder length motor data, generator data, existing protective relay settings and any other information relevant to the study.

A summary of the short circuit analysis shall be provided to the CONTRACTOR at the time shop drawings for all of the new equipment is submitted for approval.

The CONTRACTOR shall provide complete sets of switchgear shop drawings for use in the studies.

1-17.02. Scope. The short circuit study shall be in accordance with ANSI Standard C37.010 and C37.13, shall be performed to check the adequacy, and to verify the correct application of circuit protective devices and other system components specified. The study shall address the case when the system is being powered from the normal source as well as from the on-site generating facilities. Minimum as well as maximum possible fault conditions shall be adequately covered in the study.

Fault contribution of all motors shall be considered. The CONTRACTOR shall be responsible for obtaining all required data of equipment. All back-up calculations shall become part of the final report. The calculations shall be in sufficient detail to allow easy review.

The flash arc analysis study shall include the calculations of flash protection boundary limits and the incident energy exposure for the maximum arc producing flash expected from the electrical equipment. The study will determine incident energy exposure level and flash arc protection boundaries for the electrical equipment, based on IEEE-1584 and NFPA-70E. the study shall be based on the protective device settings and interrupting device clearing time.

1-17.03. Contents. The study shall include representation of the power company's system, the base quantities selected, impedance source-data, calculation methods and tabulations, one-line and impedance diagrams, conclusions and recommendations. Short-circuit momentary duties, shall be calculated on the basis of an assumed bolted three-phase short circuit at each 480 volt switchboard bus, 480 volt motor control center, distribution panelboard, pertinent branch circuit panelboard, and other significant locations throughout the systems. The short circuit tabulations shall include significant X to R ratios, asymmetry factors, KVA, and symmetrical fault current.

A protective device time current coordination study shall be included with coordination plots of key and/or limiting devices, tabulated data, rating, and/or settings selected. The study shall present an Engineering balance between the competing objectives of protection and continuity of service for the system specified, taking into account the basic factors of sensitivity, selectivity and speed.

Existing protective device settings in key locations shall be reviewed to ensure selectivity under the new conditions. Recommended changes shall be indicated in the report. The CONTRACTOR shall be made aware of the required changes immediately.

Required settings for breakers and relays shall be maximized to provide the most effective protection possible.

Tabulations indicating recommended set points for all protective devices shall be provided.

Flash Arc study shall include representation of the calculation methods and tabulations, and a one-line drawing of all identifying equipment included in this study. The complete study shall be turned over to the OWNER as per 01420. as part of the study, the Contractor shall affix permanent adhesive non-fading labeling indicating the equipment ID number and required information as required by NFPA 70E. Samples of arc flash warning labels are presented below:

! WARNING	
Arc Flash & Shock Hazard Appropriate PPE Required	
Flash Protection Flash Hazard Category 1 Incident Energy <u>2.8</u> (cal/cm ²) Flash Protection Boundary <u>30 inches</u> Glove Class <u>00</u>	Shock Protection <u>480</u> VAC Shock Hazard When Cover is Removed Limited Approach Boundary <u>42 inches</u> Restricted Approach Boundary <u>12 inches</u> Prohibited Approach Boundary <u>1 inch</u>
PPE REQUIRED CAT.1 OR 2 FR SHIRT & PANTS, AR FACE SHIELD, SAFETY GLASSES, LEATHER GLOVES, EAR PLUGS	
Bus Name: <u>CLKR-CLR-EF</u> Prot: <u>PD-CLKR-CLR</u>	
<small>February 4, 2010</small>	

Figure 1

! WARNING	
Arc Flash and Shock Hazard Appropriate PPE Required	
Arc Flash Protection • Flash Protection Boundary: _____ • Hazard Risk Category: _____ • Incident Energy at 18" (cal/cm ²): _____	Required PPE <input type="checkbox"/> Hard Hat <input type="checkbox"/> T-shirt <input type="checkbox"/> Safety Glasses <input type="checkbox"/> FR Shirt <input type="checkbox"/> Safety Goggles <input type="checkbox"/> FR Pants <input type="checkbox"/> Face Shield <input type="checkbox"/> FR Coverall <input type="checkbox"/> Flash Hood <input type="checkbox"/> Flash Suite <input type="checkbox"/> Ear Protection <input type="checkbox"/> Leather Shoes <input type="checkbox"/> Long Pants <input type="checkbox"/> Leather Gloves <input type="checkbox"/> Long Sleeve Shirt <input type="checkbox"/> Cotton Underwear <input type="checkbox"/> Voltage Rated Gloves
Shock Protection Shock Hazard when cover is OPENED or REMOVED: _____ • Limited Approach: _____ • Restricted Approach: _____ • Prohibited Approach: _____	
Equipment ID: _____ Date: _____	

Figure 2

1-17.04. Motor Current-Time Characteristic Curves. A complete independent set of current-time characteristic curves for all medium voltage motor drives indicating coordination between the protective relays and the thermal characteristics of the motor shall be provided.

The CONTRACTOR shall obtain from the motor supplier, the necessary information to perform the study. Certified curves for, "Safe time vs. current at 100 percent voltage," and "Accelerating

time vs. current at 100 percent voltage," shall become part of the final report.

1-17.05. Motor Starting Study. A motor starting study for all large electric drives to determine voltage dip or power inrush limitations at selected locations due to starting of motors shall be provided. This applies to both the normal and the emergency mode.

1-17.06. Generator protective Devices. Not used.

1-17.07. General Information for Time-Current Curves Presentation. The coordination plots shall include complete titles, representative one-line diagrams, legends, associated power company's relay or system characteristics, significant motor starting characteristics, complete parameters for power, and substation transformers, and complete operating bands for low-voltage circuit breaker trip devices.

The coordination plots shall define the types of protective devices selected, together with the proposed coil taps, time-dial settings and pickup settings required.

The short-time region shall indicate the medium voltage relay instantaneous elements, the magnetizing in-rush, and ANSI withstand transformer parameters, the low-voltage circuit breaker instantaneous trip devices, fuse manufacturing to tolerance bands, and significant symmetrical and asymmetrical fault currents.

Each primary protective device required for a delta-to-wye connected transformer shall be selected so that the characteristic or operating band is within the transformer parameters; which, where feasible, shall include a parameter equivalent to 58 percent of the ANSI withstand point to afford protection for secondary line-to-ground faults.

Low-voltage power circuit breakers shall be separated from each other and the associated primary protective device, where feasible, by a 16 percent current margin for coordination and protection in the event of secondary line-to-line faults.

Protective relays shall be separated, where feasible, by a 0.3 second time margin when the maximum three-phase fault flows, to assure proper selectivity.

1-18. CONDUIT DRAWINGS.

1-18.01. Buildings. In addition to the manufacturer's equipment shop drawings, the CONTRACTOR shall submit for the approval, electrical installation working drawings for all buildings where work is being performed containing the following:

Concealed and buried conduit layouts shown on floor plans drawn at not less than 1/4-inch = 1-foot-0-inch scale. The layouts shall include locations of electrical equipment, transformers, panelboards, control panels and equipment, motors, switches, large junction or pull boxes, instruments, and any other electrical devices connected to concealed or buried conduits.

Plans shall be drawn on high quality reproducible, size 36-inch x 24-inch, and shall be presented in a neat, professional manner utilizing Autocad format. CONTRACTOR to submit both hard copies and an electronic copy for approval.

Concrete floors and/or walls containing concealed conduits shall not be poured until conduit layouts are approved.

1-18.02. Site. In addition to the manufacturer's equipment shop drawings, the CONTRACTOR shall submit for the approval, electrical working drawings for the overall site work containing the following:

Concealed and buried conduit layouts shown on plans drawn at not less than 1-inch=30'-0" inch scale. The layouts shall include locations of cabling, transformers, manholes, conduit sleeves and any other electrical devices required.

Plans shall be drawn on high quality reproducible, size 36-inch x 24-inch, and shall be presented in a neat, professional manner utilizing Autocad format. CONTRACTOR to submit both hard copies and an electronic copy (Autocad format) for approval.

1-18.03. ACAD Drawings. ACAD drawing files are available from the ENGINEER.

1-19. OPERATIONS AND MAINTENANCE DATA. Submit complete operations and maintenance data for all equipment furnished under this Division in accordance with Division 1. The manuals shall be prepared specifically for this installation and shall include all required cuts, Drawings, equipment lists, descriptions, complete part lists, etc. that are required to instruct operating and maintenance personnel unfamiliar with such equipment.

1-20. WARRANTY. Provide a warranty for all the electrical equipment in accordance with the requirements of other sections, but in no case less than 3 year from date of substantial completion.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 16108

MISCELLANEOUS EQUIPMENT

PART 1 – GENERAL

- 1-1. SCOPE OF WORK. Furnish and install all miscellaneous equipment as hereinafter specified and as shown on the Drawings.
- 1-2. SUBMITTALS. Submit to the ENGINEER, in accordance with Division 0, detailed catalog information or drawings with sufficient detail to determine compliance with the specifications including describing electrical and physical characteristics of all equipment specified.
- 1-3. REFERENCE STANDARDS. Equipment enclosures shall have NEMA rating suitable for the location in which they are installed, as specified in Section 16050.

PART 2 – PRODUCTS

2-1. MATERIALS

2-1.01. Disconnect Switches: Disconnect switches shall be heavy-duty, NEMA type H, quick-make, quick-break, visible blades, 600 volt, 3 pole with full cover interlock. All current carrying parts shall be copper.

Enclosure type shall be NEMA 4X, 316 stainless steel with copper lugs. Exterior hardware to be 316 SS.

NEMA 7 enclosures shall be cast aluminum.

Lugs shall be copper.

Exterior hardware to be 316 SS.

Switches shall be horsepower rated as manufactured by the EATON, Square D Co., or approved equal.

Control wiring shall not pass through any disconnect enclosure. A junction box shall be provided and constructed of the same material as the disconnect. The junction box is to be utilized to separate power and control wiring prior to the disconnect enclosure. Feeder wiring shall be fed from the disconnect and control wiring shall be wired from the junction box directly to the equipment being controlled.

Each disconnect shall be provided with a plastic nameplate, affixed to the enclosure without screws, identifying the equipment served, voltage, and circuit designation.

2-1.02 FUSED DISCONNECT SWITCHES: Fused disconnect switches with rejection clips shall be NEMA 4X heavy duty, quick make, quick break, visible blades, 600 Volt, 3 Pole with

full cover interlock, interlock defeat and flange mounted operating handle unless otherwise noted. All current carrying parts shall be copper.

Fuses shall be rejection type, 600 Volt, 200,000 AIC dual element, time delay, Bussman Fusetron Class RK-5 or equal.

Enclosure type shall be NEMA 4X, 316 stainless steel with copper lugs. Exterior hardware to be 316 SS.

NEMA 7 enclosures shall be cast aluminum.

Lugs shall be copper.

Exterior hardware to be 316 SS.

Switches shall be horsepower rated as manufactured by the EATON, Square D Co., or approved equal.

Control wiring shall not pass through any disconnect enclosure. A junction box shall be provided and constructed of the same material as the disconnect. The junction box is to be utilized to separate power and control wiring prior to the disconnect enclosure. Feeder wiring shall be fed from the disconnect and control wiring shall be wired from the junction box directly to the equipment being controlled.

Each disconnect shall be provided with a plastic nameplate, affixed to the enclosure without screws, identifying the equipment served, voltage, and circuit designation.

2-1.03 MANUAL MOTOR STARTERS: Manual starters shall be furnished and installed for all typed of single-phase motors. Manual starters shall be non-reversing , reversing or two speed type as required. NEMA sizes shall be as required for the actual horsepower of the motor furnished. Manual starters shall have motor overload protection in each phase. Bulton control ststions shall be firnished as required or as shown on the drawings.

NEMA 4x enclosures shall be 316 stainless steel.

NEMA 7 enclosures shall be cast aluminum.

Each enclosure/starter shall be provided with a plastic nameplate, affixed to the enclosure without screws, identifying the equipment served, voltage, and circuit designation.

Starters shall be as manufactured by the EATON, Square D Co., or approved equal.

2-1.04 MAGNETIC MOTOR STARTERS: Motor starters shall be 2 or 3 pole, single or 3 phase as required, 60 Hz, 600 Volt, magnetically operated, full voltage non-reversing unless otherwise shown on the drawings. NEMA sizes shall be as required for the horsepowers shown on the drawings.

Two speed starters shall be for single or two winding motors as required by the actual motor furnished or as shown on the drawings.

Each motor starter shall have a 120 Volt operating coil, and control power transformer. Starters shall have motor overload protection in each phase. Auxiliary contacts shall be provided as required or as shown on the drawings. A minimum on one N.O. and one N.C. auxiliary contacts shall be provided in addition to the contacts shown on the drawings.

Overload relays shall be non-adjustable, ambient compensated and manually reset.

Control power transformers shall be sized for additional load where required. Transformer secondaries shall be equipped with time delay fuses.

Built-in control stations and indicating lights shall be furnished as specified herein where shown on the drawings.

NEMA 4x enclosures shall be 316 stainless steel.

NEMA 7 enclosures shall be cast aluminum.

Each enclosure/starter shall be provided with a plastic nameplate, affixed to the enclosure without screws, identifying the equipment served, voltage, and circuit designation.

Starters shall be as manufactured by the EATON, Square D Co., or approved equal.

2-1.05 COMBINATION MAGNETIC MOTOR STARTERS: Motor starters shall be a combination motor circuit protector and contactor, 2 or 3 pole, single or 3 phase as required, 60 Hz, 600 Volt, magnetically operated, full voltage non-reversing unless otherwise shown on the drawings. NEMA sizes shall be as required for the horsepower shown on the drawings. Motor circuit protectors shall be molded case with adjustable magnetic trip only. They shall be specifically designed for use with magnetic motor starters. Motor circuit protectors shall be current limiting type, with additional current limiters if required. Combination motor starters shall be fully rated for 22,000 Amps RMS symmetrical.

Two speed starters shall be for single or two winding motors as required by the actual motor furnished or as shown on the drawings.

Each motor starter shall have a 120 Volt operating coil, and control power transformer. Starters shall have motor overload protection in each phase. Auxiliary contacts shall be provided as required or as shown on the drawings. A minimum on one N.O. and one N.C. auxiliary contacts shall be provided in addition to the contacts shown on the drawings.

Overload relays shall be non-adjustable, ambient compensated and manually reset.

Control power transformers shall be sized for additional load where required. Transformer secondaries shall be equipped with time delay fuses.

Built-in control stations and indicating lights shall be furnished as specified herein where shown on the drawings.

NEMA 4x enclosures shall be 316 stainless steel.

NEMA 7 enclosures shall be cast aluminum.

Each enclosure/starter shall be provided with a plastic nameplate, affixed to the enclosure without screws, identifying the equipment served, voltage, and circuit designation.

Starters shall be as manufactured by the EATON, Square D Co., or approved equal.

2-1.06 CONTROL STATIONS AND INDICATORS: Control stations shall be heavy duty type, with full size (30.5 mm) NEMA 4x or 7 operators, indicators, etc.

Indicators shall be full voltage and push to test type. Indicators located indoors shall be LED type and indicators located outdoors shall be incandescent lamp type.

NEMA 4x enclosures shall be 316 stainless steel.

NEMA 7 enclosures shall be cast aluminum.

Each station shall be provided with a plastic nameplate, affixed to the enclosure without screws, identifying the equipment served, voltage, and circuit designation.

Starters shall be as manufactured by the EATON, Square D Co., or approved equal.

2-1.07 Dry Type Lighting Transformers. Transformers shall be dry type, two-winding with KVA and voltage ratings as shown on the Drawings.

Transformers shall be UL listed in accordance with applicable ANSI C89.2, NEMA ST-20 and IEEE Standards.

Transformers shall be provided in NEMA 1 enclosures unless otherwise noted on the drawings or as required by Section 16050. Where a NEMA 4X and/or stainless steel enclosures is required, the transformers shall be totally enclosed, non-ventilated heavy gauge steel enclosure.

Trannformers shall be furnished with hot dipped galvanized mounting hardware. Where NEMA 4X and/or stainless steel enclosure is required, the hardware shall be 316 stainless steel.

Core and coil shall be completely embedded within a resin compound for quiet and low temperature operation.

Four full capacity taps shall be furnished, two 2-1/2% above and two 2-1/2% below rated primary voltage.

Maximum insulation temperature rise of 80°C. Windings shall be copper.

Transformers shall be as shall be as manufactured by the EATON, Square D Co., or approved equal.

2-1.08 WIREWAY:

NEMA 1 wireway shall be gasketed painted steel with stainless steel cover.

NEMA 4X wireway shall be 316 Stainless Steel with gasketed clamped covers

NEMA 1 wireway shall be Square-Duct as manufactured by the Square D Co.,; NEMA 4X shall be Bulletin F-22 as manufactured by the Hoffman Engineering Co. or equal.

2-1.09 MANUAL TRANSFER SWITCH: Not used.

2-1.10 CONTROL RELAYS: Control relays shall be heavy duty machine type, with 10 amp, 300 Volt convertible contacts. Number of contacts and coil voltage shall be as shown on the drawings. General use relays shall be Square D Co., Class 8501 Type X, similar by Cuttler Hammer, Allen Bradley or Siemens. Latching relays shall be Square D Co., Class 8501 Type X, similar by Cutler Hammer, Allen-Bradley or Siemens.

Time delay relays shall be pneumatic, 600 Volt, 20 Amp contacts with calibrated knob operated adjustment and numerical time dial. On delay and off delay types and timing ranges shall be as shown on the drawings or as required for proper operation of the actual equipment furnished. Relays shall be Agastat Model 7012 or 7022 or equal.

2-1.11 DETECTABLE POLYETHYLENE WARNING TAPE: Warning tape shall be 5 mil red polyethylene film, 6 inch minimum width. Tape shall be capable of being detected by either conductive or inductive location techniques.

Warning tape shall be Mutual Industries Part No. 17774 or equal.

2-1.12 TERMINAL BLOCKS: Terminal blocks shall be 600 Volt, channel mounted, with tubular screw and pressure plate.

Terminal blocks shall be Bulletin 1492-CA1 as manufactured by the Allen-Bradley Co. or equal.

2-1.13 JIC BOXES FOR GF RECEPTACLES: JIC boxes shall be 6-inches x 6-inches x 4-inches aluminum continuous hinge clamp cover boxes, Hoffman Catalog No. A-606 CHAL with type L23 stainless steel fast operating JIC clamp or equal.

Install 1-1/2 inch bushings in the bottom of box for cord and plug to pass through.

2-1.14 CORROSION INHIBITORS: All equipment enclosures, terminal boxes, etc., located in a NEMA 4X rated area (where shown on the drawings) that contain electrical or electronic equipment or terminal strips shall be furnished with an internally mounted, chemically treated corrosion inhibitor pad.

The corrosion inhibitor pads shall be as manufactured by Hoffman Engineering Co., or 3M or equal.

2-1.15 EQUIPMENT MOUNTING STANDS: Mounting stands shall be custom fabricated from ¼ inch 316 stainless steel plate and 3-inch stainless steel channel, unless otherwise shown on the drawings.

All hardware shall be 316 stainless steel.

2-1.16 TERMINAL CABINETS: Interiors shall be so designed that control relays and terminal blocks can be replaced or added without disturbing adjacent units. Each cabinet shall be furnished a minimum of 50 spare terminals.

All interiors shall be completely factory assembled with control relays, terminal blocks, insulating barriers, etc. All 120 Volt AC and DC terminal blocks shall be isolated from each other by insulating barriers or separate enclosures.

All wiring within the cabinets shall be grouped together in harnesses and secured to the structure.

All shielded cables shall terminate in separate cabinets. A third terminal shall be provided for each twisted pair and the shield for each connected thereto, unless otherwise noted on manufacturer's shop drawings.

Terminal blocks shall be tubular screw type with pressure plates and shall be rated 600 Volts. Terminal blocks shall be Allen Bradley or equal.

Boxes shall be made of 14 gauge galvanized steel and shall be of sufficient size to provide a minimum of 4 inches of wiring space on all sides and between adjacent terminal blocks. A minimum 2-inch spare shall be provided between control relays. A minimum of four mounting studs shall be furnished without knockouts. Holes for raceways shall be drilled on the job.

A single or double hinged door shall cover the front of each terminal cabinet. Doors shall have a neoprene gasket, vault type handle, three-point catch and lock. Two keys shall be supplied for each lock. All locks shall be keyed alike. A terminal block schedule shall be provided with each terminal point numbered and identified (Typewritten) as to function.

All exterior and interior steel surfaces of the cabinets shall be properly cleaned and finished with ANSI 61 grey over a rust inhibiting phosphatized coating conforming to ANSI A55.1. The finish paint shall be of a type to which field applied paint will adhere.

Cabinets in wet, damp, corrosive and all outdoor locations shall be NEMA 4X 316 Stainless Steel.

Cabinets shall be Hoffman Engineering Co, with latch kit hardware or be an equal product.

2-1.17 EMERGENCY SHOWER ALARM HORN AND LIGHT: Not used.

2-1.18 INTRINSICALLY SAFE RELAYS: Intrinsically safe relays should be solid state type with 5 amp output contacts, suitable for use on a 120 Volt, 60 Hz power and shall be FM approved for pilot devices in Class 1, Division 1, Group D hazardous atmosphere.

Intrinsically safe relays shall be Gems Solid State Safe-Pak as manufactured by Gems Sensors or equal.

2-1.19 BREAK-GLASS EMERGENCY STATION: Break-Glass Emergency Station shall be of the break glass design with a weatherproof cast metal outer case finished in fire red and

have an attached chain hung “Hammer”. A glass panel shall be mounted in front of the push button operator. Switch contacts shall be 1-open, 1-closed, rated 10 amps, 600 Volts.

2-1.20 LIGHTING CONTACTOR: Lighting contactor shall be electrically operated, mechanically held type mounted in a NEMA 1 enclosure (except where noted otherwise on the drawings) with number of poles as noted on the drawings. Operating coils shall be rated for 120 Volts unless otherwise noted on the drawings. Provide a “Hand-Off-Auto” switch on cover where shown on the drawings.

2-1.21. NEMA 4 Enclosures. Unless otherwise noted, all NEMA 4 enclosures shall be 316 stainless steel. NEMA 4X push buttons and pilot lights shall be provided in all weatherproof control panels. NEMA 4X enclosures mounted outside the building shall be factory painted white.

