

**SECTION 17010
GENERAL REQUIREMENTS, INSTRUMENTATION**

PART 1 - GENERAL

1.01 Summary

- A. Scope: General requirements for Instrumentation and Control System (ICS) design, procurement, delivery, and implementation as shown on the Contract Drawings (Drawings) and as specified in these Specifications.
- B. The contractor shall retain the service of a System Integrator. The System Integrator will purchase, assemble, configure, prepare submittal material and prepare Operations and Maintenance Manuals all of the components that make up the ICS. In addition, the System Integrator will purchase, assemble, configure, prepare submittal material and prepare Operation and Maintenance Manuals for the Motor Control Centers and Variable Frequency Drives. The System Integrator shall conduct associated Factory Acceptance Testing and Site Acceptance Testing noted.
- C. Related Sections: The following list of related sections is provided for the convenience of the Contractor. It includes the commonly referenced sections that are in-general applicable to all equipment supplied. This list does not excuse the Contractor from any requirement given in sections not specifically listed below. Where there is a difference between this specification and any other specifications the conflict shall be resolved at the sole discretion of the Engineer.

<u>Section</u>	<u>Title</u>
Section 01300	Submittals
Section 01360	Operating and Maintenance Information
Section 01620	Protection of Materials and Equipment
Section 01660	Testing and Startup
Section 01661	Instruction of Operations and Maintenance Personnel
Section 11010	General Requirements for Equipment
Section 11050	Equipment Mounting
Section 11060	Electric Motors
Section 16010	General Electrical Provisions
Section 16120	Wire and Cables
Section 16130	Wiring Devices
Section 16160	Pilot Devices
Section 16200	Overcurrent Protective Devices
Section 16250	Motor Control Center
Section 16261	Automatic Transfer Switch
Section 16320	Surge Protective Devices
Section 16324	Uninterruptible Power Supply

Section 16330	Variable Frequency Drives
Section 17110	Instrumentation and Control Systems
Section 17201	Control Panels
Section 17506	Extended Warranty and Maintenance
Section 17510	Factory Acceptance Tests
Section 17512	Site Acceptance Tests
Section 17902	SCADA System
Section 17924	Control Strategies

- D. The work of this section shall be performed by a qualified System Integrator. The contractor shall retain the services of a System Integrator to provide complete, assembled, installed, setup and testing of all instrumentation and control system components. The System Integrator shall have a minimum of ten Wonderware systems in water or wastewater applications. The System Integrator shall also be responsible for the SCADA System, PLC System, Control Panels, Motor Control Centers, Harmonic Filters, and field instrumentation. The System Integrator shall be Tesco Controls, FluidIQs or pre-approved equal.
- E. System Integrator must be pre-approved by the Owner's Representative in order to submit a bid for this project. Any bid listing a System Integrator that has not been pre-approved will be automatically disqualified. For consideration, any System Integrator not listed above in Paragraph D must submit their qualifications using the Pre-Qualification Form provided in specification Section 17015-System Integrator Pre-Qualification Form. Any submitted pre-qualifications not containing a completed specification Section 17015 will be automatically considered unresponsive and will be rejected. Only one submission per System Integrator will be allowed. System Integrator shall be certified by Control System Integrators Association (CSIA). System Integrator shall be Wonderware Archestra certified.
- F. Interpretation of Drawings
1. General: Any error or omissions of details in either the Drawings or Specifications shall not relieve the System Integrator from correctly installing all materials necessary for a complete and operating ICS.
 2. Site Verification: The System Integrator shall inspect the project site and verify all measurements and conditions and shall be responsible for the correctness of final installation. No extra compensation will be allowed because of differences between work shown on the Drawings and measurements at the site.
 3. Drawings: The Instrumentation Drawings are diagrammatic, but shall be followed as closely as existing conditions and work of others will permit. All deviations from the Drawings required to make the work conform to structures as constructed, and to the work of Others, shall be made at the System Integrator's own expense.
 4. Coordination: The System Integrator shall examine the architectural, structural, mechanical and manufacturer's drawings for all equipment to coordinate and determine the exact routing and final terminations of all conduits and cables. Conduits shall be stubbed up as near as possible to equipment enclosure.
 5. Accessibility: The Drawings do not show the exact locations of equipment. All equipment shall be located and installed so that it will be readily accessible for operation and maintenance. The Owner reserves the right to require minor changes in location of outlets or equipment, prior to roughing in, without incurring any additional costs or charges.

G. Manufacturer's Directions

1. Manufacturer's directions shall be followed in all cases where manufacturers furnish instructions covering points not shown on the Drawings or specified in these Specifications.