2-1.22 ELECTRICAL SWITCHBOARD MATTING: Electrical Switchboard Matting shall be provided in the electrical room around all electrical gear including MCCs, freestanding VFDs and PLCs. The rubber matting shall provide a floor covering to prevent shock around high voltage electrical apparatus, fuse boxes, switchgear, control panels, and heavy machinery. It shall meet current ASTM, ANSI (plus IEC Division of ANSI, Tech. Committee-78) specifications for this material. Matting shall be 1/4” thick, Class 2 as manufactured by The Mat King or equal.

PART 3 - EXECUTION (not used)

END OF SECTION

SECTION 16110

RACEWAYS AND FITTINGS

PART 1 – GENERAL

- 1-1. SCOPE OF WORK. Furnish and install complete raceway systems as shown on the Drawings and as specified herein.
- 1-2. APPLICATIONS. Except where otherwise shown on the Drawings, or hereinafter specified. The following describes the conduit requirements of the project:
- All exposed power and control raceways shall be in aluminum conduit unless otherwise noted below.
 - All underground conduits in Class 1, Div 2 areas shall be aluminum conduit.
 - Underground power conductors shall be installed in PVC Schedule 80 conduits.
 - All exposed Instrumentation circuits (4-20 mA signal wire) shall be installed in aluminum conduit.
 - All Fiber Optic Cable shall be installed in PVC schedule 80 conduits.
 - Underground instrumentation circuits (4-20 mA signal wire) PVC 80 conduit, when not encased in concrete duct bank.
 - Conduit sleeves shall be PVC Schedule 80 Conduit.
 - Where Schedule 80 PVC is used, all below grade elbows and risers to above grade shall be aluminum coated with bitmastic. All elbows above grade shall be suitably grounded. Conduit spaces shall be provided for underground conduit installation.
 - All conduit of a given type shall be the product of one manufacturer.
 - All switch, outlet and control station boxes and fittings shall be cast aluminum FS boxes with aluminum covers.
 - Concealed switch, outlet and control station boxes in NEMA 1 areas shall be aluminum.
 - Terminal boxes, junction boxes, pull boxes, etc.; installed outdoors shall be NEMA 4X 316 stainless steel. All boxes installed indoors (except in corrosive areas) may be aluminum. Boxes in corrosive areas shall be PVC.
 - Combination expansion-deflection fittings shall be used where exposed or embedded conduits cross structure expansion joints.

PART 2 – PRODUCTS

2-1. MATERIALS.

2-1.01. Rigid Metal Conduit. Rigid metal conduit shall be for use under the provisions of NEC Article 346.

Rigid aluminum conduit shall be 6063 alloy and shall be as manufactured by New Jersey Aluminum Corp., AFC Co., VAW of America, Inc., or approved equal.\

2-1.02. Rigid Nonmetallic Conduit. Rigid nonmetallic conduit shall be for use under the provisions of NEC Article 347.

PVC conduit shall be rigid polyvinyl chloride schedule 80 as manufactured by Allied Tube & Conduit Corp., Western Tube & Conduit Corp., or Republic Conduit.

2-1.03. Liquid tight Flexible Conduit, Couplings and Fittings. Liquid tight flexible conduit shall be for use under the provisions of NEC Article 351A.

Liquid tight flexible conduit shall be THOMAS & BETTS, or approved equal.

Fittings used with liquid tight flexible conduit shall be nylon.

Fittings installed on tanks, filter area, chemical rooms and other outdoor process areas shall be aluminum.

2-1.04. Flexible Couplings, Non-metallic. Flexible non-metallic couplings shall be as manufactured by the Allied Tube & Conduit Corp., Western Tube & Conduit Corp., or Republic Conduit.

2-1.05. Boxes and Fittings. PVC, aluminum and stainless steel switch and outlet covers and boxes shall be manufactured by Raco Mfg, Appleton Electric Co., and Steel City Mfg. or approved equal.

All terminal boxes, junction boxes and pull boxes located indoors and outdoors shall be NEMA 4X 316 stainless steel.

Cast aluminum boxes and fittings shall be copper-free aluminum with cast aluminum covers and corrosion-proof screws as manufactured by the Killark Electric Co., Crouse-Hinds Co., Appleton Electric Co., or approved equal.

Conduit hubs shall be as manufactured by Meyers Electric Products, Inc., Raco Div., Appleton Electric Co., or approved equal. Conduit grounding hubs shall be provided for all outdoor conduit terminations.

Conduit wall seals shall be Type WSK as manufactured by the O.Z. Electrical Mfg. Co., or approved equal.

Combination expansion-deflection fittings shall be Type XD as manufactured by the Crouse-Hinds Co., or approved equal.

Conduit wall seals for new concrete walls below grade shall be O.Z./Gedney Co., Type WSK, Spring City Electrical Manufacturing Co., Type WDP, or approved equal.

Conduit wall seals for cored holes shall be Type CSML as manufactured by the O.Z./Gedney Co., or approved equal.

Conduit wall and floor seals for sleeved openings shall be Type CSMI as manufactured by the O.Z./Gedney Co., or approved equal.

Conduit sealing bushings shall be O.Z./Gedney Type CSB or approved equal.

EYSR retrofit sealing fittings shall be installed in rigid metal conduit systems in hazardous locations, in vertical or horizontal positions, indoors or outdoors as manufactured by Cooper Crouse Hinds or equal.

2-1.06. Conduit Mounting Equipment. 316 Stainless steel channel and stainless steel hardware shall be used in all areas indoors or outdoors.

PART 3 – EXECUTION

3-1. INSTALLATION. No conduit smaller than 3/4-inch electrical trade size shall be used, nor shall any have more than three 90 degree bends in any one run. Pull boxes shall be provided as required or directed. Minimum size in floor slabs shall be 3/4-inch.

No wire shall be pulled until the conduit system is complete in all details; in the case of concealed work, until all rough plastering or masonry has been completed; in the case of exposed work, until the conduit system has been completed in every detail.

UL anti-seizing compound shall be applied to all threaded connections of aluminum conduits.

The ends of all conduits shall be tightly plugged to exclude dust and moisture while the buildings are under construction.

Conduit supports shall be spaced at intervals as required to obtain rigid construction, but in no case more than as required by the NEC.

Single conduits shall be supported by means of one-hole pipe clamps in combination with one-screw back plates, to raise conduits from the surface. Multiple runs of conduits shall be supported on trapeze type hangers with steel horizontal members and threaded hanger rods. The rods shall be not less than 5/8-inch diameter. Material type shall be as specified in Section 2.

Conduit hangers shall be attached to structural steel by means of beam or channel clamps. Where attached to concrete surfaces, concrete inserts of the spot type shall be provided.

All conduits on exposed work shall be run at right angles to and parallel with the surrounding walls and shall conform to the form of the ceiling. No diagonal runs will be allowed. Bends in parallel conduit runs shall be concentric. All conduits shall be run perfectly straight and true. Conduits not installed in this fashion shall be replaced entirely at the CONTRACTOR's expense with no cost to the OWNER.

No unbroken conduit run shall exceed 300 feet in length. This length shall be reduced by 75 feet for each 90 degree elbow. Location of junction boxes must be approved before installation.

Conduit terminating in pressed steel boxes shall have double locknuts and insulated bushings installed.

Conduit terminating in gasketed enclosures shall be terminated with conduit hubs as approved in this section.

Conduit wall seals shall be used for all conduits penetrating walls below grade or other locations shown on the Drawings.

All Liquid tight flexible metal conduits with separate dedicated grounding conductor shall be used for all motor terminations and other equipment where vibration is present.

Explosion proof Flexible couplings shall be used in all hazardous locations for all motor terminations and other equipment where vibration is present.

Conduit stub outs for future construction shall be provided with threaded end caps at each end with pull string and shall be labeled as to origination and destination.

Metallic conduit entering manholes and below grade pull boxes shall be terminated with grounding type bushings and connected and loop together to a 5/8" x 30" copperweld rod with a minimum #6 bare copper wire or larger size based on the NEC code requirement.

Underground 120 volt circuits (Schedule 80 PVC) shall be installed directly to the respective lighting panels, etc. Stainless steel pull boxes shall be wall mounted on structures to eliminate excessive bends. With prior approval, below grade pull boxes, equal to Brooks #2424 (minimum), may be used.

A formed, minimum 3.5 inch high, with a minimum 3" on each side, concrete conduit housekeeping pad shall be required for all exposed conduit stub-ups. This applies to ALL exposed conduits installed indoors or outdoors. See structural and mechanical drawings for additional requirements. Coat aluminum conduits at concrete penetrations with an approved bitumastic coating for six (6) inches on either side.

END OF SECTION

SECTION 16120

WIRES AND CABLES – 600 Volt or Less

PART 1 – GENERAL

1-1. SCOPE OF WORK. Furnish, install and test all wire, cable, and appurtenances as shown on the Drawings and as hereinafter specified.

1-2. SUBMITTALS. Samples of proposed wire and cable shall be submitted to the ENGINEER for approval. Each sample shall have the size, type of insulation and voltage stenciled on the jacket.

Installed, unapproved wire shall be removed and replaced at no additional cost to the OWNER.

1-3. APPLICATIONS.

1-3.01. Wire for indoor lighting and receptacle circuits above grade shall be type THWN.

1-3.02. Wire for outdoor lighting and receptacle circuits above grade shall be type XHHW.

1-3.03. Wire for all underground shall be type XHHW.

1-3.04. Wire for all non-VFD power motor circuits shall be type XHHW.

1-3.05. Wire for all service conductors shall be type RHW or XHHW, stranded.

1-3.06. Wire for all VFD output power cable shall be type SLPE RHH/RHW-2.

1-3.07. Single conductor wire for control, indication and metering shall be type MTW No. 14 AWG, 19 strand for indoor applications or type XHHW No. 14 AWG 19 strand for outdoor applications.

1-3.08. Multi-conductor control cable shall be No. 14 AWG, 19 strand.

1-3.09. Shielded control cable shall be No. 16 AWG, shielded and stranded. All shielded cable shall have a #12 ground wire.

1-3.10. DLO/Industrial Motor Wire shall be used for 5HP motors and above from motor controller to motor connection enclosure.

1-4. MINIMUM SIZES. Except for control and signal leads, no conductor smaller than No. 12 AWG shall be used.

PART 2 – PRODUCTS.

2-1. MATERIALS. All wires and cables shall be of annealed, 98 percent conductivity, soft drawn stranded copper conductors.

2-1.01. 600 Volt Wire and Cable

Type XHHW shall be cross-linked polyethylene (XLP); as manufactured by the Southwire Co., General Cable Co., or approved equal.

Type THWN shall be as manufactured by the Southwire Co., General Cable Co., or approved equal.

Type DLO/Industrial Motor Lead Wire as manufactured by American Insulated Wire Corp or approved equal.

2-1.01. Variable Frequency Drive (VFD) Output Power Cable

Section applies to power cables routed between the output of VFD's and motor terminals.

Cable shall be rated for 2000 volts and shall meet the requirements below:

- Conductors shall be stranded Class B bare copper.
- All wire shall be brought to the job in unbroken packages and shall bear the data of manufacturing; not older than 12 months.
- Type of wire shall be XLPE RHH/RHW-2 rated 90 degrees C suitable for wet locations.
- Provide overall 5 millimeter metallic shield (copper tape shield) overlapped 50%.
- No wire smaller than No. 12 gauge shall be used unless specifically indicated.
- Cable construction shall consist of three insulated current-carrying phase conductors and three bare ground conductors, symmetrically placed between the phase conductors, and twisted beneath a continuous overall PVC polymeric jacket.

Each ground conductor size (circular mil area) shall be one-third (1/3) of the NEC required size (circular mil area) for a single ground conductor. If one third of the required circular mil area does not correspond to a standard size (circular mil area) of construction, the next largest size of standard construction shall be used. All conductors shall be megger tested after installation and insulation must be in compliance with the Insulated Power Cable Engineers Association Minimum Values of Insulation Resistance.

Manufacturers:

- General Cable
- Southwire
- Approved Equal.

2-1.02. Instrumentation and Control Cable

Multi-conductor control cable shall be stranded, 600V, cross-linked polyethylene insulated with PVC jacket, type "XLP" as manufactured by the American Insulated Wire Co., Eaton Corp. "Polyset," or approved equal.

2-1.03. Terminations

Power Conductors: Terminations shall be die type or set screw type pressure connectors as specified.

Control Conductors: Termination on saddle-type terminals shall be wired directly with a maximum of two conductors per termination. Termination on screw type terminals shall be made with a maximum of two spade connectors.

Splices shall not be made in push button control stations, conduit bodies, etc.

All 480 Volt splices will require prior approval and shall be reviewed on a case by case basis. Where approved by the ENGINEER, the splices shall be compression type with heat shrink boot.

2-1.04. Wire and Cable Tagging and Color Coding. All color coding of conductors shall be continuous throughout the length of the conductor's insulation jacket. The installation of color coded tape on the wire conductor as a permanent marking will not be accepted. Color code system shall be as follows:

480v Delta and 480/277v Wye:
Brown = Phase "A" Conductor
Orange = Phase "B" Conductor
Yellow = Phase "C" Conductor
Grey = Neutral Conductor
Green = Grounding Conductor

120/208v wye:
Black = Phase "A" Conductor
Red = Phase "B" Conductor
Blue = Phase "C" Conductor
White = Neutral Conductor
Green = Grounding Conductor

125 Volt DC:
Red (+) = Positive
Black (-) = Negative

48 Volt DC:
Blue/Red stripe (+) = Positive
Grey/White stripe (-) = Negative

24 Volt DC:
Blue (+) = Positive
Grey (-) = Negative

Wire tag labels shall be a:

Self laminating thermal transfer label with a white printable area with a permanent acrylic adhesive, Type "SB" as manufactured by Tyco, Type "BPTL" as manufactured by Brady or approved equal.

Heat shrinkable and thermal transfer wire identification sleeves, type "TMS-SCE" as manufactured by Tyco Electronics or type "BPSPT" manufactured by Brady or approved

equal.

PART 3 – EXECUTION.

3-1. INSTALLATION. All conductors shall be carefully handled to avoid kinks or damage to insulation.

Lubrications shall be used to facilitate wire pulling. Lubricants shall be U.L. listed for use with the insulation specified and be fully removed from conductors immediately after installing conductors.

Shielded instrumentation wire shall be installed from terminal to terminal with no splicing at any intermediate point.

Shielded instrumentation wire shall be installed in PVC 80 conduit and pull boxes that contain only shielded instrumentation wire. Instrumentation cables shall be separated from control cables in manholes.

Shielding on instrumentation wire shall be grounded at one end only, as directed by supplier of the instrumentation equipment and approved by the plant's Industrial Automation Group Management.

Wire and cable connections to terminals and taps shall be made with compression connectors. Connections of insulated conductors shall be insulated and covered. All connections shall be made using materials and installation methods in accordance with instructions and recommendations of the manufacturer of the particular item of wire and cable. The conductivity of all completed connections shall be not less than that of the uncut conductor. The insulation resistance of all completed connections of insulated conductors shall be not less than that of the uncut conductor.

All wire and cable shall be continuous and without splices between points of connection to equipment terminals, except a splice will be permitted by the ENGINEER if the length required between the points of connection exceeds the greatest standard shipping length available from the manufacturer specified or approved by the ENGINEER as the manufacturer of the particular item of wire and cable.

Steel fish tapes and/or steel pulling cables shall not be used in PVC conduit runs.

All control circuits and wiring shall be clearly and permanently numbered and labeled at each end so as to identify the location of the opposite end and the function of the circuit. Method of wire/cable tagging must be approved in a shop drawing prior to any installation. Individual wires in a multi-wire circuit shall be identified with wire number labels as specified in this section. Labeling shall be in place prior to turnover of any equipment, system or sub-system to OWNER.

CONTRACTOR shall:

- Measure the attenuation of the fiber optic cable prior to installation and determine the average attenuation per foot.
- Install the fiber cable runs in accordance with the manufacturer's recommendations and including:

- Use recommended cable pulling lubricant.
- Continuously measure the pull tension during installation and do not exceed the manufacturer's stated maximum tension.
- Note from the distance markers on the cable the exact length of each installed run.
- Following installation, measure the attenuation of each run and compare the attenuation per foot readings with those taken prior to installation. Replace any runs whose attenuation per foot reading is more than 10% higher than the pre-installation value.
- All testing shall be completed in the presence of the OWNER's representative.

3-2. TESTS. All 600-volt wire insulation shall be tested with a meg-ohmmeter after installation. Tests shall be made at not less than 1,000 VDC. All testing shall be completed in the presence of the OWNER's representative. See 16050 for additional testing requirements.

END OF SECTION

SECTION 16150

MOTORS

PART 1 – GENERAL

1-1. SCOPE OF WORK. Furnish and install the motors as hereinafter specified and as called for in other sections of these Specifications.

1-2. QUALIFICATIONS. Motor shall be sufficient size for the duty to be performed and shall not exceed their full-rated load when the driven equipment is operating at specified capacity. Unless otherwise noted, motors driving pumps shall not be overloaded at any head or discharge condition of the pump.

1-3. SUBMITTALS. The motor manufacturer shall submit to the ENGINEER certified dimension prints showing nameplate data and outline dimensions within three weeks of the date they receive the order.

Guarantee: All equipment furnished and installed under this Section shall be guaranteed against defects of workmanship, materials and improper installation for a period of one year from date of acceptance. All such equipment or parts proven defective, due to the above noted causes, shall be replaced in the machines by the CONTRACTOR at no expense to the OWNER.

Provide equipment warranty in accordance with Division I.

PART 2 – PRODUCTS

2-1. RATING. Unless otherwise noted, all motors shall be of the low voltage type. All motors 1/2 through 100 horsepower shall be rated 230/460 volt, 3 phase, 60 Hertz A.C.; motors 125 horsepower through 800 horsepower shall be rated 460 volt, 3-phase, 60 Hertz, and motors below 1/2 horsepower shall be rated 115/230 volt, 1 phase, 60 Hertz A.C.

2-2. THREE PHASE INDUCTION MOTORS.

All outdoor Motors 1 HP and larger and all indoor motors 5 HP and larger shall have a 120-volt space heater for moisture control.

Each phase of the motor shall contain a bi-metallic temperature monitor in the upper portion of the stator windings to monitor stator temperatures. The temperature monitors shall be imbedded in the start winding coils, connected in series and coupled to the motor contactor coil to provide single switch shutdown capability.

Unless specifically noted in other sections of these Specifications, all motors shall have a minimum as indicated in the table below. All motors shall be "premium efficiency" type. Motors operating with variable frequency drives shall state that they are suitable for their intended applications. Motor nameplate shall read "Inverter Duty Rated". In addition, Motors operating with Variable Frequency Drives (VFDs) shall meet the requirements of NEMA MG1 Part 31.

TABLE 1

Motor HP	Min. Eff.	Max. dba	Motor HP	Min. Eff.	Max. dba
1-2	84.0%	74	25-30	92.0%	92
3-5	86.5%	79	40-50	93.0%	97
7.5-10	90.2%	84	60-75	94.0%	100
15-20	91.0%	89	100	94.1%	102
			200	94.3%	105

Motors larger than 100 Hp or operating with a VFD shall have a thermistor type winding temperature switch.

All motors in Class I and Class II areas shall be explosion proof rated for area in which installed, including all cables, junction boxes, fittings, switches, etc.

2-3. CONSTRUCTION

2-3.01 General. All drip-proof and weather protected Type I motors shall have epoxy encapsulated windings. Totally enclosed motors shall not be encapsulated. Motors not readily available with encapsulated windings may be standard type. Motors exposed to the outside atmosphere shall be totally enclosed fan cooled (TEFC) unless otherwise specified.

Squirrel-cage rotors shall be made from high-grade steel laminations adequately fastened together and to the shaft, or shall be cast aluminum or bar-type construction with brazed end rings.

2-3.02. Low Voltage, Three Phase Motors. Motors shall be of the squirrel-cage or wound rotor induction type as noted. Horizontal, vertical solid shaft, vertical hollow shaft, normal thrust and high thrust types shall be furnished as specified herein. All motors shall be built in accordance with current NEMA, IEEE, ANSI and AFBMA standards where applicable.

Motors shall be of the type and quality described by these Specifications, fully capable of performing in accordance with manufacturer's nameplate rating, and free from defective material and workmanship.

Motors shall have normal or high starting torque (as required), low starting current (not to exceed 600 percent full load current), and low slip.

Motors shall be totally enclosed fan-cooled construction with 1.15 service factor unless otherwise noted. Indoor motors shall be WPI unless otherwise noted.

Motors shall be suitable for operation in moist air with hydrogen sulphide gas present.

The output shaft shall be suitable for direct connection or belt drive as required.

Motors shall have a Class B nonhygroscopic insulation system. Class F insulation may be used but shall be limited to Class B temperature rise.

All motors shall have a final coating of chemical resistant corrosion and fungus protective epoxy fortified enamel finish sprayed over red primer over all interior and exterior surfaces. Stator bore and rotor of all motors shall be epoxy coated.

All fittings, bolts, nuts, and screws shall be 316 stainless steel. Bolts and nuts shall have hex heads.

All machine surfaces shall be coated with rust inhibitor for easy disassembly.

Conduit boxes shall be gasketed. Lead wires between motor frame and conduit box shall be gasketed.

Totally enclosed motors shall be provided with condensate drain hole and epoxy coated motor windings to protect against moisture.

Nameplates shall be stainless steel. Lifting lugs or "O" type bolts shall be supplied on all frames 254T and larger. Enclosures will have stainless steel screen and motors shall be protected for corrosion, fungus and insects.

Low voltage, three phase motors shall be manufactured by U.S. Motors, G.E. and Baldor.

2-3.02.1. Fractional Horsepower:

Fractional horsepower motors shall be rigid, welded-steel, designed to maintain accurate alignment of motor components and provide adequate protection. End shields shall be reinforced, lightweight die-cast aluminum. Windings shall be of varnish-insulated wire with slot insulation of polyester film, baked-on bonding treatment to make the stator winding strongly resistant to heat, aging, moisture, electrical stresses and other hazards.

Motor shaft shall be made from high-grade, cold-rolled shaft steel with drive-shaft extensions carefully machined to standard NEMA dimensions for the particular drive connection.

For light to moderate loading, bearings shall be quiet all-angle sleeve type with large oil reservoir that prevents leakage and permits motor operation in any position.

For heavy loading, bearings shall be carefully selected precision ball bearings with extra quality, long-life grease, and large reservoir providing 10 years' normal operation without relubrication.

2-3.02.2. Integral Horsepower:

Motor frames and end shields shall be cast iron or heavy fabricated steel of such

design and proportions as to hold all motor components rigidly in proper position and provide adequate protection for the type of enclosure employed.

Windings shall be adequately insulated and securely braced to resist failure due to electrical stresses and vibrations.

The shaft shall be made of high-grade machine steel or steel forging of size and design adequate to withstand the load stresses normally encountered in motors of the particular rating. Bearing journals shall be ground and polished.

Rotors shall be made from high-grade steel laminations adequately fastened together, and to the shaft. Rotor squirrel-cage windings may be cast-aluminum or bar-type construction with brazed end rings.

Motors shall be equipped with vacuum-degassed antifriction bearings made to AFBMA Standards, and be of ample capacity for the motor rating. The bearing housing shall be large enough to hold sufficient lubricant to minimize the need for frequent lubrication, but facilities shall be provided for adding new lubricant and draining out old lubricant without motor disassembly. The bearing housing shall have long, tight, running fits or rotating seals to protect against the entrance of foreign matter into the bearings, or leakage of lubricant out of the bearing cavity.

Bearings of high thrust motors will be locked for momentary upthrust of 30% downthrust. All bearings shall have a minimum B10 life rating of 100,000 hours in accordance with AFBMA life and thrust values.

Vertical motors will have nonreverse ratchets to prevent backspin.

2-3.02.3. Low Voltage, Single Phase Motors.

Single phase motors shall be split-phase and capacitor-start induction types rated for continuous horsepower at the rpm called for on the Drawings. Motors shall be rated 115/230 volts, 60 Hertz, single phase, open drip-proof, or totally enclosed fan cooled as called for on the Drawings, with temperature rise in accordance with NEMA Standards for Class B insulation.

Totally enclosed fan cooled motors shall be designed for severe-duty.

Motors shall have corrosion and fungus protective finish on internal and external surfaces. All fittings shall have corrosion protective plating.

Mechanical characteristics shall be the same as specified for polyphase fractional horsepower motors.

PART 3 – EXECUTION

3-1. INSTALLATION. Motor Connections: All motors shall be connected to the conduit system by means of a short section 18-inch minimum of flexible conduit unless otherwise indicated. For all motor connections, the CONTRACTOR shall install a grounding conductor in

the conduit and terminate at the motor control center with an approved grounding clamp.

3-2. TEST AND CHECKS. The following tests shall be performed on all motors after installation but before putting motors into service.

The CONTRACTOR shall megger each motor winding before energizing the motor, and, if insulation resistance is found to be low, shall notify the ENGINEER and shall not energize the motor. The following table gives minimum acceptable insulation resistance in megohms at various temperatures and for various voltages with readings being taken after one minute of megger test run.

TABLE 2

Degree Winding Temperature		Voltage			
⁰ F	⁰ C	115V	230V	460V	4,160V
37	3.9	60	108	210	1,700
50	10	32	60	120	1,000
68	20	13	26	50	460
86	30	5.6	11	21	195
104	45	2.4	4.5	8.8	84
122	50	1	2	3.7	35
140	60	.5	.85	1.6	15

The CONTRACTOR shall check all motors for correct clearances and alignment and for correct lubrication, and shall lubricate if required in accordance with manufacturer's instructions. The CONTRACTOR shall check direction of rotation of all motors and reverse connections if necessary.

All motors shall be given the standard short commercial test prior to shipment. This shall consist of no load current; check current balance, winding resistance, air gap measurement, high potential tests, and bearing inspection. Six (6) hard copies and one (1) pdf electronic copy of the certified short commercial test shall be mailed to the ENGINEER prior to shipment.

END OF SECTION

SECTION 16160

PANELBOARDS

PART 1 – GENERAL

1-1. SCOPE OF WORK. Furnish all labor materials, equipment and incidentals required and install all panelboards as hereinafter specified and as shown on the Drawings.

PART 2 – GENERAL

2-1. RATINGS. Panelboard ratings shall be as shown on the Drawings. All panelboards shall be rated for the intended voltage.

2-2. STANDARDS. Panelboards shall be in accordance with the Underwriter Laboratories, Inc. "Standard for Panelboards" and "Standard for Cabinets and Boxes" and shall be so labeled where procedures exist. Panelboards shall also comply with NEMA Standard for Panelboards and the National Electrical Code.

2-3. RELATED WORK.

SPD shall be as specified under section 16709.

2-4. CONSTRUCTION

2-4.01. Interiors:

All interiors shall be completely factory assembled with circuit breakers, wire connectors, etc. All wire connectors, except screw terminals, shall be of the anti-turn solder less type and all shall be suitable for copper wire of the sizes indicated.

Interiors shall be so designed that circuit breakers can be replaced without disturbing adjacent units and without removing the main bus connectors and shall be so designed that circuits may be changed without machining, drilling or tapping.

Branch circuits shall be arranged using double row construction. Branch circuits shall be numbered by the manufacturer.

A nameplate shall be provided listing panel type, number of circuit breakers and ratings.

2-4.02 Buses:

Bus bars for the mains shall be of copper. Full size neutral bars shall be included. Bus bar taps for panels with single pole branches shall be arranged for sequence phasing of the branch circuit devices. Bussing shall be braced throughout to conform to industry standard practice governing short circuit stresses in panelboards. Phase bussing shall be full height without reduction. Cross connectors shall be copper.

Neutral bussing shall have a suitable lug for each outgoing feeder requiring a neutral connection.

Spaces for future circuit breakers shall be bussed for the maximum device that can be fitted into them.

Buses for 480V panelboards shall be rated for 65,000 amperes RMS symmetrical. Buses for 120/208V light panels shall be rated 10,000 amperes RMS symmetrical.

2-4.03 Boxes:

Surface mounted boxes shall have an internal and external finish as hereinafter specified in paragraph D4.

At least four (4) interior mounting studs shall be provided.

All conduit entrances shall be field punched.

All installed panelboards shall be NEMA 4X 316 stainless steel.

2-4.04. Trim:

Two piece continuous hinged doors covering all circuit breaker handles shall be included in all panel trims.

Doors shall have semi flush type cylinder lock and catch, except that doors over 48-inches in height shall have a vault handle and 3-point catch, complete with lock, arranged to fasten door at top, bottom and center. Door hinges shall be concealed. Two keys shall be supplied for each lock. All locks shall be keyed alike; directory frame and card having a transparent cover shall be furnished on each door.

The trims shall be fabricated from code gauge sheet steel.

All exterior and interior steel surfaces of the panelboard shall be properly cleaned and finished with ANSI Z55.1, No. 61 light gray paint over a rust-inhibiting phosphatized coating. The finish paint shall be of a type to which field applied paint will adhere.

Trims for flush panels shall overlap the box by at least 3/4-inch all around. Surface trims shall have the same width and height as the box. Trims shall be fastened with quarter turn clamps.

2-5. MANUFACTURER:

EATON
Square D
Or Approved Equal.

2-6. CIRCUIT BREAKERS:

Panelboards shall be equipped with circuit breakers with frame size and trip settings as shown on the Drawings.

Circuit breakers shall be molded case, bolt-in type.

Circuit breakers used in 120/240 and 120/208V panelboards shall have an interrupting capacity of not less than 10,000 - amperes, RMS symmetrical.

Three pole breakers used in 480V panelboards shall have an interrupting capacity of not less than 65,000 - amperes RMS symmetrical.

GFCI (ground fault circuit interrupter) shall be provided for circuits where indicated on the Drawings. GFCI units shall be 1 pole, 120 volt, molded case, bolt-on breakers, incorporating a solid state ground fault interrupter circuit insulated and isolated from the breaker mechanism. The unit shall be U.L. listed Class A Group I device (5 milliamp sensitivity, 25 millisecond trip time), and an interrupting capacity of 10,000 amperes RMS.

PART 3 – EXECUTION

3-1. INSTALLATION. Boxes for surface mounted panelboards shall be mounted so there is at least 1/2-inch air space between the box and the wall.

Unless otherwise noted on the Drawings, top of cabinets shall be mounted 6-feet 0-inch above the floor, properly aligned and adequately supported independently of the connecting raceways.

All wiring in panelboards shall be neatly formed, grouped, laced, and provide circuit identification labeling as specified in accordance of section 16120. A typewritten directory card identifying all circuits shall be placed in the cardholder inside the front cover.

All panelboards provided shall provide a minimum (six) 6 spare circuit spaces for future expansion.

END OF SECTION

SECTION 16370

VARIABLE FREQUENCY DRIVES

PART 1 - GENERAL

1-1. SCOPE. Furnish all labor, materials, equipment and incidentals required and install variable frequency drives as shown on the Drawings and as specified herein.

These specifications are intended to give a general description of what is required, but do not cover all details which will vary in accordance with the requirements of the equipment furnished. They are, however, intended to cover the furnishing, the shop tests, the delivery and complete installation and field testing, of all materials, equipment and appurtenances for the variable frequency drives herein specified.

1-2. DESCRIPTION OF SYSTEM. The variable frequency drives shall be furnished by the Contractor. The Contractor is responsible for complete system operation and necessary coordination.

The drives furnished herein under shall be totally compatible and adequately sized with both the Pumps and Motors to be supplied.

This section covers fabrication, performance and functional requirements of a true six (6) Pulse, Pulse Width Modulated (PWM) adjustable frequency AC drive (VFD) system. The VFD is to include a solid state reduce voltage starter bypass shall be installed. Control and status of devices shall be modbus communications This section covers AC voltage source, pulse width modulated (PWM) type variable speed/frequency drives (VFDs) for constant torque application loads as shown on the project drawings or noted in project motor list.

VFDs shall be sized to as shown on the electrical drawings.

VFDs shall be provided with Reduced Voltage Solid State (RVSS) bypass starters.

VFDs shall be provided with amp meter to provide motor amperage signal to Reclaimed PLC (R-PLC).

1-3. QUALIFICATIONS. Variable speed drives shall be sized to operate the ampacity shown on the electrical drawings. To assure unit responsibility, all equipment specified in this section of the specifications shall be furnished and coordinated by the CONTRACTOR. The CONTRACTOR shall be responsible for coordinating the sizing of all VFDs.

The drives covered by these Specifications are intended to be equipment of proven ability as manufactured by reputable manufacturers having long experience in the production of identical units. The equipment furnished shall be designed, constructed and installed in accordance with the best practice and methods, and shall operate satisfactorily when installed.

The variable frequency control shall operate satisfactorily when connected to a bus supplying other solid state power conversion equipment which may be causing up to 10% total harmonic voltage distortion and commutation notches up to 36,500 volt microseconds, or when other variable frequency drives are operated from the same bus.

Individual or simultaneous operation of the variable frequency drives shall not add more than 3% total harmonic voltage distortion to the normal bus, nor more than 10% total current distortion to the normal bus (calculated at the load side of the utility transformer), per IEEE 519, latest edition. The load side of the utility transformer shall be the point of common coupling (PCC). The short circuit current at point of common coupling under utility operation is approximately 50,000 symmetrical amperes at 277/480 volts. A harmonic (voltage and current) analysis must be submitted by the variable frequency drive manufacturer with shop drawings. This must include all calculations, simply a statement of compliance is not acceptable. Voltage and current harmonics compliance per IEEE519 shall be verified by the variable frequency drive manufacturer with field measurements of the harmonic distortion difference at the point of common coupling with and without variable frequency drives operating. See testing requirements.

The variable frequency drive manufacturer shall maintain and staff engineering service and repair shops through the United States, including the State of Florida, trained to do start up service, emergency service calls, repair work, service contracts and training of customer personnel.

The variable frequency drives shall be manufactured by Danfoss, Eaton or Schneider Electric Square D.

Provide Ethernet module for each VFD for monitoring of parameters.

1-4. SUBMITTALS. Copies of all materials required to establish compliance with the specifications shall be submitted. Submittals shall include at least the following:

Certified shop and erection drawings showing all important details of construction, dimensions and anchor bolt locations.

Descriptive literature, bulletins and/or catalogs of the equipment.

Data on the characteristics and performance of the variable frequency drives. Data shall include certification that the variable frequency drives are warranted for use with the motors specified in Division 11 and Division 16.

Complete drawings shall be furnished for approval before proceeding with manufacture and shall consist of master wiring diagrams, elementary or control schematics including coordination with other electrical control devices operating in conjunction with the variable frequency drive, and suitable outline drawings with sufficient details for locating conduit stub-ups and field wiring. Generic schematics not specific to this project shall not be acceptable.

A list of the manufacturer's recommended spare parts with the manufacturer's current price for each item. Include gaskets, packing, etc. on the list. List bearings by the bearing manufacturer's numbers only.

1-5. OPERATING INSTRUCTIONS. Three copies of the operating and maintenance manuals shall be furnished. The manuals shall be prepared specifically for this installation and shall include all required cuts, drawings, equipment lists, descriptions, etc. that are required to instruct operating and maintenance personnel unfamiliar with such equipment.

A factory representative who has complete knowledge of proper operation and maintenance shall be provided for one (1) day after completion of all training to instruct representatives of the Owner on proper operation and maintenance.

1-6. TOOLS AND SPARE PARTS. One (1) set of all special tools required for normal operation and maintenance shall be provided. If no special tools are required then a statement to this effect shall be provided.

1-7. PRODUCT HANDLING. All parts shall be properly protected so that no damage or deterioration will occur during a prolonged delay from the time of shipment until installation is completed and the units and equipment are ready for operation.

All equipment and spare parts must be properly protected against any damage during a prolonged period at the site.

Factory assembled parts and components shall not be dismantled for shipment unless permission is received in writing from the Engineer.

Each box or package shall be properly marked to show its net weight in addition to its contents.

1-8. START-UP AND WARRANTY. A factory-authorized service technician shall perform start-up on each drive. ("Start up" shall not include installation or termination of either power or control wiring.) Start-up costs provided with the bid shall include time and travel for the estimated number of visits required, but shall not be less than at least one half-day with travel. Additional labor or return trips to the site shall be billed at the VFD supplier's published straight-time rates. The rates shall be submitted with the VFD shop drawings. Upon completion, a start-up service report shall be provided.

A 5-year on-site warranty shall be provided. The Owner shall not be responsible for any warranty costs including travel, labor, parts, or other costs for a full 5 years from the date of manufacture of the Drive. The warranty shall cover all Drive failures including lightning strikes. The cost of the warranty shall be included in the bid.

PART 2 - PRODUCTS

2-1. GENERAL. The CONTRACTOR shall furnish complete variable frequency drive systems for installation by the Contractor. The CONTRACTOR is responsible for the start up of all VFD drives furnished on this project.

The Contractor shall be responsible for the erection and installation of all equipment defined in this section of the contract documents.

The variable frequency drive shall comply with the latest applicable standards of ANSI, NEMA, IEEE, and the National Electrical Code.

Variable frequency drive shall operate as specified on standby generators or normal power sources.

The CONTRACTOR shall provide a listing of all programmable parameters that are different

from the factory default values. For each indicate:

The factory default and meaning

The revised value and meaning

The CONTRACTOR shall provide a copy of PC compatible remote programming/ diagnostic software and any required cables to the supplier of the control system. Refer to Division 13. The software shall be able to communicate to the VFDs via an ethernet network connection.

Reduced Voltage Solid State Starter Bypass:

1. Reduced voltage starter shall be combination solid state motor controller with circuit breaker (Allen Bradley SMC Plus or Square D).
2. Starters shall be provided with isolation and full voltage bypass contactors with overloads. Selector switch shall be on WPCP inner door. AIC rating shall be 25,000 amps.
3. Motor starter shall have a 120-volt operating coil, overload relay in each phase and control power transformer.
4. Motor starter shall have 1-N.O. and 1-N.C. auxiliary contacts. Additional auxiliary contacts shall be furnished where shown on the Drawings or as required by the control scheme.
5. Overload relays shall be adjustable and manually reset by push button in compartment door. Replaceable individual overload relay heaters of the proper size shall be installed in each phase.
6. Control power transformer shall be sized for additional load where required. Transformer secondaries shall be equipped with time-delay fuses.
7. Motor circuit protector shall be molded case with adjustable magnetic trip only. They shall be specifically designed for use with solid state reduced voltage starters. Motor circuit protectors shall have auxiliary disconnect contacts when used with starters having external control circuits.
8. The following options shall be required:
 - Soft start
 - Soft stop
 - Protective module - line side of each starter

2-2. CONSTRUCTION. Each variable frequency drive shall consist of a 460V, 3-phase rectifier, DC link and variable frequency inverter with features, functions and options as specified. The inverter shall be voltage source design using pulse width modulation (PWM) techniques.

The variable frequency drives shall be rated for continuously operating at 1.15 times the full load current of the motor. The variable frequency drives shall be designed to provide continuous

speed adjustment of three-phase motors. The variable frequency output voltage shall provide constant volts-per-Hertz excitation to the motor terminals up to 60 Hertz.

Inverters shall be capable of converting incoming three phase, 460V (+10 to -10%) and 60 Hertz (+/-2) Hertz power to DC bus levels. The DC voltage shall be inverted to a variable frequency output.

Controllers shall be rated for an ambient temperature of 0°C to 40°C and humidity of 0 to 95% non-condensing.

VFDs shall have complete front accessibility. All VFD openings shall be filtered.

The following standard basic control features shall be provided on the inverter:

1. Field Hand-Off-Auto Switch.
 - HAND: This is a manual hand switch position. When this position is selected, the final control element or device will change state to “Run” or “On.”
 - OFF: This is a manual hand switch position. When this position is selected, the final control element or device will change state to “Off.”
 - AUTO (Manual Hand Switch): This is a manual hand switch position that is wired as an input to the PLC. When this position is selected, the final control element or device is controlled by the main plant PLC system.
2. Unidirectional operation, coast to rest upon stop.
3. Variable linear independent timed acceleration.
4. Variable torque performance from 4 to 60 Hertz.
5. All variable frequency drives shall be furnished with AC power line reactors or integral DC link reactor.
6. Frequency stability of 2% for 24 hours with voltage regulation of +2% of maximum rated output voltage.
7. LCD status indication for Power On, Run, Inverter Enable, Overcurrent, Overvoltage, Overtemperature, Low Supply, and Phase Loss.
8. 115V AC control power for operator devices.
9. Phase insensitive to input power.
10. Automatic restart upon return of power following a utility outage. Drive shall require manual reset after three (3) attempts in a 60 second period.

The following protective features shall be provided on the drive:

1. Input AC circuit breaker with an interlocked, pad lockable handle mechanism and AC input line current limiting fuses for fault current protection of AC to DC converter section and circuit breaker. Minimum short circuit rating of 65,000 AIC shall be provided.
2. Electronic overcurrent trip for instantaneous overload protection.
3. Undervoltage and phase loss protection of output.
4. Over-frequency protection.
5. Over-temperature protection.
6. Surge protection from input AC line transients.
7. Electrical isolation between the power and logic circuits, as well as between the 115V AC control power and the static digital sequencing.
8. Drive to be capable of withstanding output terminal line short or open circuits without component failure.
9. Output dv/dt protection filter to minimize dv/dt to acceptable levels at motor terminals.
10. Units shall have an English language (no codes) alphanumeric diagnostic display. LED indication of over frequency, instantaneous overcurrent, DC over voltage, AC undervoltage/loss-of-phase, emergency stop, overload, over temperature, inverter pole trip and standby modes shall be provided and door mounted. Additional door mounted status indicating LEDs for self-diagnostic including run, phase loss, micro-processor fault, as well as board mounted LEDs including one for each inverter pole gating signal, each inverter pole status and each logic level VDC used. A comprehensive microprocessor based digital diagnostic system which monitors its own control functions and displays faults and operating conditions is also approved.
11. Provide passive harmonic filtering to reduce harmonic distortion to required specified levels.

The following standard independent adjustments shall be provided on the inverter:

1. Minimum speed (12 to 54 HZ).
2. Maximum speed (40 to 60 HZ).
3. Acceleration time 6 to 60 Sec. (minimum).
4. Deceleration time 6 to 60 Sec. (minimum).
5. Volts per Hertz.
6. Stability adjustment, if required.

7. Voltage boost (100 to 600 percent of nominal V/Hz ratio at 1 Hz tapering to 100 percent at 20 Hz).

The following shall be furnished with each controller:

1. Isolated process instrument speed input signal of 4-20 mA DC.
2. Isolated process instrument speed output signal 4-20 mA DC.
3. Relay output auxiliary contacts as shown on the drawings or as required herein, in Division.
4. Door-mounted output load ammeter, voltmeter, and speed output indicating meters.
5. Built-in self diagnostics.
6. Relay output auxiliary contacts as shown on the drawings.
7. Local/Off/Remote and Start/Stop selector switches.
8. Input filter if required for IEEE519 compliance.
9. All openings in the VFD shall be filtered.
10. Supply an Ethernet connection to access operating parameters and data, power, temperature, voltages and currents to be polled by IFIX.

The Variable Frequency Drive shall allow Ethernet communications.

1. The embedded web server shall contain web-pages that provide the ability to configure, control, monitor and diagnose the AC drives via Internet Explorer. No additional software shall be required.
2. The embedded web-pages must be secured by use of a customizable User Name and Password.

The Ethernet Communications Card shall support the following services via the standard ethernet Port 502:

1. TCP/Modbus Client, with support for periodic I/O Scanning
2. HTTP Server for drive configuration, control, and monitoring.
3. ICMP client to support certain IP services such as the "ping" command.
4. BOOTP client to assign an IP Address via an address server.
5. FTP Server for modifying, deleting or creating embedded web pages

PART 3 - EXECUTION

3-1. INSTALLATION. Installation shall be in strict accordance with the manufacturer's instructions and recommendations in the locations shown on the Drawings. Field wiring shall be in accordance with manufacturer's recommendations. Anchor bolts shall be stainless steel and set in accordance with the manufacturer's recommendations. VFD motor leads shall be in rigid conduit. Each VFD shall have its own rigid conduit for its motor leads. Motor leads shall not be mixed with any other wiring. See VFD manufacturer's instruction manuals for detailed directions on installation of the VFD's and the installation of the motor leads.

3-2. SPARE PARTS. Contractor to include a \$5000.00 Allowance for the Owner to select spare parts from the manufacturers list of recommended spare parts. List to include all recommended spare parts with pricing.