H. Inspection

1. The System Integrator and Contractor shall cooperate with the Owner's Representative and shall provide assistance at all times for the inspection of the instrumentation work. Remove covers, or perform any reasonable work, which in the opinion of the Owner's Representative will be necessary to determine the quality or adequacy of the work.
2. If any material does not conform to these Specifications the Contractor shall, within three (3) days after being notified by the Owner's Representative, remove the materials from the premises.
3. Work shall not be closed in or covered before inspection and approval by the Owner's Representative. Cost of uncovering and making repairs where un-inspected work has been closed in shall be borne by the Contractor.

I. Supervision and Workmanship

1. The Contractor shall employ a competent instrumentation foreman on the job throughout the entire period of construction to see that his work is carried on without delay and completed as rapidly as possible.
2. Before the start of construction and in conjunction with the schedule of others, the Instrumentation Sub-Contractor shall furnish to the General Contractor a tentative construction schedule showing the order of the work, the process control panel shop drawings submittal dates and the anticipated delivery dates of all instrumentation equipment.

J. Cooperative Work with Others

1. The System Integrator and Contractor shall cooperate with others, with due regard to their work, towards promotion of rapid completion of project. If any cooperative work must be altered due to lack of proper supervision of such, or failure to make proper provision in time by System Integrator or the Contractor, then it shall bear expense of such changes as necessary to be made in work of others.
2. Labor and materials, including templates, sleeves, anchors, concrete inserts and the like shall be furnished in ample quantities at such times as necessary to ensure uninterrupted progress of work.
3. The Contractor shall cease work at any particular point temporarily and transfer its operations to such points or execute such portions of work as directed, when in the judgment of the Owner's Representative it is necessary to do so.

K. Quality of Materials

1. All instrumentation components used on this project shall be new and free from defects.
2. All instrumentation components used on this project shall conform where applicable, to the Codes and Standards in Section 1.02, References.
3. Each type of material shall be of the same manufacturer and quality throughout the work.

L. Substitutions

1. No substitutions shall be allowed unless specifically noted as "or equal" or as "or approved equal." Specific brand names and catalog numbers are used to describe materials in order to establish standards of performance and quality.

2. The decision of the Engineer or Owner's Representative shall govern as to what is equal to the item specified. Equality will be judged on the basis of the following:
 - a. Conformance to description or performance required
 - b. Equality in quality
 - c. Comparable in appearance and artistic effect where these are considerations
 - d. Comparable operation, maintenance and performance
 - e. Equal in longevity and service under conditions of climate and usage
 - f. Conformance with space allocations and requirements for operations from mechanical or electrical services provided without necessitating changes in details and construction or related work
3. If the Owner's Representative considers it necessary, tests to determine the quality of the proposed materials shall be made, at the expense of the Contractor, by an unbiased laboratory, satisfactory to the Owner's Representative.
4. Any material, article, or method judged by the Engineer equal to that specified will be approved, provided the Contractor submit a single written request, in triplicate, to the Owner's Representative, within 30 days after contract award, with the following information for each item:
 - a. Complete data substantiating compliance of proposed substitution with Contract Documents
 - b. Product Identification including trade or brand name including type, model, style, and/or catalog number
 - c. Manufacturer's literature marked to indicate specific model, type, size, and options to be considered.
 - d. Size or capacity rating
 - e. Names and addresses of a minimum of three (3) references for similar installations to this Contract
 - f. Manufacturers' statements that proposed products are equal or superior in all respects to that specified.
5. The System Integrator assumes full responsibility for including complete and correct data in its request for substitution. The System Integrator shall also attach complete referenced diagrams and technical data sheets for the Engineer's review and determination of equality or suitability of any substitution item. Only one such request may be submitted. The Engineer's rejection of any substitute shall automatically require the System Integrator furnish the specified item without further discussion or delay.

1.02 References

- A. General: The work shall comply with the most recent Codes and Standards as published at the date of the Contract and as listed in the Specifications.

<u>Reference</u>	<u>Title</u>
NFPA 70	National Electrical Code – Latest Edition
NFPA 101	Life Safety Code - Latest Edition

<u>Reference</u>	<u>Title</u>
UBC	Uniform Building Code - Latest Edition
ANSI	American National Standard Institute
ASTM	American Society for Testing and Materials
ASME	American Society of Mechanical Engineers
IEEE	Institute of Electrical and Electronic Engineers
ISA	Instrument Society of America
JIC	Joint Industrial Council
NEMA	National Electrical Manufacturers Association
OSHA	Occupational Safety and Health Administration
SAMA	Scientific Apparatus Makers Association
UL	Underwriters' Laboratories, Inc
EIA	Electronic Industries Association
	City Mechanical and Electrical Codes
	Any additional codes effective at the job site

- B. Additional Requirements: The System Integrator shall furnish without extra charge any additional material and labor which may be required for compliance with these laws, rules, and regulations, even though the work is not mentioned in the Specifications or shown on the Drawings.
- C. Permit Requirements: The Contractor shall apply and pay for all permits required by any of the legally constituted public authorities for the installation or construction of the work included in these Specifications. The Contractor shall arrange and pay for any inspections or examinations so required and deliver certificates of all such inspections to the Owner's Representative. When these Specifications call for materials or construction of a better quality or larger sizes than required by the above mentioned rules and regulations, the provisions of the Specifications shall take precedence.