3-3. SHOP PAINTING. Prior to shop painting, all surfaces shall be thoroughly cleaned, dry, and free from all mill/scale, rust, grease, dirt, and other foreign matter. Drives shall be shop painted.

3-4. TESTING. Tests and Check:

The drive manufacturer shall test the drive controller with a motor load prior to shipment. The motor shall have equal or greater full load current than the specified motor.

A certified copy of all tests and checks performed in the field, complete with meter readings and recordings, where applicable, shall be submitted to the Owner.

The SYSTEM SUPPLIER shall provide the services of a competent and experienced equipment manufacturer's factory field engineer to supervise start-up and provide training to the Owner's personnel. The factory field engineer shall be available for one (1) - eight (8) hour day to inspect the installed equipment and supervise the start-up demonstration and testing as specified in Section 01650: Start-up, and additional testing and training as specified herein. The factory field engineer shall be available for two (2) additional eight (8) hour days (a total of three (3) - eight (8) hour days) to provide factory and on-site training to the Owner's personnel as specified herein. Training of the Owner's personnel will only be considered valid for approval by the Engineer if it takes place after the successful start-up and demonstration test.

3-5. TRAINING. The cost of training programs to be conducted with Owner's personnel shall be included in the Contract price. The training and instruction, insofar as practicable, shall be directly related to the System being supplied. The Supplier shall provide \$3,000.00 worth of factory training. Classes to be selected by the Owner.

The Supplier shall provide classroom training detailed manuals to supplement the training courses. The manuals shall include specific details of equipment supplied and operations specific to the project.

The Supplier shall make use of teaching aids, manuals, slide/video presentations, etc. After the training services, such materials shall be delivered to Owner.

The training program shall represent a comprehensive program covering all aspects of the variable frequency drive and maintenance of the system.

All training schedules shall be coordinated with, and at the convenience of the Owner. Shift training may be required to correspond to the Owner's working schedule.

On-site Training: Additional on-site (field) training shall be conducted at the Owner's Plant Site and shall provide detailed hands-on instruction to Owner's personnel covering: system debugging, program modification, trouble-shooting, maintenance procedures, calibration procedures, and system operation. On site training for general plant staff shall be conducted over a period of one day.

3-6. START UP SERVICES. The supplier shall provide start up services for the VFDs to the Contractor. A minimum of two days and two trips shall be provided.

END OF SECTION

SECTION 16450

GROUNDING SYSTEM

PART 1 – GENERAL

1-1. SCOPE OF WORK. Furnish and install a complete grounding system in strict accordance with Article 250 of the National Electrical Code and as hereinafter specified and shown on the Drawings.

1-2. RELATED WORK

Wire shall be as specified under Section 16120.

Conduit shall be as specified under Section 16110.

Motors shall be grounded as specified in Section 16150, Motors.

PART 2 – PRODUCTS

2-1. MATERIALS. Ground rods: Ground rods shall be copperclad steel 5/8-inch x 30 foot. Ground rods shall be Copperweld or be an approved equal product.

PART 3 – EXECUTION

3-1. GENERAL. The service entrance equipment ground bus shall be grounded to the ground grid and to the building steel. The protecting conduits shall be bonded to the grounding conductor at both ends.

Ground bus in switchboard shall be connected to the service entrance equipment ground bus.

All steel building columns shall be bonded together and connected to the building ground grid and to the service entrance ground with a copper conductor.

Conduits stubbed-up below electrical equipment shall be fitted with insulated grounding bushings. The grounding wire shall, unless otherwise indicated on the drawings, be sized in accordance with the National Electrical Code, except that a minimum No. 12 AWG shall be used.

Lighting transformer neutrals shall be grounded to a grounding electrode and the service entrance ground.

Grounding electrodes shall be driven as required. Where rock is encountered, grounding plates may be used in lieu of grounding rods.

All equipment enclosures, motor and transformer frames, conduits systems, cable armor, exposed structural steel and similar items shall be grounded.

Exposed connections shall be made by means of approved grounding clamps. Exposed connections between different metals shall be sealed with No-Oxide Paint Grade A or approved

equal. All buried connections shall be made by welding process equal to Cadweld.

For reasons of mechanical strength, grounding conductors extending from the grounding grid to the ground buses of switchboard shall be as shown on the contract drawings.

The grounding grid conductors shall be embedded in backfill material around the structures.

In addition to above artificial grounds, one ground conductor shall be connected to water piping system with approved water pipe type strap connector.

All underground conductors shall be laid slack and where exposed to mechanical injury shall be protected by pipes or other substantial guards. If guards are iron pipe or other magnetic material, conductors shall be electrically connected to both ends of the guard.

The CONTRACTOR shall exercise care to insure good ground continuity, in particular between the conduit system and equipment frames and enclosures. Where necessary, jumper wires shall be installed.

3-2. TESTS. The CONTRACTOR shall test the ground resistance of the system. All test equipment shall be provided by the CONTRACTOR and approved by the ENGINEER. Submit copy of test results in PDF format for OWNER's records. Dry season resistance of the system shall not exceed 5 ohms. If such resistance cannot be obtained with the system as shown, the CONTRACTOR shall provide additional grounding as directed by the ENGINEER, without additional payment.

The CONTRACTOR shall submit all grounding system test results to the ENGINEER for review. Submit copy of test results in paper and PDF format for OWNER's records.

END OF SECTION

Section 16482

600 VOLT CLASS MOTOR CONTROL CENTERS

PART 1 - GENERAL

1-1. SCOPE. This section covers motor control center (MCC) equipment which shall be furnished and installed as specified herein and as indicated on the drawings. Motor control centers shall meet the following requirements, and the design conditions and features specified herein.

Motor control centers shall be designated and shall be located as follows:

Tag number(s)	MCC-7 MCC-8
Location of motor control center(s)	Well House No. 7 Well House No. 8

1-2. GENERAL. Equipment furnished and installed under this section shall be fabricated, assembled, erected, and placed in proper operating condition in full conformity with the drawings, specifications, engineering data, instructions, and recommendations of the equipment manufacturer, unless Engineer notes exceptions.

1-2.01. General Equipment Stipulations. The General Equipment Stipulations shall apply to all equipment furnished under this section. If requirements in this specification differ from those in the General Equipment Stipulations, the requirements specified herein shall take precedence.

1-2.02. Dimensional Restrictions. Layout dimensions will vary between manufacturers and the layout area indicated on the drawings is based on typical values. The supplier shall review the contract drawings, the manufacturer's layout drawings and installation requirements, and make any modifications required for proper installation subject to acceptance by Engineer.

1-2.03. Workmanship and Materials. Equipment supplier shall guarantee all equipment against faulty or inadequate design, improper assembly or erection, defective workmanship or materials, and leakage, breakage, or other failure. Materials shall be suitable for service conditions.

All equipment shall be designed, fabricated, and assembled in accordance with applicable governing standards. Individual parts shall be manufactured to standard sizes and thicknesses so that repair parts, furnished at any time, can be installed in the field. Like parts of duplicate units shall be interchangeable. Equipment shall not have been in service at any time prior to delivery, except when required by tests.

1-2.04. Governing Standards. All equipment furnished under this section shall be designed, constructed, and tested in accordance with NEMA ICS 18 and UL 845.

Equipment covered by this section shall be listed by UL or a nationally recognized third-party testing laboratory. All costs associated with obtaining the listing shall be the responsibility of the Contractor. In the event, no third-party testing laboratory provides the required listing; an independent test shall be performed at the Contractor's expense. Before testing, the Contractor shall submit a copy of the testing procedure that will be used in evaluating the equipment.

1-2.05. Nameplates. Nameplates with unit description and designation of each control or indicating device shall be provided on all hinged doors. Nameplates shall be black and white laminated phenolic material of suitable size, and shall be engraved with 3/8 inch [10 mm] high letters for compartment identity and 3/16 inch [5 mm] letters for other information. The engraving shall extend through the black exterior lamination to the white center.

Each control device and each control wire terminal block connection inside the units shall be identified with permanent nameplates or painted legends to match the identification on the manufacturer's wiring diagram.

1-2.06. System Characteristics. This equipment will be connected to a power system with characteristics as specified below.

Voltage	480 V
Frequency	60 Hz
Type	Three phase

1-3. SUBMITTALS.

1-3.01. Drawings and Data. Complete assembly, foundation, and installation drawings, together with complete engineering data covering the materials used, parts, devices, and accessories forming a part of the motor control center shall be submitted in accordance with the submittals section. The drawings and data shall include, but shall not be limited to, the following:

Motor Control Center

Elevation, plans, and weight.

Unit wiring diagrams showing devices, connections, and terminal designations.

Interconnection diagrams.

Control schematic diagrams.

Circuit breaker time-current characteristic curves.

Transient voltage surge suppressor submittals shall include drawings (including unit dimensions, weights, component and connection locations, mounting provisions, and wiring diagrams), equipment manuals that detail the installation, operation and maintenance instructions for the specified unit(s), and manufacturer's descriptive bulletins and product sheets.

Where it is not explicitly shown and completely obvious from the outline drawings the following items shall be verified in a written statement accompanying the shop drawings: type of terminal blocks used and that the removal of plug-in compartments can be performed without disconnecting or removing wires, silver or tin plating of bus, insulation and isolation of vertical bus, U.L. approval.

1-3.02. Operation and Maintenance Data and Manuals. Adequate operation and maintenance information shall be supplied as required in the Submittals section. Operation and maintenance manuals shall be submitted in accordance with the Submittals section. The operation and maintenance manuals shall be in addition to any instructions or parts lists packed with or attached to the equipment when delivered.

1-4. SPARE PARTS. Spare parts shall be suitably packaged, as specified herein, with labels indicating the contents of each package. Spare parts shall be delivered to Owner as directed. Spare parts shall be provided as follows:

<u>Spare Parts</u>	<u>Quantity</u>
Indicating lamps	100% replacement set
Power fuses of each size furnished	One (1) box
Starter contacts for each NEMA size installed	One (1) set
Starter coil for each NEMA size installed	One (1)
Spare breakers for each type used	Two (2)
Motor circuit protectors/starters, each type used	Two (2)

1-5. COORDINATION STUDY. A coordination study of the power distribution system will be conducted in accordance with the Electrical section. The initial equipment drawing submittal shall include the circuit breaker coordination curves for the main breaker(s), the tie breaker, the largest circuit breaker utilized in a combination starter and the smallest circuit breaker provided as a part of the motor control center assembly.

1-6. DELIVERY, STORAGE, AND HANDLING. Shipping shall be in accordance with the Shipping section. Handling and Storage shall be in accordance with the Handling and Storage section.

Motor control centers shall be equipped to be handled by a crane. Where cranes are not available, control centers shall be suitable for skidding in place on rollers using jacks to raise and lower the groups.

1-7. RELATED WORK.

Lighting Panels are included in Section 16160.

Dry type lighting transformers are included in Section 16108.

PART 2 - PRODUCTS

2-1. ACCEPTABLE MANUFACTURERS. The equipment shall be manufactured by Allen-Bradley, Cutler-Hammer, General Electric, or Square D, without exception.

2-2. CONSTRUCTION. Each control center shall conform to the arrangement, one-line diagram, schematics, and requirements indicated on the drawings or specified herein.

Motor control center wiring shall be NEMA Class IIS and NEMA Type B. Construction shall be as specified below.

Tag number(s)	MCC-7	MCC-8
Bus bracing and combination motor starter rating	65,000 A	65,000 A
Horizontal bus rating	600 A	600 A
Service entrance rated	No	No
Cable entry	Bottom	Bottom
Enclosure type	NEMA Type 1 gasketed	NEMA Type 1 gasketed
Main TVSS exposure level	Medium-high	Medium-high

2-2.01. Outdoor Enclosures. Not used.

2-2.02. Vertical Sections. The control center shall consist of standardized, freestanding structures bolted together to form a single dead-front panel assembly containing combination motor control units; feeder units; transformers; lighting panels; and metering, relaying, and interlocking, and miscellaneous control devices, as indicated on the drawings. A removable lifting angle shall be mounted on the top of each shipping group. Removable front and rear bottom channel sills shall extend the full width of the motor control center.

Each vertical section shall be 90 inches [2250 mm] high and not less than 20 inches [500 mm] wide. Sections shall be 20 inches [500 mm] deep. Each 20 inch wide standard section shall have all necessary hardware and busing for modular plug-in units to be added and moved around. All unused space shall be covered by hinged blank doors and equipped to accept future units. Removable rear plates shall be sectionalized so that it is unnecessary to handle any plate larger than the section width or one-half the section height.

A metal barrier extending the full height and depth of the section shall be provided to isolate each section from the next section.

2-2.03. Compartmented Units. Each vertical section shall be constructed of modular components of various sizes. The modular components shall be designed to accommodate not more than six Size 1 or Size 2 full voltage combination motor starters per vertical section.

Removable circuit breaker and motor starter units shall be provided with a mechanical interlock to prevent insertion or withdrawal when in the "on" position.

Individual motor starter units, feeder breaker units, transformers, lighting panels, and control device compartments shall be isolated from each other by barriers of metal or a suitable insulating material.

Each vertical section shall have a vertical-wiring trough for power and control wiring, and wiring troughs on top and bottom, which are continuous through the entire control center. Wire ties shall be provided in the vertical wireways unless the wireways are separated from the plug-in units by a permanent wall.

2-2.04. Wiring Labels and Terminal Blocks. All internal wires shall be labeled at each termination. Terminals shall also be identified with labels showing the terminal block and terminal number.

All starter units shall be provided with unit control terminal blocks. Terminal blocks shall be pull-apart type rated 20 amperes. All current carrying parts shall be tin-plated. The removable portion of the terminal blocks shall be used for factory installed wiring.

2-2.05. Busing. The horizontal main bus and the vertical bus extensions shall be tin-plated copper mounted on supports formed of materials having high dielectric strength, low moisture absorbency, and high impact strength. The main bus shall extend the full length of the motor control center and shall have provisions for splicing additional sections onto either end. Both horizontal and vertical busing shall be braced against forces resulting from fault current.

The vertical bus connecting an incoming power feeder cable shall have the same ampere rating as the main horizontal bus. Each vertical bus extension shall be rated for the total connected load of the vertical section.

A tin-plated copper ground bus rated 300 amperes shall extend through the entire control center and shall be located where it will not interfere with pulling of external cable. Grounding connections shall be accessible from the front. The ground bus shall be provided with six 0.38 inch [10 mm] holes for each vertical section to accept ground lugs for any loads requiring a ground conductor. A solderless connector shall be provided on the ground bus in each end section for an external ground cable, sized from 1/0 AWG to 250 kcmil [50 to 120 mm²].

Each vertical section shall have a vertical ground bus. The plug-in units shall engage the ground bus prior to engagement of the power stabs and shall disengage only after the power stabs are disconnected.

A 1/1-inch x 2-inch ground bus shall be furnished the entire length of the motor control centers.

All buses except neutral and ground buses shall be completely isolated by steel plates or insulating material.

The buses shall be sized for a maximum current density of 1000 amperes per square inch.

2-2.05.01. Neutral Bus. Not used.

2-2.05.02. Neutral Pad. Not used.

2-2.06. Isolation of Buses. The main bus shall be isolated from the horizontal wiring trough. The entire vertical bus assembly shall be enclosed within grounded steel or glass filled polyester barriers. The barriers shall have openings for power stabs of plug-in units. Shutters shall be provided to close the openings when units are removed.

2-2.07. Combination Magnetic Starters. As indicated on the drawings, control center starters shall be breaker combination, magnetic, reduced voltage, or across-the-line type as follows:

- a. Starters shall be 3 phase, 60 Hz contactors with overloads, a 120 volts ac coil, a dry type control transformer, and a molded-case circuit breaker. Control transformers shall be mounted with the removable starters and shall have capacity for all simultaneous loads. Control transformers shall have both primary leads fused, one secondary lead fused, and one secondary lead grounded.
- b. Contactors shall be NEMA rated and have an 8 hour current rating in accordance with the latest NEMA standards. Contactors of reversing or multispeed starters shall be mechanically and electrically interlocked.
- c. One NO and one NC spare interlock contacts, whether on the starter or a relay, shall be wired separately to the unit terminal board.
- d. A 3 phase ambient-compensated bimetallic style thermal overload relay with external manual reset shall be furnished with each starter.
- e. An external manual breaker operating handle with provisions for up to three padlocks shall be provided on each starter. The access door shall be interlocked with the circuit breaker so that the door cannot be opened, except by an interlock override, while the breaker is closed.

- f. Contractor shall match control transformers, overloads, heaters, and minimum sizes of starters to equipment furnished, which may differ from the estimated values indicated on the drawings. Overload relay elements shall be sized to reflect reduced motor current caused by load-side power factor correction capacitors.
- g. Unless otherwise specified, spare starters shall have breakers and overloads sized for the largest rated motor and 100 watts extra transformer capacity.
- h. Full voltage, non-reversing starters, NEMA size 4 and smaller shall be of plug-in design with stab-on connectors engaging the vertical buses. Larger units shall be of fixed design.
- i. Overload relays shall be adjustable and manually reset by push button in compartment door. Replaceable individual overload relay heaters of the proper size shall be installed in each phase.
- j. Control power transformers shall be sized for additional load where required. Transformer secondaries shall be equipped with time-delay fuses.
- k. Motor circuit protectors shall be molded case with adjustable magnetic trip only. They shall be specifically designed for use with magnetic motor starters. Motor circuit protectors shall have auxiliary disconnect contacts when used with starters having external control circuits.

2-2.08. Combination Solid-State Starters. As indicated on the drawings, control center starters shall be breaker combination, solid-state, reduced voltage type. Six back-to-back silicon controlled rectifiers shall be used to provide smooth, stepless motor acceleration. When the motor reaches full speed, a bypass contactor shall close and carry the continuous duty motor current.

- a. Starters shall be 3 phase, 60 Hz, with overloads, a 120 volts ac bypass contactor coil, a dry-type control transformer, and a molded-case circuit breaker. Control transformers shall be mounted with the removable starters and shall have capacity for all simultaneous loads. Control transformers shall have both primary leads fused, one secondary lead fused, and one secondary lead grounded.
- b. The bypass contactor shall have an 8 hour current rating in accordance with the latest NEMA standards.
- c. One NO and one NC spare interlock contacts, whether on the starter or on a relay, shall be wired separately to the unit terminal board.
- d. Starters shall include smooth starting and stopping, adjustable starting torque, adjustable ramp time, inverse time overload current trip, current limit, phase loss protection, and adjustable electronic overloads.

- e. An external manual breaker operating handle with provisions for up to three padlocks shall be provided on each starter. The access door shall be interlocked with the circuit breaker so that the door cannot be opened, except by an interlock override, while the breaker is closed.
- f. Contractor shall match control transformers, overloads, and the minimum sizes of starters to equipment furnished, which may differ from the estimated values indicated on the drawings. Overload relay devices shall be adjusted to reflect reduced motor current caused by load-side power factor correction capacitors.
- g. Unless otherwise specified, spare starters shall have breakers and overloads sized for the largest rated motor and 100 watts extra transformer capacity.
- h. Starters shall include an auxiliary contactor for connection to a line-side power factor correction capacitor. The contactor shall be interlocked to prevent the capacitor from being connected before the bypass contactor has energized.
- i. Reduced-voltage starters shall be auto-transformer type with closed circuit transition. Auto-transformers shall be dry type with 50, 65 and 80 percent voltage taps. Auto-transformers shall have over-temperature protection. Timing relays shall be pneumatic, adjustable.
- j. Overload relays shall be adjustable and manually reset by push button in compartment door. Replaceable individual overload relay heaters of the proper size shall be installed in each phase.
- k. Control power transformers shall be sized for additional load where required. Transformer secondaries shall be equipped with time-delay fuses.
- l. Motor circuit protectors shall be molded case with adjustable magnetic trip only. They shall be specifically designed for use with magnetic motor starters. Motor circuit protectors shall have auxiliary disconnect contacts when used with starters having external control circuits.

2-2.09. Adjustable Frequency Drives. Not used.

2-2.10. Contactors. Contactors for control of bus voltage loads other than motors shall be the same as contactors for combination magnetic starters, except overloads will not be required. Mechanically held contactors shall have 120 volts ac coils with disconnecting contacts. Other contactors shall have 120 volt, continuous duty coils and contacts where indicated on the drawings.

2-2.11. Relays and Timers. Auxiliary relays and timers shall have 120 volt, 60 Hz coils for continuous duty in 40°C ambient, and 10 ampere, 120 volts ac contacts. Auxiliary relays shall be NEMA rated.

2-2.12. Control Switches and Pilot Lights. Control switches and pilot lights shall be 30.5 mm heavy-duty, oiltight construction. Pilot lights shall be full voltage type with LED lamps.

2-2.13. Motor Current Sensor Relays. Motor current sensor relays shall be provided and installed as indicated on the drawings.

2-2.14. Circuit Breakers. Control center disconnects shall be three pole, single-throw, 600 volt, molded-case air circuit breakers. Circuit breakers of combination starters shall be magnetic motor circuit protector type. Feeder circuit breakers shall be thermal-magnetic type and shall be manually operated, with quick-make, quick-break, trip-free toggle mechanism. Bimetallic thermal elements shall withstand sustained overloads and short-circuit currents without injury and without affecting calibration. Thermal elements shall trip the breaker at 125 percent of trip rating. The instantaneous elements of 225 ampere frame and larger breakers shall be adjustable and shall be set at 800 percent of trip rating. Circuit breakers shall be rated for 65,000 amperes, RMS interrupting capacity.

Main circuit breakers and feeder circuit breakers 225 amperes and larger shall be furnished with a solid-state trip unit complete with built-in current transformers. The ampere rating of the trip unit shall be as indicated on the drawings. The trip unit shall have adjustable settings for continuous amperes, and short-time pickup. The trip unit shall be provided with additional short delay trip time adjustment for better system coordination. Where indicated on the drawings, main circuit breakers shall be provided with instantaneous pickup and integral ground fault protection with shunt trip devices.

2-2.15 Transient Voltage Surge Suppression.

2-2.15.01. Scope. Transient voltage surge suppression (TVSS) devices shall be provided as specified herein and as indicated on the drawings. Each unit shall be designed for parallel connection to the facility's wiring system and shall utilize non-linear voltage-dependent metal oxide varistors (MOV) in parallel.

TVSS devices shall be furnished and installed for the electrical equipment indicated on the drawings and designated in this section and as specified herein. TVSS devices shall be installed integral to each MCC and MCC panelboard.

2-2.15.02. Standards. The specified unit shall be designed, manufactured, tested and installed in compliance with the following standards:

ANSI/IEEE C62.41-1991 and C62.45-1992;

ANSI/IEEE C62.1 and C62.11;

National Electrical Manufacturers Association (NEMA LS1-1992 Guidelines);

National Fire Protection Association (NFPA 20, 70 [NEC], 75, and 78);

Underwriters Laboratories UL 1449 Second Edition and 1283

The unit shall be UL 1449 Second Edition Listed as a Transient Voltage Surge Suppressor and UL 1283 Listed as an Electromagnetic Interference (EMI) Filter.

2-2.15.03. Environmental Requirements.

- a. Operating Temperature: -40°F to +140°F [-40°C to +60°C].
- b. Relative Humidity: Reliable operation with 5 percent to 95 percent non-condensing.

2-2.15.04. Electrical Requirements.

- a. Unit Operating Voltage. The nominal unit operating voltage and configuration shall be as indicated on the drawings.
- b. Maximum Continuous Operating Voltage (MCOV). The TVSS device shall be designed to withstand a MCOV of not less than 115 percent of nominal RMS voltage.
- c. Operating Frequency. Operating frequency range shall be 47 to 63 Hertz.
- d. Protection Modes. All protected modes are defined per NEMA LS-1-1992, paragraph 2.2.7. Following IEEE Standard 1100-1992, section 9.11.2 recommendations, Four-wire configured systems shall provide Line-to-Neutral (L-N), Line-to-Ground (L-G), Line-to-Line (L-L), and Neutral-to-Ground (N-G) protection. Three-wire configured systems shall provide Line-to-Line (L-L) protection and Line-to-Ground (L-G) protection.
- e. Rated Single Pulse Surge Current Capacity. The rated single pulse surge current capacity, in amps, for each mode of protection of the unit shall be as required and shall be no less than listed in the following table. Lighting panels shall be rated for the low exposure level capacity unless otherwise noted.

	L-N	L-G	N-G	L-L
High Exposure Level	120 kA	120 kA	120 kA	120 kA
Medium-High Exposure Level	100 kA	100 kA	100 kA	100 kA
Medium Exposure Level	80 kA	80 kA	80 kA	80 kA
Low Exposure Level	60 kA	60 kA	40 kA	60 kA

- f. UL 1449 Second Edition Suppression Voltage Rating (SVR). The maximum SVR for the device (inclusive of disconnect) shall be as required and shall not exceed the following:

Voltage	L-N	L-G	N-G	L-L
120/208 3-phase	500 V	500 V	500 V	800 V
480 V 3W		1500 V		1800 V

- g. Noise Attenuation. EMI noise rejection or attenuation values shall be measured in accordance with test and evaluation procedures outlined in NEMA LS-1-1992. The unit shall be capable of a minimum -40 dB

- attenuation at 100kHz when tested per the 50 ohm insertion loss method as defined by MIL-STD-220A.
- h. Minimum Repetitive Surge Current Capacity. The minimum number of repetitive surges per mode as a result of testing a 20 kV, 10kA ANSI/IEEE C62.41 Category C3 surge current with less than a 10 percent degradation of clamping voltage shall be as follows:
 - For MCCs: 5,000
 - For lighting panels: 3,500
 - i. Overcurrent Protection. At high and medium-high exposure levels, the TVSS device shall incorporate internal fusing capable of interrupting, at minimum, up to 200kA symmetrical fault current with 600 volts ac applied. At medium and low exposure levels, the TVSS device shall incorporate internal fusing capable of interrupting, at minimum, up to 65kA symmetrical fault current with 600 volts ac applied. The device shall be capable of allowing passage of the rated maximum surge current for every mode without fuse operation.
 - j. Unit Status Indicators. The unit shall include long-life, externally visible phase indicators that monitor the on-line status of the unit.

2-2.15.05. Warranty. The manufacturer shall provide a minimum Five Year Limited Warranty from date of shipment against failure when installed in compliance with applicable national/local electrical codes and the manufacturer's installation, operation and maintenance instructions.

2-2.15.06. Installation. The TVSS devices shall be installed according to the manufacturer's recommendations. If possible for the integral units, provide direct bus connections.

2-2.15.07. Options.

- a. Disconnect Switch. Each TVSS device shall be furnished with an integral disconnect switch. The unit shall be UL1449 Second Edition listed as such, and the UL1449 Second Edition Suppression Voltage Ratings shall be provided. The disconnect switch shall be fused and capable of withstanding the published maximum surge current magnitude without failure or damage to the switch.
- b. Dual Form "C" Dry Contacts. Not used.

2-2.16. Incoming Line Metering Compartment. The incoming line section(s) shall be provided with a microprocessor-based, digital power meter as shown on drawings. Current transformers and potential transformers shall be provided for input of current and voltage signals to the metering package. Currents, voltages, active power, reactive power, power factor, watt-hours, frequency, and demand values shall be available for display. Total harmonic distortion waveforms shall also be available. The following alarm features shall be provided: undervoltage, power factor leading or lagging, kVAR limit, voltage sequence reversal, under frequency, and overcurrent. The metering package shall be capable of RS 485 serial communication for remote monitoring. The digital power meters shall be Allen-Bradley "Power

Monitor II”, Cutler-Hammer "IQ Analyzer", Multilin “PQM”, or Square D “PowerLogic Model CM3350”.

Sufficient lengths of communication cable shall be provided for connection of metering units within the motor control center and as indicated on the drawings.

The metering package shall be compatible with the metering system software and metering system network as specified in the Electrical section. Contractor shall furnish and install applications software for origination and display of all metering unit data and microprocessor-based trip-unit data in accordance with the Electrical section.

The unit shall have two isolated 4-20 mA selectable outputs.

2-2.17. Miscellaneous. Other items indicated on the drawings shall conform to the applicable provisions of NEMA ICS 2 and UL 845.

2-2.18. Lighting Transformers. Lighting and auxiliary power transformers shall be dry type, with at least two full capacity taps.

2-2.19. Panelboards. Panelboards shall have a main circuit breaker, buses, bolted thermal-magnetic breakers, and provisions for breakers in the sizes, quantities, and poles indicated on the drawings. Breakers indicated to be multiple pole shall be common trip. Circuit breakers shall be fully rated, with an interrupting rating of at least 10,000 amperes, and shall be coordinated with the control center short-circuit rating. Each panel shall be provided with a typewritten directory listing the load identities of all circuits. Six breaker handle clips shall be provided to prevent casual tripping. Panelboards shall be 120/208 V, 3-phase.

Lighting panels shall have TVSS devices rated for a low exposure levels.

2-2.20. Special Panels. Not used.

2-2.21. Shop Painting. All iron and steel surfaces, except stainless steel and machined surfaces, shall be plated or shop painted with the manufacturer's standard coating. Finish color for both indoor and outdoor equipment shall be ANSI 61. Field painting, other than touchup painting, will not be required. A sufficient quantity of additional coating material and thinner shall be furnished to permit field touchup of damaged coatings.

2-2.22. Space Heaters. Not used.

2-2.23. Signage. Each motor control center shall be furnished with a sign marked "DANGER - HIGH VOLTAGE." Letters shall be not less than 1-inch high, 1/4-inch stroke. Signs shall be laminated plastic, engraved red letters with a white background.

All compartments with voltages from sources outside of the compartment, not disconnected by the motor circuit protector, shall have a sign on the compartment door marked "CAUTION - THIS UNIT CONTAINS A VOLTAGE FROM A SOURCE OUTSIDE OF THIS UNIT."

Letters shall be black on a high visibility yellow background. Background shall be laminated plastic approximately 3 inches x 5 inches.

2-2.24. Running Time Meters (Hour Meter). Running time meters shall be 3-1/2-inch square case; non-reset, 99,999.9 hour range; Type 246 Series as manufactured by Yokogawa or equal.

2-2.25. Instrument Transformers. Instrument transformers shall be indoor, 600-volt, butyl-rubber molded, metering class designed in accordance with ANSI and NEMA standards.

2-3. SHOP TESTS. The complete control center shall be tested at the factory. All circuits, including power and control, shall be given dielectric tests in accordance with NEMA ICS 2-322.

PART 3 - EXECUTION

3-1. INSTALLATION. Installation will be in accordance with the Electrical Equipment Installation section.

3-2. FIELD QUALITY CONTROL.

3-2.01. Installation Check. An experienced, competent, and authorized representative of the manufacturer shall visit the site of the Work and inspect, check, adjust if necessary, and approve the equipment installation. The representative shall be present when the equipment is placed in operation in accordance with Startup Requirements section, and shall revisit the job site as often as necessary until all trouble is corrected and the equipment installation and operation are satisfactory in the opinion of Engineer.

The manufacturer's representative shall furnish a written report certifying that the equipment has been properly installed and lubricated; is in accurate alignment; is free from any undue stress imposed by connecting piping or anchor bolts; and has been operated under full load conditions and that it operated satisfactorily.

All costs for these services shall be included in the contract price.

3-2.02. Installation Supervision. Installation supervision by the manufacturer is not required.

3-3. TEST AND CHECKS. The following minimum tests and checks shall be made after the assembly of the motor control centers, but prior to the termination of any field wiring.

Megger terminals and buses after disconnecting devices sensitive to megger voltage.

A 1,000 VDC megger shall be used for these tests.

The first test shall be made with main circuit breaker closed and all remaining breakers open. A second test shall be made with all circuit breakers closed.

The test results shall be recorded and forwarded to the Engineer for his review. Minimum megger readings shall be 100 megohms in both tests.

The following shall be done before energizing the motor control centers.

Remove all current transformer shunts after completing the secondary circuit.

Install overload relay heaters based on actual motor nameplate current. If capacitors are installed between starter and motor, use overload relay heaters based on measured motor current.

Check all mechanical interlocks for proper operation.

Vacuum clean all interior equipment.

End of Section

SECTION 16500

LIGHTING SYSTEMS

PART 1 – GENERAL

1-1. SCOPE OF WORK. Furnish and install complete lighting systems including panelboards, transformers, lighting fixtures, receptacles, switches, CONTRACTORS, clocks and all necessary accessories and appurtenances required as hereinafter specified and shown on the Drawings.

1-2. STANDARDS. All lighting fixtures shall be in accordance with the National Electrical Code and shall be constructed in accordance with the latest edition of the Underwriters Laboratories "Standards for Safety, Electric Lighting Fixtures." All lighting fixtures shall be Underwriters Laboratories labeled.

1-3. RELATED WORK

Panelboards shall be as specified under Section 16160.

Conduit shall be as specified under Section 16110.

Wire shall be as specified under Section 16120.

Transformers shall be specified under Section 16108.

PART 2 – PRODUCTS

2-1. MATERIALS

2-1.01. Switches. Wall switches shall be of the indicating, toggle action, flush mounting quiet type. All switches shall conform to Federal Specification W-S-896-D.

Wall switches shall be of the following types and manufacturer or approved equal.

- (1) Single pole - Arrow-Hart or Leviton Model# 1221.
- (2) Timer Switch – Intermatic Model# FF60MHC
- (3) Single pole, key operated - Arrow-Hart or Leviton Model#1221L.
- (4) Momentary contact, 2 circuit, center off - Arrow-Hart or Leviton. Model #1262

2-1.02 Receptacles. Wall receptacles shall be of the following types and manufacturer or approved equal.

- (1) Single, 20A, 125V, 1P, 3W; Arrow-Hart or Leviton. Model# 5361
- (2) Duplex, 20A, 125V, 2P, 3W; Arrow-Hart or Leviton. Model# 5362

- (3) Weatherproof Cover; Arrow-Hart or Leviton and Crouse-Hinds or Leviton. Model# 5978-DGY
- (4) Corrosion-resistant, duplex, 20A, 125V, 2P, 3W; Arrow-Hart or Leviton and Crouse-Hinds cover. Model# 53CM-62
- (5) Ground fault interrupter, duplex, 20A, 125V, 3P, 2W; Arrow-Hart or Leviton. Model# 8898
- (6) Stainless steel indoor mounting plate for G.F.I. receptacle; Arrow-Hart or Leviton Model# 84401-40.
- (7) Weatherproof cover for G.F.I. receptacle in FS box; Arrow-Hart or Leviton. Model# 5996 DGY
- (8) Single, 20A, 250V, 2P, 3W; Arrow-Hart or Leviton. Model# 5461

2-2. DEVICE PLATES. Plates for flush mounted devices shall be of the required number of gangs for the application involved and shall be 302 (18-8) high nickel stainless steel of the same manufacturer as the device.

Plates for surface mounted device boxes shall be of the same material as the box.

2-3. LIGHTING FIXTURES. Lighting fixture types shall be as shown on the "Lighting Fixture Schedule" on the Drawings. See below listing of manufacturers. The catalog numbers listed are given as a guide to the design and quality of fixture desired. Equivalent designs and equal quality fixtures of other manufacturers will be reviewed. Photometric evaluation shall be submitted in order for ENGINEER to consider equivalency.

2-4. LAMPS

- a. All light fixture lamps shall be LED.
- b. All lamps shall be of one manufacturer and shall be as manufactured by Hubble Lighting, Sesco Lighting, Sylvania Electric Products, Inc., General Electric Company, or Westinghouse Electric Corporation or approved equal.

2-5. Lighting Contactor. Lighting contactor shall be of the electrically operated, mechanically held type in NEMA 1 enclosures of the number of poles as called for on the Drawings. Contactors shall be rated for 30A-600 volt contacts and be similar and equal to Automatic Switch Company bulletin 1255-166 RC.

2-6. Photocell: Photocell shall be Tork 2101 or equal.

PART 3 – EXECUTION

3-1. INSTALLATION. Each fixture shall be a completely finished unit with all components, mounting and/or hanging devices necessary, for the proper installation of the particular fixture in its designated location and shall be completely wired ready for connection to the branch circuit wires at the outlet.

When fixtures are noted to be installed flush, they shall be complete with the proper accessories for installing in the particular ceiling involved. All flush mounted fixtures shall be supported from the structure and shall not be dependent on the hung ceilings for their support.

Flexible fixture hangers shall be used for all pendant mounted fixtures.

Receptacles shall be mounted 36 inches above the floor unless otherwise noted on the Drawings.

3-2. SPARE LAMPS. Spare lamps shall be provided for all fixture types supplied. Quantity shall be 15 percent of total used on project.

3-3. CLEAN UP. All fixtures shall be left in a clean condition, free of dirt and defects, before acceptance by the ENGINEER.

END OF SECTION

SECTION 16670

LIGHTNING PROTECTION SYSTEM

PART 1 – GENERAL

1-1. SCOPE OF WORK. A Lightning Protection System shall be provided and installed for all structures greater than five (5) feet above grade level. The system shall be provided and installed in compliance with provisions of Code for Lightning Protection Systems as adopted by the National Fire Protection Association and Lightning Protection Institute. All equipment to that result shall be included whether or not specifically called for herein. Installers shall be LPI (Lightning Protection Institute) certified, master and Journeyman in accordance with LPI standards or of equal qualifications as approved by ENGINEER. A LPI label and a UL Master label for the system shall be required.

Material shall comply in weight, size and composition with the requirements of the Lightning Protection Institute and the National Fire Protection Code relating to this type of installation, and shall be LPI labeled.

All materials, where available by any one manufacturer, shall be cast. All bolts shall have hexagonal heads; no screw heads will be permitted.

Lightning protection cable shall be Class I copper. Grounding counterpoise shall be as shown. Fittings and straps shall be cast copper.

1-2. SUBMITTALS. Shop Drawings: Shop drawings shall be submitted before work is done. Drawings shall include full layout of cabling and points, and connections.

Product Data: Product Data shall be submitted on all equipment to show compliance with this section of the specifications and shall include manufacturer's written recommendations for installation.

PART 2 – PRODUCTS

2-1. AIR TERMINALS. Air terminals shall be copper as required to match roof conductors, and shall have proper base support for surface on which they are attached, and shall be securely anchored to this surface. Terminals shall project a minimum of 10" above top of object to which attached.

2-2. CONDUCTORS. Roof conductors shall consist of copper complying with the weight and construction requirements of the Code, and shall be coursed to interconnect with air terminals, and in general, provide a two-way minimum path to ground. The angle of any turn shall not exceed 90 degrees, and shall provide an approximately horizontal or downward course. Down conductors shall be copper, concealed within the structure. Radius of bends shall not be less than 8 inches. Roof conductor material shall match and/or be compatible with roof flashing material.

2-3. FASTENER. Conductor fasteners shall be of the same material as the conductor, having ample strength to support conductor. Where fasteners are to be mounted in masonry or structural work, they shall be furnished to the Masonry or Structural CONTRACTOR so they may be installed during construction of the project.

2-4. GROUND CONNECTIONS. Ground connections shall be made in accordance with requirements of all applicable codes. Ground rods shall be placed in a minimum of two (2) feet from building foundations. The down conductors shall be connected to the building ground grid. All ground rods shall be 5/8" diameter, with a minimum length of 30' cadweld type. Each installed ground rod shall be checked for resistance to ground. If a 0 to 5 ohm reading is not obtained, extend 10' rod lengths and continue driving rods until the required reading is obtained. No rod can be connected to the bonding cable without the required ohm reading. The system must also be tied into the existing plant system.

PART 3 – EXECUTION

3-1. INSTALLATION. Installation shall be made in an inconspicuous manner with conductors coursed to conceal equipment as much as possible. Down conductors shall be concealed within structure, and shall be run in 1" PVC conduit. All metallic equipment within 6 feet of any lightning conductor shall be bonded to conductor. System shall also be tied to the main service electrical ground.

3-2. EQUIPMENT. Equipment shall be as manufactured by National Lightning Protection, Inc., Lightning Masters Corp., or Heary Bros Lightning Protection.

END OF SECTION

SECTION 16709

SURGE PROTECTION DEVICES (SPD)

PART 1 – GENERAL.

1-1. DESCRIPTION. The specified unit shall provide effective high energy transient voltage surge suppression, surge current diversion and high frequency noise attenuation in all electrical modes for equipment connected downstream from the facility's meter or load side of the main overcurrent device. The unit shall be connected in parallel with the facility's wiring system.

1-2. RELATED DOCUMENTS AND APPLICABLE STANDARDS. Systems shall be designed, manufactured, tested and installed in accordance with the following applicable documents and standards:

1. Underwriters Laboratories (UL1449 3rd Addition and UL 1283)
2. ANSI/IEEE (C62.41 and C62.45)
3. Military Standards (MIL – STD 220A)
4. National Electric Code (NEC)
5. Underwriter's Laboratories 248

PART 2 – PRODUCTS.

2-1. APPROVED MANUFACTURER

Power Only Protection

For low voltage protection use: MTL, Phoenix, Edco Surge Protection

Current Technologies

Power & Systems Innovations

PO Box 590223

Orlando, FL 32859-0223

Contact: John West Sr.
Phone (407) 380-9200
Phone (800) 260-2259
FAX (407) 380-3911 FAX
E-mail jwest@psihq.com
Internet www.psihq.com

Joslyn, AKA (Total Protection Solutions)

Total Protection Solutions

4366 LB McLeod Road

Orlando, FL 32804

Contact: Bob Levit
Phone 407-841-4405
FAX 407-841-4407
E-mail: bob@treborpowersystems.com

Internet www.treborpowersystems.com

Surge Suppression Inc
Surge Suppression Incorporated
P.O. Box 674
Destin, FL 32540-0674

Contact: Mike Barton
Phone (888) 987-8877
FAX (888) 900-8879
E-mail mbarton@surgesuppression.com

2-2 DEVICES. Surge Protection Devices (SPD's) shall be UL listed at or above the available fault current level at the point of SPD application by UL, Per UL 1449 latest edition.

The SPD shall be a parallel design using fast-acting energy protection that will divert and dissipate the surge energy.

Units shall have:

- Minimum 10 mode operation for all 3 phase Y and high leg Delta configurations and six modes of protection for all 3 phase Delta “no Neutral” configurations.
- One nanosecond or less response time for any individual component, and shall be self restoring and fully automatic.
- Extended noise filtration with a 10 kHz to 100 MHz range.
- LED indication of unit failure to indicate the continuous positive operational status of each protected phase.
- System Voltage shall be as indicated on the drawings.
- The fusing system shall be capable of allowing the rated maximum single impulse surge current to pass through without fuse operation.
- SPD's shall be installed with leads as short as possible (not to exceed 24 inches). SPD's may be mounted internally in Motor Control Centers, switchgear and switchboards. SPD's shall be mounted externally at panelboards and control panels.
- All SPD panel units shall be guaranteed by the installing contractor and surge suppression manufacturer to be free of defects in materials and workmanship for a period of not less than 10 years from the date of substantial completion of the system to which the suppressor is installed.
- For each SPD type or size used on this project provide the following submittal data:
 - Complete schematic data for suppressor, indicating part numbers, dimensional drawings and mounting arrangement.
 - Cut sheets which include Peak Surge Current “per mode”, Let Through Current, UL tested voltage protection rating (VPR) and maximum Continuous Operating Voltage

(MCOV).

- Copy of Warranty statement.

2-3 APPLICATIONS

- Surge Current RATING OF 150 kA PER MODE AT 480 Volt distribution panels.
- Surge Current RATING OF 150 kA PER MODE AT 480 Volt Motor Control Centers.
- Surge Current RATING OF 150 kA PER MODE AT 480 Volt branch panels or control panels.
- Surge Current RATING OF 40 kA PER MODE AT 208 or 240 Volt three phase or single phase branch panels.

2-4. FILTERING. The system shall provide a UL 1283 Listed Electromagnetic Interference Filter capable of attenuating noise levels produced by electromagnetic interference and radio frequency interference.

2-5. FUSING. Fuse component(s) identification and surge rating. The manufacture shall provide documentation demonstrating the tested surge current rating (8x20μsec) of the fuse. The surge rating of the fuse shall be greater than the combined surge current rating of all downstream connected suppression elements.

Fusing: Suppression component(s) identification and surge rating. The manufacturer shall provide documentation identifying the suppression element(s) connected in series with fuse element(s) and provide the suppression elements published 8x20μsec surge current rating. The rating of the suppression element(s) shall be less than the rating of upstream fusing element(s).

Fusing: Surge performance. All fusing shall be required to meet the single pulse surge current testing requirements of Section 2.2 above.

Fusing: Isolation. The unit shall have each MOV fused and designed to operate only in the event of an MOV failure within the SPD device.

Fusing Coordination: Units that can't demonstrate MOV-fuse coordination in 2.4.a and 2.4.d are not acceptable.

Fusing: UL Rating. All fusing shall be 200kAIC UL248 Recognized.

2-6. UL 1449 SUPPRESSED VOLTAGE RATING. The unit shall be UL 1449 3rd Edition Listed and shall be as follows for L-N, L-G, N-G, and L-L, modes, inclusive of the disconnect switch: (Select appropriate product rating from below)

1. 40kA – 80kA rated products/120/208V units: L-N = 400V, L-G=500, N-G=500, and L-L=700
2. 60kA – 80kA rated products/277/480V units: L-N = 900V, L-G=1000, N-G=90, and L-L=1800
3. 100kA – 150kA rated products/120/208V units: L-N = 400V, L-G=500, N-G=500, and L-L=700

4. 100kA – 150kA rated products/277/480V units: L-N = 900V, L-G=1000, N-G=800, and L-L=1500
5. 200kA – 300kA rated products/120/208V units: L-N = 400V, L-G=500, N-G=500, and L-L=700
6. 200kA – 300kA rated products/277/48V units: L-N = 800V, L-G=1000, N-G=800, and L-L=1500

2-7. IN FIELD TESTING. The unit shall be equipped with a performance data extraction protocol allowing unit performance data, including percent of protection remaining, to be transmitted to an internal, external status analyzer.

2-8. ENCLOSURE.

Outside - Units shall be provided in a NEMA type 4X plastic enclosure.

Interior – Units shall be provided in NEMA type 1 enclosure.

PART 3 – EXECUTION

3-1. SYSTEM TESTING. Upon completion of installation, a factory-authorized local service representative shall provide product startup testing services. The tests shall include:

1. On-line Testing: Verification that all suppression and filtering paths are operating with 100% protection as well as verification of proper facility neutral-to-ground bond by measuring neutral-to-ground current and voltage.
2. Off-line Testing: Impulse injection to verify the system tolerances as well as verification of proper facility neutral-to-ground bond. To be compared to factory benchmark test parameters supplied with each individual unit.

3-2. DOCUMENTATION AND REPORTING. A copy of the startup test results and the factory benchmark testing results shall be supplied to the engineer and the owner for confirmation of proper system function. This letter shall also clarify that the integrity of all neutral-to-ground bonds were verified through testing and visual inspection, and that all grounding bonds were observed to be in place.

3-3. SYSTEM WARRANTY. The TVSS system manufacturer shall warranty the entire system against defective materials and workmanship for a period of ten (10) years following substantial completion.

END OF SECTION

CARD ACCESS SYSTEM

PART 1 - GENERAL

1-1. DESCRIPTION. This section covers design, furnishing, and installation of a motorized entrance gate with a card access system which includes, but is not limited to, security control panels, power supplies, gate and gate operators, gate control panels, SCADA system interface, and proximity/keypad card controller and readers.

The motorized gate and card access system shall be compatible with OWNER existing card access control systems. The System Supplier shall be responsible to provide all equipment specified herein, and shall subcontract the gate and gate control system to an OWNER approved, certified installer. The System Supplier shall subcontract the card access control system to an OWNER approved, certified installer.

The System Supplier and his subcontractors shall be responsible for the integration and configuration of the new Card Access Control System equipment with the SCADA equipment and Ethernet connectivity to the hub such that personnel the remote regional facilities shall be able to access and make changes that may be necessary to the Card Access Control System to control access to the Meadow Woods Well House entrance gate.

All associated equipment, devices, cabling (fiber-optic and copper), system configuration, and controls necessary for proper operation shall be included.

1-2. GENERAL. The System Supplier shall furnish all installation drawings, tools, equipment, conduit, wiring, materials, and supplies and shall perform all labor to complete the work as specified, and in compliance with all applicable codes, standards, and regulations.

System Supplier shall coordinate with CONTRACTOR and any sub-contractors (including electrical) to provide all additional conduit and wiring required for a complete operable system beyond the use of conduit marked for security use as shown on drawings.

The card access system shall use Electronic Card Access System (ECAS) pass cards. As such, the new card access system shall be compatible with the recently installed systems at other OWNER facilities by the System Supplier.

The Supplier shall review the specifications and supply equipment that meets the functional requirements indicated, and shall furnish and install additional or differing components if required.

1-2.01. Supplier's Qualifications. The design, equipment, installation, and installation supervision furnished under this section shall be provided by a manufacturer or supplier who has been engaged in the business of supplying these types of equipment for at least 5 years.

The card access system supplier shall be a Lenel Security Management System certified dealer/installer.

1-2.02. Governing Standards. All wiring and components shall meet the applicable requirements of the National Electrical Code NEC.

1-2.03. Nameplates. Major components of equipment shall be identified with a permanently affixed nameplate bearing the manufacturer's name and address, and type or style and catalog number of the item.

1-2.04. Tags. Keys and locks, where required, shall be furnished with tags bearing stamped identification number. Cable and conduit runs, wiring circuits, and all spare parts supplied to maintain the equipment shall be furnished with hard phenolic or stainless steel tags.

1-2.05. Power Requirements. Primary power supply to all components will be 120 volts, 60 Hz, single phase. The System Supplier shall be responsible for meeting all additional power supply requirements and shall furnish any transformers or other power supply equipment needed.

1-3. SUBMITTALS. Complete wiring diagrams; assembly and installation drawings; detailed specifications; and data covering the materials used and the parts, devices, and other accessories forming a part of the equipment furnished shall be submitted in accordance with the submittals section. The equipment submittals shall include the following:

- A complete description of all components, including certification of listing by UL.
- Complete sequence of operation for all functions of the equipment.
- Complete wiring diagram for all components and interfaces to equipment supplied under other sections or by the Owner.
- Location drawings for all components.
- A listing of the manufacturer's representatives responsible for installation and servicing.
- Conduit and cabling to all equipment locations.

1-4. SECURITY SYSTEM DESCRIPTIONS.

1-4.01. Electronic Card Access System Well House No. 8. The system shall be furnished as a complete package consisting of a security panel, gate card reader control panel gate keypad and proximity card readers to monitor and control access to the Meadow Woods well access gate. The system shall consist of one (1) security control and gate card access panel located in the Well House No. 8, one (1) keypad, one (1) proximity card reader for the gate. Any additional equipment required to provide a functional system shall be provided by the System Supplier.

1-4.02. Electronic Card Access System Reclaimed Pump Building. The existing system shall be re-commissioned as a complete package consisting of a security panel, gate card reader control

panel gate keypad and proximity card readers to monitor and control access to the Meadow Woods Reclaimed Pump Station access gate. Any additional equipment required to provide a functional system shall be the responsibility of the System Supplier.

1-5. COMPONENTS. Where required by NEC or local codes, all security equipment and materials, devices, and assemblies shall be listed and/or labeled by UL or another accepted testing laboratory for the intended purpose. The equipment shall not be installed, altered, or modified in any way that would void the label or listing.

All control equipment shall have transient voltage protection devices in compliance with UL 864.

1-6. SPARE PARTS AND SPECIAL TOOLS. Spare parts and special tools as recommended by the equipment supplier and as may be listed below shall be furnished. These will include three sets of any disposable parts which would normally be changed during routine equipment maintenance and any special tools required for disassembly of the equipment.

The following minimum spare parts shall be supplied with the security equipment; one (1) each of each type of card reader.

Spare parts shall be suitably packaged for shipment.

1-7. OPERATION, MAINTENANCE AND INSTRUCTION MANUALS. Operation, Maintenance and Instruction Manuals for the equipment and systems identified in Section 01620 – EQUIPMENT SCHEDULE, and as may be required in this section of these project specifications shall be furnished in accordance with Section 01730 – OPERATION, MAINTENANCE AND INSTRUCTION MANUALS.

1- 8. MANUFACTURERS' FIELD SERVICES. Equipment manufacturers or suppliers shall provide the services of a factory-trained manufacturer's representative or agent and maintenance personnel as required to participate in installation, check-out, and testing of equipment and systems, and in the training of Owner plant operating personnel. The representative shall have complete knowledge of proper installation, operation, and maintenance of the equipment and systems supplied.

The manufacturer's representative or agent shall visit the site or classroom designated by the Owner, for the minimum person-days listed below, travel time excluded. The time listed below shall be extended as required to meet the manufacturer's service representative or agent requirements included in Section 01650 – Startup Requirements and any additional requirements of the manufacturer's service representative or service personnel as may be identified in this section of these project specifications.

- Full time as required. The System Supplier shall provide on-site supervision of installation.
- 3 days. Inspection, checking, and adjustment of equipment.
- 2 days: Participate in Functional Tests, Start-Up Tests, and Demonstration Tests and in preparation of required certifications.

- 2 days: Participation in Manufacturer's Training Services of Owner's Personnel.

PART 2 - PRODUCTS.

2-1. ELECTRONIC CARD ACCESS EQUIPMENT.

2-1.01. Security Panel. Lenel 2220 security control panel and controller. The controller shall have Ethernet capability. The enclosure shall be a Lenel LNL CTX or approved equal. The security control panel shall include power supplies, fiber optic transceivers, and fiber optic patch panels as required. Fiber optic transceivers shall be model IFS D1300. Power supplies shall be model AL300ULX. The controller shall be battery backed-up. Panel shall be capable of supporting the number of inputs and outputs required for the card readers indicated on the drawings. The panel shall have ample room for wiring and circuit boards, be capable of storing up to 32,000 cards per site, retain last 6000 transactions, monitor forced entry and held open conditions, heavy duty 10 amp relays monitored by the plant control system, fiber optic patch panel, fiber optic transceiver, Lenel card reader(s) and Lenel Intelligent System Controller.

The control panel shall operate from a 120 volt AC, 60 Hz power supply. Control panel shall be manufactured by Lenel, Inc. and no other.

The System Supplier shall be responsible to connect and fully integrate the System Controller Panel to OWNER existing card access system used at other OWNER facilities.

2-1.02. Remote Card Reader Control Panel. Lenel 1320 card reader interface and control panel located at gate. Enclosure shall be NEMA TYPE 4X aluminum or 316 stainless steel. Panel shall provide interface for the gate proximity card reader. The panel shall have ample room for wiring and circuit boards, monitor forced entry and held open conditions, contain fiber optic patch panel, fiber optic transceiver and Lenel card reader.

2-1.03. Proximity Card Reader. Microprocessor based magnetic type card reader terminals shall be located as shown on the drawings, one mounted at automobile height shall be located at Well House entrance gate. Card Readers shall have an operating temperature of -22 to 150 degrees Fahrenheit, and shall have an operating humidity of 0-95% non-condensing. Card Readers shall have a typical read range of up to 9 inches. Card Readers shall read encoded data from access card and transmit the data back to the Card Reader Control Panel. Card Reader shall give an audible and visual indication of a properly read card. Card Readers shall be operated from a 10-28 volt DC power supply. Card Readers shall be furnished with transient voltage surge suppression devices. Card Readers for the operations building shall be the HID ProxPro 5355.

2-1.04. Gate Operator Pedestal. Double goose necked aluminum pedestal mount for high (truck) and low (automobile) mounted card readers.

2-2. ENCLOSURES.

2-2.01. General. All components supplied shall be mounted in a NEMA rated enclosure designed for use in the environment in which they will be installed.

All enclosures shall be fitted for direct connection of conduit and shall be designed for wall or column mounting unless otherwise specified or indicated on the drawings. Any special mounting components or brackets shall be provided by the System Supplier.

2-3. CABLE AND RACEWAYS.

2-3.01. The System Supplier shall provide all wiring and fiber optic cabling in accordance with Section 16050 and as shown on the drawings in coordination with CONTRACTOR and electrical sub-contractor. Electrical sub contractor to supply conduits, raceways and boxes as shown on the drawings. System Supplier shall provide any additional boxes or conduits required for system operation but not shown on the drawings. Cable used for the intrusion equipment shall be multi-conductor cable, at least 18 AWG size, specifically designed for industrial systems and UL listed for indoor/outdoor installations.

Fiber Optic cabling used solely for the Security shall be independent of other fiber optic cabling provided at the site, and shall be compatible with the security system. Fiber Optic cabling shall be multi-mode, 12 fiber minimum. All fibers shall be terminated after installation. Connecters shall be as required to coordinate with network switch connections.

2-4. ELECTRIC MOTORIZED GATE: The facility gate system shall be furnished as a complete package by the Contractor consisting of a vehicular motorized slide gate as shown on the drawings and as specified in Specification Section 02850 Motorized Gate. The gate system shall include the slide gate, automatic gate operator, and all required structural and safety equipment. Facility ingress shall be by the card access system above. Facility egress shall be by road imbedded proximity vehicle detector. The gate controller and gate operation shall be integrated with the card access control system and the SCADA system.

PART 3 - EXECUTION.

3-1. GENERAL. All work shall be installed in accordance with the manufacturer's diagrams and recommendations except where otherwise indicated.

After completion of the installation, the System Supplier shall clean the inside and the outside of the security equipment and shall remove any dirt and debris from the site.

3-1.01. Cable. Cable shall be installed in accordance with Section 16050. The conductors shall be installed in conduits or junction boxes separate from conductors of other systems. Conduit fill shall meet applicable NEC requirements.

3-1.02. Raceways. Conduit shall be installed in accordance with section 16050. Exposed conduit systems shall be rigid steel. Concealed conduit systems shall be PVC schedule 40.

3-2. FIELD QUALITY CONTROL, CHECKOUT AND TESTING. The Contractor shall perform field quality control, checkout, and testing, and shall submit required documentation in accordance with Section 01400 – QUALITY CONTROL, Section 01650 – START-UP REQUIREMENTS, and any special field testing requirements as may be listed below or elsewhere in this section of these project specifications. Shop testing, if required, is addressed elsewhere in this section.

End of Section



**FLORIDA DEPARTMENT OF
ENVIRONMENTAL PROTECTION**
CENTRAL DISTRICT
3319 MAGUIRE BOULEVARD, SUITE 232
ORLANDO, FLORIDA 32803-3767

RICK SCOTT
GOVERNOR

JENNIFER CARROLL
LT. GOVERNOR

HERSCHEL T. VINYARD JR.
SECRETARY

November 13, 2012

BY ELECTRONIC MAIL

Paul.Wagner@ocfl.net

Paul Wagner
9100 East Curry Ford Road
Orlando, Florida 32825

OCD-TK-12-0387

Orange County - Storage Tanks
Meadow Woods Water Treatment Plant
13421 Landstar Boulevard
Orlando, Florida 32824
Facility ID # 9100601

Chapter 62-762, FAC, Storage Tank Closure Assessment Report – Review

Dear Mr. Wagner:

The Department of Environmental Protection's Central District has reviewed the November 01, 2012 Tank Closure Assessment Report that was submitted by Tisha Pence CHMM, CES of Orange County Risk Management Division on November 07, 2012 for the above referenced facility. The November 1, 2012 Tank Closure Assessment Report appears to comply with the Department's April 1998 "Storage Tank Closure Assessment Requirements".

The results as provided in the November 01, 2012 Tanks Closure Assessment Report does not indicate the presence of petroleum contamination in the area addressed in excess of Department Cleanup Target Levels. Please note that this letter does not certify that this site is not contaminated, and the Department reserves the right to require appropriate actions for this site in accordance with Chapter 62-770, Florida Administrative Code, if any contamination is discovered in the future in excess of Department Cleanup Target Levels.

If you have any questions, you may contact me by telephone at (407) 897-4330 or by e-mail at george.martin@dep.state.fl.us.

Sincerely,

A handwritten signature in black ink that reads "G. Bud Martin".

G. Bud Martin
Environmental Specialist
Storage Tank Program


GBM/gbl/gbm

c: Tisha Pence, Orange County Risk Management Division, Tisha.Pence@ocfl.net

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Florida Department of Environmental Protection
 Twin Towers Office Bldg. 2600 Blair Stone Road. Tallahassee, Florida 32399-
 Division of Waste Management
 Bureau of Petroleum Storage Systems

Storage Tank Facility Closure Site Inspection Report

Facility Information:

Facility ID: 9100601 County: ORANGE Inspection Date: 11/01/2012
 Facility Type: I -County Government
 Facility Name: ORANGE CNTY-MEADOW WOODS WTP # Of Inspected ASTs: 1
 13421 LANDSTAR BLVD USTs: 0
 ORLANDO, FL 32824 Mineral Acid Tanks: 0
 Latitude: 28° 22' 26.9314"
 Longitude: 81° 21' 53.4246"
 LL Method: DPHO

Inspection Result:

Result : In Compliance
 Description: Facility is In Compliance.

Financial Responsibility

Financial Responsibility: INSURANCE
 Insurance Carrier: ACE
 Effective Date: 04/01/2012 Expiration Date: 04/01/2015

Signatures:

TKCD - DEP - CD STORAGE TANK PROGRAM

Storage Tank Program Office

(407) 897-4321

Storage Tank Program Office Phone Number

George Martin

INSPECTOR NAME

INSPECTOR SIGNATURE

Tisha Pence

REPRESENTATIVE NAME

REPRESENTATIVE SIGNATURE

Facility ID: 9100601

Owners of UST facilities are reminded that the Federal Energy Policy Act of 2005 requires Operator Training at all facilities by August 8, 2012. For further information please visit: http://www.dep.state.fl.us/waste/categories/tanks/pages/op_train.htm

Inspection Comments

11/01/2012

No Records were checked during this inspection. The tank is cleaned and all piping has been cleaned and disconnected from the generator. The day tank has also been cleaned and capped. The tank is marked as closed in place. The closure paperwork is to be forwarded to the Department in 60 days.

Inspection Photos

Added Date 11/01/2012

12-11-01 MEADOW WOODS WTP Closure piping disconnected1



Added Date 11/01/2012

12-11-01 MEADOW WOODS WTP Closure day tank disconnected



Added Date 11/01/2012

12-11-01 MEADOW WOODS WTP Closure tank





RISK MANAGEMENT DIVISION

109 E. Church Street, Suite 200
Orlando, Florida 32801
(407) 836-9640 • FAX (407) 836-9630

November 1, 2012

Florida Department of Environmental Protection
Central District
3319 Maguire Boulevard, Suite 232
Orlando, Florida 32803-3767

Attention: Mr. George (Bud) Martin

VIA E-MAIL: George.Martin@dep.state.fl.us

Reference: **Tank Closure Assessment Report**
Meadow Woods Water Treatment Plant
13421 Landstar Boulevard
Orlando, Orange County, Florida
FDEP Facility No. 48/9100601

Dear Mr. Martin,

ACTs Construction, Inc. (ACTs), on behalf of the Orange County Risk Management Division (OCRMD) and the Orange County Water Production Division, has completed the tank decommissioning / closure activities at the above referenced facility. OCRMD discussed this closure with Florida Department of Environmental Protection (FDEP) Central District staff on November 1, 2012 and determined that closure sampling was not required based on the site's compliance history and the lack of discharges from the tank system. The product piping was capped on October 31, 2012 and the aboveground storage tank (AST) was cleaned on November 1, 2012. A copy of the tank closure form and petroleum contact water (PCW) manifest as provided by ACTs Construction as well as photos obtained during the tank closure activities are included as **Attachment A** of this document. If there are any questions or comments to this request, please do not hesitate to contact me at (407) 836-9638 or via e-mail at Tisha.Pence@ocfl.net.

Sincerely,

A handwritten signature in cursive script that reads "Tisha Pence".

Tisha Pence, CHMM, CES
Environmental Loss Prevention Coordinator

cc: John Petrelli, Manager, Risk Management Division, john.petrelli@ocfl.net
Paul Wagner, Manager, Southern Regional Water Supply Facility, paul.wagner@ocfl.net
Robert Sutherland, Sr. Utilities Maintenance Coordinator, SRWS, robert.sutherland@ocfl.net
Bret LeRoux, Program Manager, FDEP – Central District, Storage Tanks and Waste Cleanup, Bret.LeRoux@dep.state.fl.us

ATTACHMENT A

November 1, 2012

Tisha Pence, CES
Environmental Loss Prevention Coordinator
Orange County Risk Management
109 E. Church Street, Suite 200
Orlando, Florida 32801

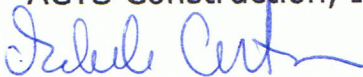
Re: Orange County Meadow Woods WTP
Fac # 48/ 9100601

Dear Tisha,

Please note on November 1, 2012, one (1) 4,000 gallon tank was cleaned and decommissioned. Attached is manifest and DEP Form.

If you have any questions or need additional information, please advise.

Sincerely,
ACTS Construction, Inc.



Michele Cintron FOR
Keri Placke
Vice President

cc: Job file SR6055



Underground Storage System Installation and Removal Form for Certified Contractors

SR6055

Pollutant Storage Systems Contractor as defined in Section 489.113, Florida Statutes (certified contractors as defined in Section 62-761.200, Florida Administrative Code) shall use this form to certify that the installation, replacement or removal of the underground storage tank system(s) located at the address listed below was performed in accordance with Department Reference Standards. This includes system components such as dispenser liners, piping sumps, and overflow protection devices.

General Facility Information

Facility Name: Orange County Meadow Woods WTP	DEP Facility Identification No. : 9100601
Street Address (physical location): 13241 Landstar Blvd., Orlando 32824	
County: Orange	Telephone #: (407) 254-9527
Owner Name: Orange Co. Water Production	Telephone #: () _____
Owner Address:	

Storage Tank System Information

Number of Tanks Installed: -0-	Number of Tanks Removed: -0-
Date Work Initiated: 10-31-12	Date Work Completed: 11-1-12
Tank(s) Manufactured by: Unknown	
Description of work Completed: Fuel lines blown back, tank clean and decommissioned.	

Certification

I hereby certify and attest that I am familiar with the facility that is registered with the Florida Department of Environmental Protection; that to the best of my knowledge and belief, the storage tank system installation, replacement or removal at this facility was conducted in accordance with Chapter 489, Florida Statutes, Section 376.303, Florida Statutes, and Chapter 62-761, Florida Administrative Code, and its adopted reference standards and documents for underground storage tank systems.

Acts Construction, Inc.
Lynn N. Crowell, Jr.
(Type or Print)

Certified Pollutant Tank Contractor Name

Lynn N. Crowell, Jr.
Certified Tank Contractor Signature

Bobby Hewlett
Field Supervisor Name

PCC045038
PSSC Number
Pollutant Storage Systems
Contractor License Number

11-1-12
Date

11-1-12
Date

The owner or operator of the facility must register the tanks with the Department upon completion of the installation. The installer must submit this form to the County no more than 30 days after the completion of installation, replacement, or removal of a storage tank

NON-HAZARDOUS WASTE MANIFEST

Please print or type (Form designed for use on elite (12 pitch) typewriter)

m-8

NON-HAZARDOUS WASTE MANIFEST		1. Generator's US EPA ID No.		Manifest Document No.	2. Page 1 of	
3. Generator's Name and Mailing Address <i>Meadow Woods Water Treatment</i>		<i>13421 Lundston Blvd Orlando FL 32824</i>				
4. Generator's Phone (<i>407</i>) <i>242-7367</i>						
5. Transporter 1 Company Name <i>Aqua Clean</i>		6. US EPA ID Number <i>FLR000034033</i>		A. State Transporter's ID		
7. Transporter 2 Company Name		8. US EPA ID Number		B. Transporter 1 Phone		
9. Designated Facility Name and Site Address <i>Aqua Clean 3210 Whitten Rd Lake Land FL 33811</i>		10. US EPA ID Number <i>FLR000034033</i>		C. State Transporter's ID		
				D. Transporter 2 Phone		
				E. State Facility's ID		
				F. Facility's Phone <i>863-644-0665</i>		
11. WASTE DESCRIPTION				12. Containers		13. Total Quantity
				No.	Type	14. Unit Wt./Vol.
a. <i>P.C. W.</i>				<i>1</i>	<i>π</i>	<i>231 Gals</i>
b.						
c.						
d.						
G. Additional Descriptions for Materials Listed Above				H. Handling Codes for Wastes Listed Above		
15. Special Handling Instructions and Additional Information <i>Butter worth</i>						
16. GENERATOR'S CERTIFICATION: I hereby certify that the contents of this shipment are fully and accurately described and are in all respects in proper condition for transport. The materials described on this manifest are not subject to federal hazardous waste regulations.						
Printed/Typed Name <i>X Robert Hewlett</i>				Signature <i>X Robert Hewlett</i>		Date Month Day Year <i>11 1 12</i>
17. Transporter 1 Acknowledgement of Receipt of Materials Printed/Typed Name <i>David Johns</i>				Signature <i>David Johns</i>		Date Month Day Year <i>11 1 12</i>
18. Transporter 2 Acknowledgement of Receipt of Materials Printed/Typed Name				Signature		Date Month Day Year
19. Discrepancy Indication Space						
20. Facility Owner or Operator; Certification of receipt of the waste materials covered by this manifest, except as noted in item 19.						
Printed/Typed Name				Signature		Date Month Day Year

NON-HAZARDOUS WASTE

GENERATOR

TRANSPORTER

FACILITY





Photo of tank during decommissioning process 10/31/12



Photo of capped product piping 10/31/12

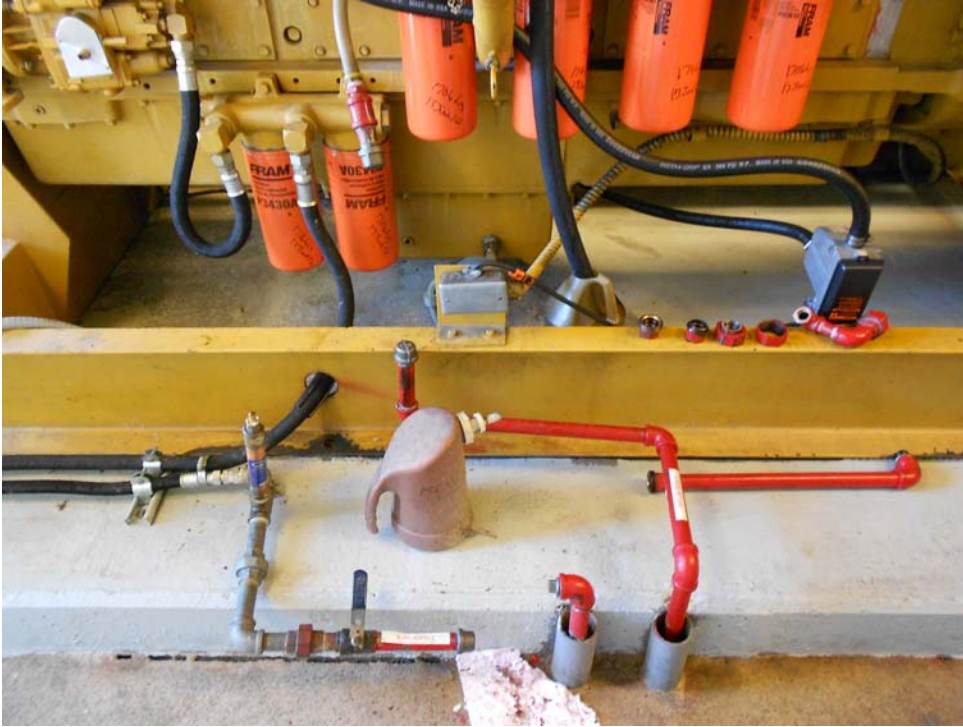



Photo of capped product piping to generator 10/31/12




Photo of AST after being decommissioned / closed 11/1/12

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Report of Geotechnical Engineering Investigation
SOUTH WATER SERVICE AREA
Meadow Woods Water Supply Facility
Orange County, Florida
GEC Project No. 3433G





**Geotechnical
and
Environmental
Consultants, Inc.**

At the very foundation of our community

January 31, 2013

Black & Veatch
201 South Orange Avenue, Suite 500
Orlando, Florida 32801

Attention: Mr. Brad W. Vanlandingham, P.E.

Subject: Report of Geotechnical Engineering Investigation
SOUTH WATER SERVICE AREA
Meadow Woods Water Supply Facility
Orange County, Florida
GEC Project No. 3443G

Dear Mr. Vanlandingham:

Geotechnical and Environmental Consultants, Inc. (GEC) is pleased to present this Report of Geotechnical Engineering Investigation for the above-referenced project. This study was performed in general accordance with our Proposal No. 6390G dated October 21, 2009. The purpose of this study was to explore soil and groundwater conditions at the subject site and use the information obtained to develop geotechnical engineering recommendations regarding site preparation and design of the new pump building foundations and yard piping. This report describes our field investigation, documents the results and presents our recommendations.

GEC appreciates the opportunity to be of service to you on this project and trusts that the information contained herein is sufficient for your needs. Should you have any questions concerning the contents of this report, or if we may be of further assistance, please do not hesitate to contact us.

Very truly yours,

GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS, INC.

Certificate of Authorization No. 00005882

 1/31/13

V. Eugene Williford IV, E.I.
Engineer Intern

VEW/CPM/cew



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APPENDIX

Figure 1: USGS Quadrangle and NRCS Soil Survey Maps

Figure 2: Boring Location Plan with Boring Results

Corrosion Series Test Results

Field Permeability Test Calculations

1.0 SITE AND PROJECT DESCRIPTION

The subject site is located on the east side of Landstar Boulevard between Pinnacle Cove Boulevard (also known as Greenway Professional Court) and Rhode Island Woods Circle (also known as Chicago Woods Circle) in Orlando, Florida. The site is the existing Meadow Woods Water Supply Facility. The site is a relatively open and grassed area bounded to the east by an existing stormwater pond.

...project plans for the site include...small pump buildings...a small quantity of miscellaneous yard piping.

We understand that project plans for the site include the modification of the existing water supply facility into a new reclaimed water facility. This modification includes rerouting the existing water supply pipeline offsite to a new water supply facility and converting the remainder of the site elements to create a reclaimed water facility. We understand that the only new structures to be added to the site will be small pump buildings at each of the two existing wells. Also included in the new construction at the site will be a small quantity of miscellaneous yard piping.

2.0 USGS QUADRANGLE MAP

Based upon data obtained from the USGS Quadrangle map the project site elevation is approximately +85 feet NGVD. The approximate project location is indicated on the St. Cloud North, Florida Quadrangle Map on **Figure 1** in the **Appendix**. The site vicinity and site plan are shown on the attached **Figure 2** in the **Appendix**.

3.0 NRCS SOIL SURVEY

The Natural Resources Conservation Service (NRCS) Soil Survey of Orange County, Florida was reviewed to obtain near surface soils and groundwater information in the vicinity of the subject site. The NRCS soils near the project site are summarized in Table 1 below:

Table 1
NRCS Soil Survey Classification

Map Symbol	Soil Name	Depth (in)	Soil Description	Unified Classification	Depth to Seasonal High Water Table (ft)
42	Sanibel muck	0 - 11 11 - 15 15 - 80	Muck Fine sand, sand, mucky fine sand Fine sand, sand	PT SP-SM, SP SP, SP-SM	+1.0 - 0.0

Map Symbol	Soil Name	Depth (in)	Soil Description	Unified Classification	Depth to Seasonal High Water Table (ft)
44	Smyrna fine sand	0 - 4 4 - 17	Fine sand Fine sand, sand	SP-SM, SP SP, SP-SM	0.5 - 1.5
44	Smyrna fine sand	17 - 27 27 - 80	Fine sand, sand Fine sand, sand	SM, SP-SM SP-SM, SP	0.5 - 1.5

An excerpt of the NRCS Soil Survey map showing the approximate site is presented on **Figure 1** in the **Appendix**. The majority of the site contains Smyrna fine sand soil. *Information contained in the NRCS Soil Survey is very general and may be outdated.* It may not therefore be reflective of actual soil and groundwater conditions, particularly if recent development in the site vicinity has modified soil conditions or surface/subsurface drainage. The information obtained from the soil borings provides a better characterization of actual site conditions.

4.0 SUBSURFACE EXPLORATION

GEC explored subsurface conditions at the subject site by performing 2 Standard Penetration Test (SPT) borings to a depth of 15 feet within the footprint of the new pump buildings locations. GEC also conducted 2 auger borings to depths of 10 feet at the locations of proposed yard piping. A field permeability test was conducted at Boring AB-1.

The boring locations are shown on **Figure 2** in the **Appendix**. The boring locations were not surveyed, but established by taping distances from existing features shown on a plan provided by you. Therefore, they should be considered approximate. Although the boring locations are therefore given only approximately, the methods used to locate the borings are, in GEC's opinion, sufficient to meet the intent of our study. If greater accuracy is desired, a registered Professional Land Surveyor should be retained to survey the boring location.

4.1 SPT Borings

Standard Penetration Test (SPT) borings were drilled in general accordance with ASTM Procedure D-1586. The boreholes were advanced by the rotary wash method with bentonite-based mud used as the circulating fluid and to help stabilize the borehole. After first hand augering to a depth of 6 feet to help avoid damaging buried utilities, GEC's field crew obtained SPT samples continuously in the borings to a depth of 10 feet and at 5-foot depth intervals thereafter. A GEC engineering technician supervised the drilling operation, and collected, examined and visually classified each sample. A field SPT boring log was prepared that detailed the soils penetrated, reported the SPT blow counts for each 6-inch increment tested, records the groundwater depth at

the time of drilling and other details of the boring, methods used, and selected other boring and site conditions at the time of drilling. He then packaged representative portions of each sample for transport to our laboratory for further examination and laboratory testing as needed.

4.2 Machine Auger Borings

Machine auger borings were performed in general accordance with ASTM Procedure D-4700. Machine auger borings were performed by hydraulically turning continuous flight, solid-stem auger into the ground in 5-foot increments until the desired boring termination depth was achieved. The auger flights were retrieved in 5-foot increments, without further rotation of the auger, and the retrieved soil was examined by our technician prior to collection of representative samples. A field auger boring log was prepared that detailed the soils penetrated, records the groundwater depth at the time of drilling, if encountered, and includes other details of the boring, methods used, and selected other boring and/or site conditions at the time of drilling. The samples were placed in sealed jars and transported to GEC's laboratory for further examination and limited laboratory testing as needed.

4.3 Field Permeability Test

A constant head permeability test was performed in the field at this site. The field permeability test was performed by driving a 3-inch diameter casing into the ground to the desired test depth and washing the soil out of the casing with water. The casing was backfilled with quartz gravel to 30 inches above the bottom of the casing and was then raised a distance of 24 inches. Water was then added to the casing to achieve a stable water level. Once the water level stabilized, the flow required to maintain the stable water level in the casing was measured.

The flow and stable water level height were used to calculate the permeability of the soil. Field permeability tests and calculations were performed in general conformance with NAVFAC DM 7.1-103 to 7.1-108.

4.4 Redox and Corrosion Sampling

A sample was obtained at boring location B-2 for redox and corrosion testing. The sample was obtained at a depth of 4 to 8 feet below existing grade at this location. The sample was immediately placed in a glass jar and returned to our laboratory for corrosion testing.

4.5 Groundwater Measurement

A GEC engineering technician measured the depth to groundwater in the boreholes at the time of drilling and again after approximately 24 hours. After the groundwater levels were recorded, the boreholes were backfilled with soil cuttings to the prevailing ground surface.

5.0 LABORATORY TESTING

Selected soil samples retrieved from the borings were tested in accordance with Florida Standard Testing Methods (FM). Florida Standard Testing Methods are adaptations of recognized standard methods, e.g., ASTM and AASHTO, which have been modified to accommodate Florida's geological conditions. The GEC laboratory is reviewed annually by the Construction Materials Engineering Council, Inc. (CMEC) to verify compliance with FM. Our laboratory testing program is summarized on the following table:

Table 2
Summary of Laboratory Testing Program

Type of Test	Number of Tests
Percent Fines (FM 1 - T88)	2
Organic Content (FM 1-T267)	1
Natural Moisture Content (FM 1 – T265)	1

The results of our laboratory tests are shown adjacent to the soil profiles on **Figure 2** in the **Appendix**.

5.1 Corrosion Testing

...results of our corrosion testing are shown in **Table 4** in the **Appendix**...

Corrosion testing that included testing of pH, Sulfates, Chlorides, and Resistivity, was performed in general accordance with FM 5-551 through FM 5-553. Re-dox testing was also included in general accordance with Ductile Iron Pipe Research Association (DIPRA) guidelines. The results of our corrosion testing are shown in **Table 4** in the **Appendix** of this report.

6.0 DESCRIPTION OF SUBSURFACE CONDITIONS

Detailed records of subsurface conditions encountered in our SPT and auger borings are shown on **Figure 2** in the **Appendix**. The boring logs describe the soil layers using the Unified Soil Classification System (USCS) symbol (e.g. SP-SM) and ASTM soil descriptions (e.g. sand with silt). We based our soil classifications and descriptions on visual examination and the laboratory test results presented in this report.

The boring logs and related information included in this report are indicators of subsurface conditions only at the specific boring location at the time of our field exploration.

Subsurface conditions, including groundwater levels, at other locations of the site may differ from conditions we encountered at the boring locations. Moreover, conditions at the boring locations can change over time. Groundwater levels fluctuate seasonally, and soil conditions can be altered by earthmoving operations.

The depths and thicknesses of the subsurface strata indicated on the boring logs were interpolated between samples obtained at different depths in the boring. The actual transition between soil layers may be different than indicated. *These stratification lines were used for our analytical purposes. Earthwork quantity estimates based on the boring results will differ from the actual quantities measured in the field.*

6.1 Soil Strata

In general, the SPT borings at the 2 proposed pump building locations (B-1 and B-2) encountered medium dense fine sand with silt (SP-SM) to a depth of 6 to 8 feet. The "N" values for this layer ranged from 12 to 21. Below this layer, loose to medium dense silty fine sand (SM) was encountered to the boring termination depth of 15 feet below the existing ground surface. The "N" value for this layer ranged from 6 to 24.

...boring AB-1 encountered mucky fine sand (PT) from 8 feet below the existing ground surface to the boring termination depth of 10 feet.

Borings AB-1 and AB-2 generally encountered fine sand with silt (SP-SM) to 5 feet below the existing ground surface, underlain by silty fine sand (SM) to the boring termination depths of 10 feet. However, boring AB-1 encountered mucky fine sand (PT) from 8 feet below the ground surface to the boring termination depth of 10 feet.

Please refer to **Figure 2** in the **Appendix** for the specific subsurface profile at the boring locations.

6.2 Groundwater Levels

Our field technician encountered the groundwater levels in the boreholes performed at depths ranging from approximately 2.7 to 3.4 feet below the existing ground surface. The estimated seasonal high groundwater level is... ranging from approximately 2.7 to 3.4 feet below the existing ground surface. The estimated seasonal high groundwater level is anticipated to be approximately 1.7 to 2.4 feet below existing ground surface... existing ground surface at the boring locations.

Groundwater levels can vary seasonally and with changes in subsurface conditions between boring locations. Alterations in surface and/or subsurface drainage brought about by site development can also affect groundwater levels. *Therefore, groundwater depths measured at different times or at different locations on the site can be expected to vary from those measured by GEC during this investigation.*

For purposes of this report, estimated seasonal high groundwater levels are defined as groundwater levels that are anticipated at the end of the wet season during a “normal rainfall” year under pre-development site conditions. We define a “normal rainfall” year as a year in which rainfall quantity and distribution were at or near historical averages.

6.3 Field Permeability Test Results

As requested, a field permeability test was performed at boring location AB-1 to evaluate the hydraulic conductivity of the in-situ soil. The field permeability test calculation is included in the **Appendix** and the calculated horizontal permeability rate is shown adjacent to the boring profile on the Boring Location Plan with Boring Results sheet (**Figure 2**). The following table summarizes the field permeability test result.

Table 3
Summary of Field Permeability Test Results

Boring No.	Test Depth (ft)	Soil Type	Horizontal Permeability Rate (ft/day)
AB-1	3 - 5	SP-SM	3.7

7.0 ANALYSIS AND DESIGN RECOMMENDATIONS

The analyses and recommendations contained in this report are based in part on the data obtained from a limited number of soil samples and the groundwater measurements obtained from the borings. The sampling methods used indicate subsurface conditions only at the boring locations where samples were obtained, only at the time they were obtained, and only to the depth penetrated. The borings cannot be relied upon to accurately reflect the variations that usually exist between the borings and these variations may not become evident until construction. If variations from the subsurface conditions described in this report do become evident during construction or if the project characteristics described in this report change, GEC should be retained to reevaluate this report's conclusions and recommendations in light of such changes.

7.1 Pump Buildings Foundations

Based on the data obtained from this investigation, in our opinion the site is suitable for support of the proposed pump buildings upon a system of conventional shallow isolated spread footings, continuous strip footings, and/or monolithic slab foundation systems. This conclusion is contingent upon the design engineer's and contractor's adherence to the following recommendations:

- ◆ Prepare the structure area in accordance with the recommendations in the **General Site Preparation** and **Fill Selection, Placement and Compaction** sections of this report.
- ◆ Prepare footing subgrade soils in accordance with the recommendations presented in the **Foundation Subgrade Preparation** section of this report.

Use a maximum allowable net soil bearing pressure of 3,000 psf

- ◆ Use a maximum allowable net soil bearing pressure of 3,000 pounds per square foot (psf) in footing design.
- ◆ Use minimum footing dimensions of 24 inches for isolated spread footings and 18 inches for strip footings and thickened edges of monolithic slabs even though the maximum net soil bearing pressure may not be fully developed in all cases.
- ◆ Design foundations so that footings bear at least 18 inches below finished exterior grades (12 inches for thickened edges on monolithic slabs).

- ◆ Support floor slabs constructed on-grade on a compacted sand base (95% modified proctor).
- ◆ Overexcavate excessively loose or disturbed soils encountered in the floor slab areas and replace with sands selected and compacted in accordance with the **Fill Selection, Placement and Compaction** section of this report.

7.2 Pipe Bedding, Backfill and Compaction

The soils encountered in the borings to a depth of 10 feet below existing grade are generally suitable for use as pipe bedding material and pipe excavation backfill. Ideally pipe bedding and pipe trench backfill soils should consist of non-plastic sands with less than about 15% fines

...mucky fine sand...is not suitable for backfill or bedding and should be removed to 2 feet below the pipe invert...

content. The fill should not contain any significant amount of organic substances (less than 3% by weight) or other deleterious materials. Boring AB-1 encountered mucky fine sand (PT) from 8 to 10 feet below the existing ground surface. The mucky fine sand (PT) encountered is not

suitable for backfill or bedding and should be removed to 2 feet below the pipe invert where encountered.

The contractor should adhere to the following recommendations for preparation of pipe bedding and pipe trench backfill placement and compaction.

- ◆ Remove any soft, loose, or organic soils from below the pipe invert elevation, for the full width of the trench, and to the depth required to reach suitable foundation material.
- ◆ Compact suitable pipe bedding material to a minimum of 95% of the soil's Modified Proctor maximum dry density to a minimum depth of 6 inches below the bottom of pipe.
- ◆ Excavate and shape bedding soils to accommodate pipe "bells", valves, and fittings to completely support each pipe section and help to eliminate point loading conditions.
- ◆ Place fill and backfill soil in level lifts no thicker than 12 inches.

- ◆ Compact each backfill lift to a minimum of 95% of the soil's modified Proctor maximum dry density as determined by ASTM D-1557 for each lift of fill placed.
- ◆ Compaction tests should be performed for each run of pipe between manholes and/or structures or at least one test per 300 lineal feet.
- ◆ Allow an Engineering Technician, working under the direction of a registered Geotechnical Engineer, to perform in-place density tests to verify that the recommended degree of compaction has been achieved.
- ◆ Install sheeting and bracing or properly designed trench shields, if required, to support the sides of excavations during pipe installation.
- ◆ All excavations including utility trenches, should comply with the recommendations included in the **Temporary Excavations** section of this report.

Where utility lines will traverse roadways and/or other permanent structures, such as sidewalks, the backfill should be compacted to 98% of the soil's Modified Proctor maximum dry density for a depth of 2 feet below ground surface

8.0 CONSTRUCTION ISSUES

The following sections of this report include comments on issues related to the geotechnical aspects of the proposed construction. *These recommendations are not intended to dictate construction methods or sequences.* Instead, they are furnished as an aid to design professionals and to identify important construction issues related to foundation and earthwork plans and specifications. These recommendations may also be useful to personnel who observe construction activity.

Prospective contractors for this project should evaluate potential construction problems on the basis of their review of the contract documents, their own knowledge and experience in the local area, and on the basis of similar projects in other localities, taking into account their own proposed methods and procedures.

8.1 General Site Preparation

Our recommendations regarding routine site preparation of the structure areas can be summarized as follows:

- ◆ Remove all concrete, asphalt, vegetation and organic topsoil, major root systems, buried utilities, sprinkler systems and other deleterious materials from beneath and to a minimum of 5 feet beyond the proposed structure limits.
- ◆ Standard clearing, grubbing, and topsoil stripping procedures should be appropriate for this site.
- ◆ Perform temporary dewatering as required to achieve proper site preparation, fill placement and compaction.
- ◆ Allow a Geotechnical Engineer to inspect the site after it has been stripped to verify adequate topsoil and vegetation removal and also to observe subsequent proofrolling.
- ◆ In structure areas where fill is required, proofroll the stripped ground surface using a large vibratory roller (Dynapac CA-25 or equivalent). Proofroll cut areas after excavation to proposed grade to allow adequate compaction of the exposed subsoil.

Nearby structures may be adversely affected by vibratory rolling operations.

- ◆ ***Exercise extreme caution when operating vibratory equipment near existing structures.*** Operate roller in the static mode if excessive vibrations are experienced by any near-by structures or if the soil subgrade becomes unstable. Nearby structures may be adversely affected by vibratory rolling operations. Provisions should be made to monitor the adjacent structures and neighborhood for excessive vibrations.
- ◆ Proofroll the structure area with a minimum of 10 overlapping passes in each of two perpendicular directions. Allow a Geotechnical Engineer, or his representative, to observe proofrolling operations. The purposes of the proofrolling will be to detect unstable soils that yield when subjected to compaction and to densify the near-surface loose sands for support of shallow foundations and soil-supported floor slabs.

- ◆ Remove material that yields excessively during proofrolling and replace with fill selected and compacted as described in the next section of this report. The Geotechnical Engineer, based on his observations, should recommend the nature and extent of any remedial work. If the soil subgrade is saturated, or if the fill is at a moisture content over “optimum”, then instability may occur and the contractor will be required to implement remedial measures to successfully place and compact the fill.
- ◆ Silty sand (SM) may be exposed at the compaction surface during site preparation. These soils can be unstable during proofrolling if they contain excess moisture. The contractor should be prepared to manipulate the moisture content of unstable subgrade soils as necessary to achieve stability and compaction requirements.
- ◆ Continue proofrolling until the soil at a depth of 12 inches below the compaction surface has attained a minimum of 95% of the soil's modified Proctor maximum dry density as determined by ASTM Standard D-1557.
- ◆ Allow an Engineering Technician, working under the direction of a Geotechnical Engineer registered in the State of Florida, to perform in-place density tests to verify that the required degree of compaction has been achieved.

8.2 Fill Selection, Placement and Compaction

The soils encountered in the borings appear suitable for use as structural fill with exception of the mucky fine sand (PT) encountered in boring AB-1. We recommend that all fill be selected, placed and compacted as follows:

Use fill material comprised of non-plastic sands with less than about 12% fines content.

- ◆ Use fill material comprised of non-plastic sands with less than about 12% fines content. The fill should not contain any significant amount of organic substances (less than 3% by weight) and should be substantially free from roots or other organic or deleterious materials.
- ◆ Our borings encountered sands with varying silt content (SP-SM, SM) which appear suitable for use as fill. Sands excavated above the water table may have to be wetted to attain the moisture content needed to achieve the required degree of compaction.

- ◆ Place fill in level lifts no thicker than 12 inches. Thinner lifts may be needed to achieve compaction in the silty sands.

Compact fill to a minimum of 95% of the soil's modified Proctor maximum dry density...

- ◆ Compact fill to a minimum of 95% of the soil's modified Proctor maximum dry density as determined by ASTM Specification D-1557 for each lift of fill placed.

- ◆ Allow an Engineering Technician, working under the direction of a registered Geotechnical Engineer, to perform in-place density tests to verify that the recommended degree of compaction has been achieved.
- ◆ Provide fill slopes no steeper than 2 horizontal to 1 vertical.
- ◆ Compact fill placed in utility trenches to the specifications stated above. However, in restricted working areas, compact fill with lightweight, hand-guided compaction equipment and limit lift thicknesses to a maximum of 6 inches.
- ◆ All excavations including utility trenches, should comply with the recommendations included in the **Temporary Excavations** section of this report.

8.3 Foundation Subgrade Preparation

We recommend the following steps be taken during footing excavation and subgrade preparation:

- ◆ Excavate footings in accordance with the recommendations presented in the **Temporary Excavations** section of this report.
- ◆ Compact footing subgrade soils to a depth of 12 inches below footing bearing elevations to a minimum of 95% of the soil's modified Proctor maximum dry density as determined by ASTM Standard D-1557.
- ◆ Perform in-place density tests to verify foundation subgrade compaction.
- ◆ Allow a Geotechnical Engineer, or his representative, to observe footing excavation conditions prior to placement of reinforcing steel or concrete.

- ◆ On the basis of the Geotechnical Engineer's observations, remove any unsuitable material encountered in the footing excavations and replace with sand selected and compacted in accordance with the **Fill Selection, Placement and Compaction** section of this report.

8.4 Temporary Excavations

The owner and the contractor should be familiar with local, state and federal safety regulations, including current Occupational Safety and Health Association (OSHA) excavation and trench safety standards. Construction site safety is the responsibility of the contractor. The contractor should also be responsible for the means, methods, techniques, sequences, and operations of the construction.

The contractor should be aware that slope height, slope inclination, and excavation depths (including utility trench excavations) should not exceed those specified in local, state, or federal safety regulations; e.g., OSHA Health and Safety Standards for Excavations, 29 CFR Part 1926. *OSHA regulations are strictly enforced and, if not followed, the owner, contractor, earthwork subcontractor or utility subcontractor could be liable for substantial penalties.*

The soil encountered in the borings performed by GEC at this site is primarily sand with varying amounts of silt. We anticipate that OSHA will classify these materials as Type C. OSHA recommends a maximum temporary slope inclination of 1.5 horizontal to 1 vertical for this soil type. Soils encountered in the construction excavations may vary significantly across the site. Our soil classifications are based on the materials encountered in widely-spaced borings. The contractor should verify that similar conditions exist throughout the proposed excavation area. If different subsurface conditions are encountered at the time of construction, GEC should be contacted immediately to evaluate the conditions encountered.

8.5 Temporary Dewatering

Depending on groundwater levels at the time of construction and final design grades, temporary dewatering may be required to facilitate stable excavations and placement and compaction of fill. The contractor should be required to provide a dewatering system which maintains groundwater levels at least 2 feet below compaction surfaces, including the bottom of excavations. A system of ditches and sumps may be sufficient in some instances to achieve adequate dewatering, but the contractor should be prepared to install wellpoint dewatering systems in deeper excavations as necessary.

Additionally, the contractor must provide positive site drainage during site preparation and fill placement. Surface runoff should not be allowed to accumulate. Temporary rim ditches may be required to facilitate site preparation.

9.0 QUALITY ASSURANCE

We recommend establishing a comprehensive quality assurance program to verify that all site preparation and foundation construction is conducted in accordance with the appropriate plans and specifications. Materials testing and inspection services should be provided by Geotechnical and Environmental Consultants, Inc. due to our familiarity with the site conditions and the intent of our recommendations.

As a minimum in-situ density tests should be conducted during earthwork activities and below all slabs to verify that the required densities have been achieved. In-situ density values should be compared to laboratory Proctor moisture-density results for each of the different natural and fill soils encountered.

Finally, we recommend inspecting and testing the construction materials for the foundations and other structural components.

10.0 USE OF THIS REPORT

GEC has prepared this report for the exclusive use of our client, Black & Veatch, for specific application to our client's project. GEC will not be held responsible for any third party's interpretation or use of this report's subsurface data or engineering analysis without our written authorization.

In addition, this report makes recommendations for designers to use in developing the project plans and specifications. However, the recommendations in this report are not written in specification language and are not intended to be used verbatim as a part of the plans and specifications. This report should not be wholly incorporated into the project contract documents.

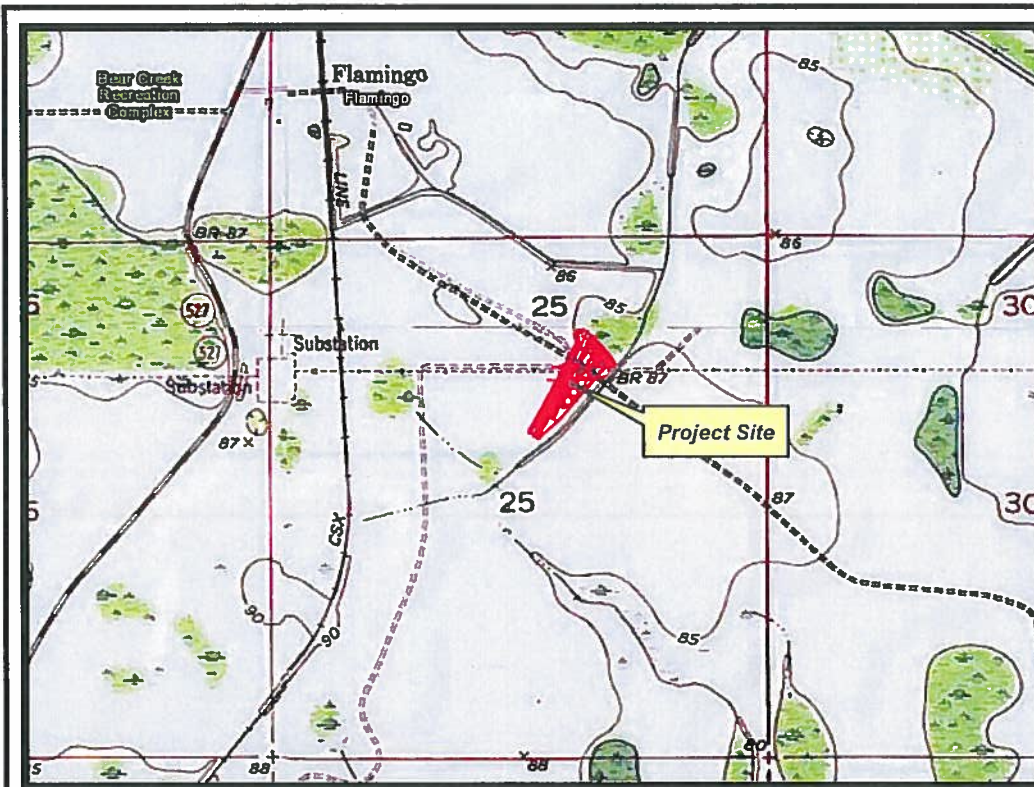
The sole purpose of the borings made by GEC at this site was to obtain indications of subsurface conditions as part of a geotechnical exploration program. GEC has not evaluated the site for the potential presence of contaminated soil or groundwater, nor have we subjected any soil samples to analysis for contaminants.

GEC has strived to provide the services described in this report in a manner consistent with that level of care and skill ordinarily exercised by members of our profession currently practicing in Central Florida. No other representation is made or implied in this document.

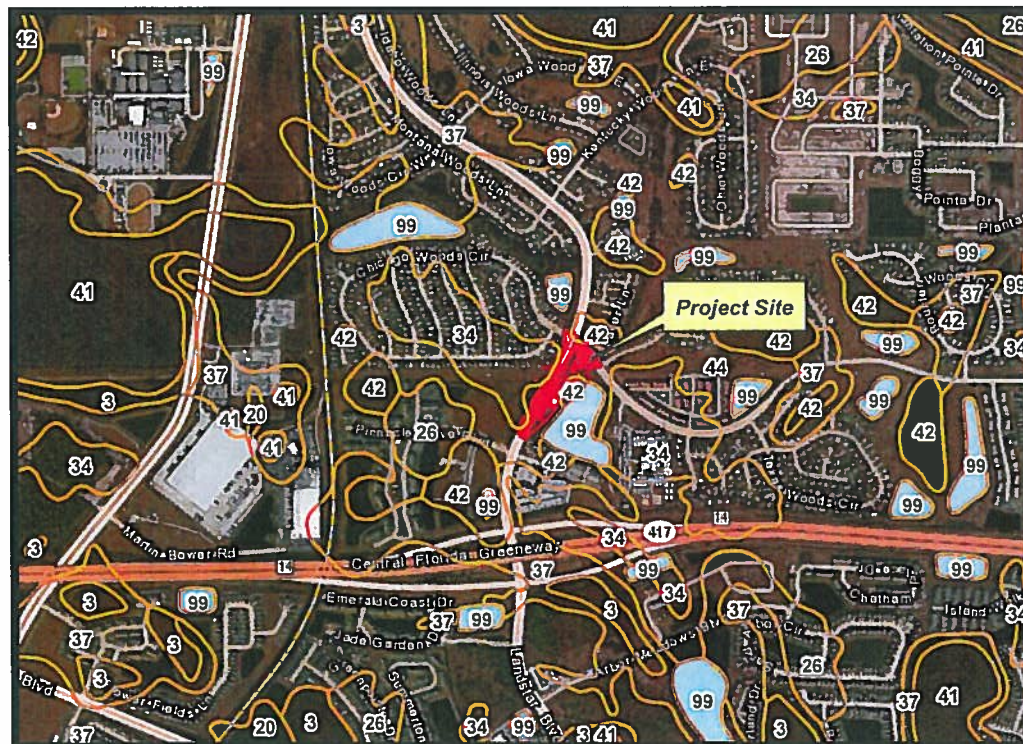
The conclusions or recommendations of this report should be disregarded if the nature, design, or location of the facilities is changed. If such changes are contemplated, GEC should be retained to review the new plans to assess the applicability of this report in light of proposed changes.

APPENDIX

**USGS QUADRANGLE AND
NRCS SOIL SURVEY MAPS**



Prepared from
 USGS St. Cloud North, FL. Quadrangle Map
 Section: 25
 Township: 24 South
 Range: 29 East



Prepared from
 NRCS Soil Survey of Orange County, FL.
Orange County Map Unit Legend
 34 - Pomello fine sand, 0 to 5 percent slopes
 42 - Sanibel muck
 44 - Smyrna fine sand



**Geotechnical and Environmental
 Consultants, Inc.**

919 Lake Baldwin Lane
 Orlando, FL 32814
 (407) 898-1818
 FAX (407) 898-1837
 COA No. 00005882

**SOUTH WATER
 SERVICE AREA
 MEADOW WOODS
 WATER SUPPLY
 FACILITY**

PROJECT NO.: 3433G

DATE: 1-23-13

SENIOR PROFESSIONAL: CPM
 P.E. NO.: 49328

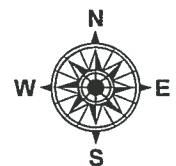
PROJECT PROFESSIONAL: VEW

DRAWN: SKR

REVISION:



Aerial photograph and
 map source:
 ESRI's on-line map services



**USGS QUADRANGLE AND
 NRCS SOIL SURVEY MAPS**

FIGURE 1

**BORING LOCATION PLAN
WITH BORING RESULTS**



Geotechnical and Environmental Consultants, Inc.

919 Lake Baldwin Lane
Orlando, FL 32814
(407) 898-1818
FAX (407) 898-1837
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**SOUTH WATER SERVICE AREA
MEADOW WOODS WATER SUPPLY FACILITY**

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REVISION:

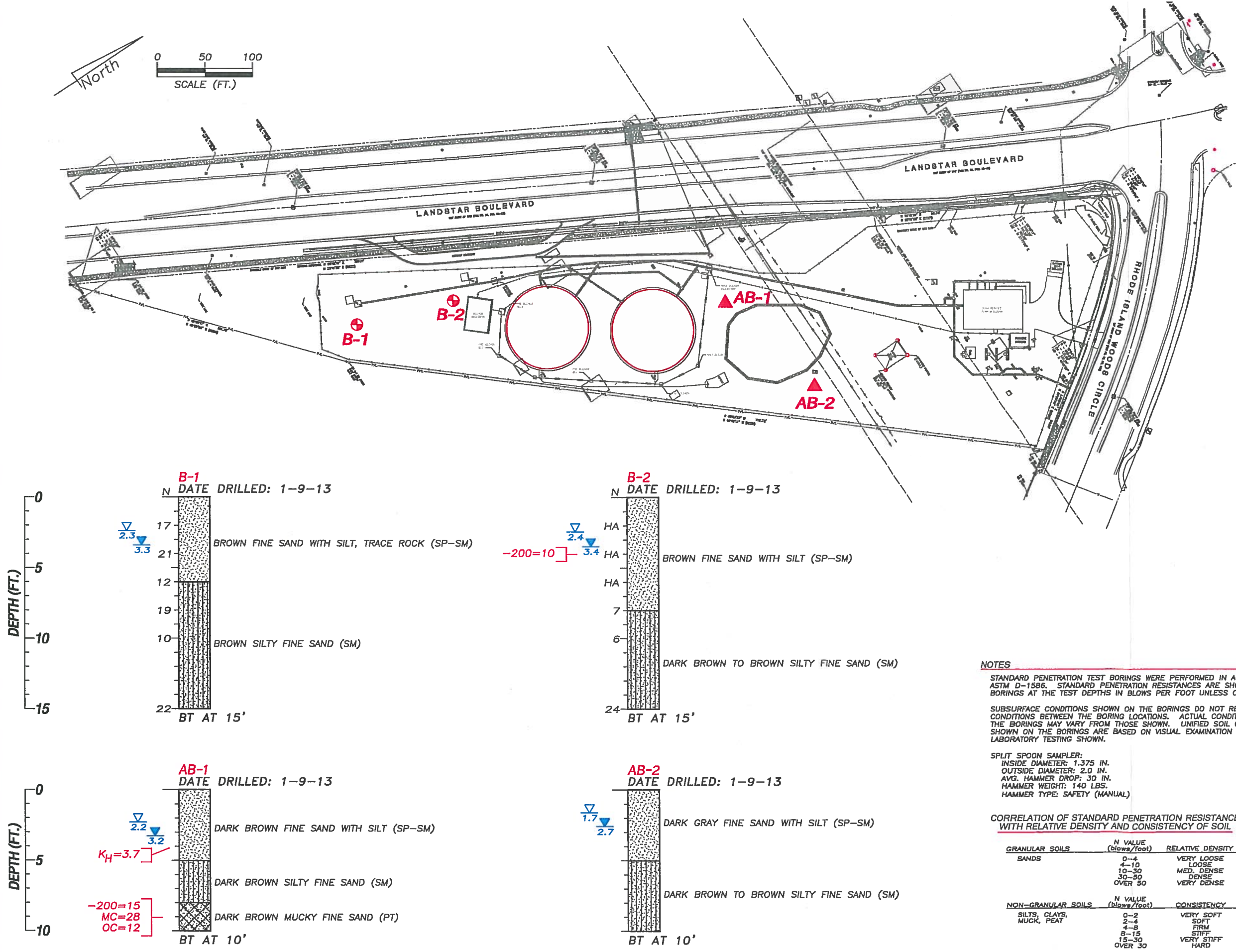
LEGEND

- ⊕ APPROXIMATE AUGER BORING LOCATION
- ▲ APPROXIMATE SPT BORING LOCATION
- N STANDARD PENETRATION RESISTANCE, BLOWS PER FOOT
- HA HAND AUGERED FOR CLEARANCE OF UTILITIES
- $\nabla_{2.3}$ ESTIMATED SEASONAL HIGH GROUNDWATER DEPTH (FT.)
- $\nabla_{3.3}$ ENCOUNTERED GROUNDWATER DEPTH (FT.)
- 200= PERCENT PASSING NO. 200 U.S. STANDARD SIEVE
- MC= PERCENT NATURAL MOISTURE CONTENT
- OC= PERCENT ORGANIC CONTENT
- K_H = HORIZONTAL PERMEABILITY RATE (FT./DAY)

- SAND
- SAND AND SILT
- SAND AND MUCK

BORING LOCATION PLAN WITH BORING RESULTS

FIGURE 2



J:\D104\3433G\3433Gsite.dwg, 1/29/2013 10:30:32 AM, 1:100

CORROSION SERIES TEST RESULTS

Table 4
Corrosion Series Test Results
SOUTH WATER SERVICE AREA
Meadow Woods Water Supply Facility
GEC Project No. 3433G

Boring No.	Unified Soil Classification	Sample Depth (feet)	pH	Minimum Resistivity (ohm-cm)	Chlorides (ppm)	Sulfates (ppm)	Redox Potential (mV)	Substructural Environmental Classification ¹		DIPRA ² 10 Point Soil Test Evaluation ³
								Concrete	Steel	
B-2	SP-SM	4 - 8	5.8	28,000	30	39	97	M.A.	E.A.	4.5

Notes:

- (1) E.A. - Extremely Aggressive M.A. - Moderately Aggressive
- (2) Ductile Iron Pipe Research Association
- (3) Test series does not include sulfide test. Maximum point total for sulfides is 3.5.

FIELD PERMEABILITY TEST CALCULATIONS



**Geotechnical
and
Environmental
Consultants, Inc.**

At the very foundation of our community

**CONSTANT HEAD FIELD PERMEABILITY
TEST CALCULATIONS
South Water Service Area
Meadow Woods Water Supply Facility
GEC Project No. 3433G**

Input From Test

Test Location	AB-1
Test Depth (ft)	3 - 5
Soil Type	SP-SM
Diameter of Gravel Pack, D (in)	3.00
Riser Height, H_r (ft)	2.0
Groundwater Depth, D_{wt} (ft)	3.0
Length of Gravel Pack, L (ft)	2.0
Water Level in Casing, D_{wl} (ft)	0.0
Flow, q (gal/min)	0.384
Flow, q (ft ³ /day)	73.9
Field Horizontal Permeability Rate, k_h (ft/day)	3.7

Calculations

$$m = \sqrt{\frac{k_h}{k_v}}$$

Transformation Ratio

$$m = \sqrt{2}$$

Assuming $k_v = 0.5k_h$

$$H_c = D_{wt} + H_r - D_{wl}$$

Constant Piezometric Head

$$k_h = q \cdot \frac{\ln \left[m \cdot \frac{L}{D} + \sqrt{1 + \left(m \cdot \frac{L}{D} \right)^2} \right]}{2 \cdot \pi \cdot L \cdot H_c}$$

From NAVFAC TM 5-818-5 PG. 35*