1.03 System Description

- A. General: Furnish all necessary labor, materials, equipment and incidentals required to install a complete and operational Instrumentation and Control System in accordance to the intent of these Specifications and Drawings.
- B. Itemized Work: The following list shall be considered major work items, but not an inclusive and complete description of the scope of work. The Drawings in conjunction with the Specifications shall be used to determine the complete ICS work. The general scope of work includes the furnishing, installing, programming, testing, and commissioning of the following items:
 1. Instrumentation and Control System. This Item includes programming and configuration of the new Programmable Logic Control (PLC) systems, Operator Interface Terminals (OITs), Communication System, and Supervisory Control and Data Acquisition (SCADA) system.
 2. Coordination with vendors or subcontractors (others) to interface with the control systems provided by others. This Item includes all interconnection wiring required for interfacing with such control systems including SCADA screens for monitor, control and alarm of the same functions that are available from their Operator Interface Terminals.

3. All supports, bases, anchors, sleeves, hangers, conduit seals, and the like.
 4. Shop Drawings and Operation and Maintenance (O&M) manuals.
 5. Control Panels including all control components required for proper operation of the control system.
 6. All power supplies, transformers, pushbuttons, pilot lights and selector switches.
 7. Instrumentation system including but not limited to level transmitters, pressure transmitters, pressure switches, pressure gauges, and flow meters,
 8. Interconnection wiring diagrams.
 9. Telemetry including hardware and programming,
 10. Factory Acceptance Tests
 11. Site Acceptance Tests
 12. Throughout this Contract, provide protection for materials and equipment against loss or damage in accordance with provisions specified elsewhere in these Specifications.
 13. Throughout this Contract, follow manufacturer's recommendations for storage of equipment. Protect everything from the effects of weather. Prior to installation, store items in clean, dry, indoor locations. Store items subject to corrosion under damp conditions, in clean, dry, indoor, and heated locations.
- C. Following installation, protect materials and equipment from corrosion, physical damage, and the effects of moisture on insulation. Energize all space heaters furnished with equipment

1.04 Submittals

- A. General: Submittals for all ICS equipment shall be prepared and submitted in accordance to Section 01300-Submittals and 01360-Operating and Maintenance Information.
- B. Requirements: The submittal package for each individual equipment or groups of related equipment shall include all the required data and information and shall be complete. As a condition to the review of submittals required under these specifications, the System Integrator shall furnish the manufacturer's statement for the equipment accepting the unit responsibility. The purpose of this provision is to ensure compatibility of all components specified under the specific Technical Specifications; and to provide sole source responsibility for system performance and maintenance. Notwithstanding these provisions, however, the System Integrator is not relieved of his responsibility for the indicated portions of the work. The following submittal data shall be provided for each item of equipment. Additional data specific to individual equipment specified under individual Specifications shall be submitted in addition to the following.
- C. Contract Drawings: The Drawings are generally diagrammatic unless detailed or dimensioned. Structural conditions, physical interference and locations of terminations of equipment shall govern the exact locations and routing of wiring, conduit and pipe. The Contractor and System Integrator shall examine the architectural, structural, mechanical, electrical and instrumentation plans and shop drawings for the equipment to determine the exact routing and final terminations of conduit, cables and pipes. Conduits and pipes shall be stubbed as near as possible to equipment terminals.
- D. Deviations from Specifications: Should the System Integrator's proposed system specifications deviate from these Specifications, such deviation shall be documented and submitted to the Engineer for approval. All deviations shall be stated on the submittal transmittal sheet.
- E. Organization and Binding of Submittals: The initial and subsequent submittals of drawings and data for review shall be organized and bound so that eventually they may be used as guides for

preparing the required maintenance manuals. The submittal shall be organized in three (3) parts, not including preliminary administrative material such as table of contents, as follows:

1. Part 1 shall consist of a series of sections, one for each process control system. Each section shall be divided by a tab and shall include the material specified below.
 2. Part 2 shall include outline dimension drawings for panels, cabinets, consoles and the like, as specified below.
 3. Part 3 shall include data on miscellaneous parts and accessories not included in Part 1.
- F. Data Sheets: Data sheets shall be in a standardized format and shall include the following:
1. Components name used herein and on the drawings,
 2. Manufacturer's model number or other product designation,
 3. Project tag number,
 4. System of which the component is a part,
 5. Location or assembly at which the component is to be installed,
 6. Input and output characteristics,
 7. Scale range and units (if any) and multiplier (if any),
 8. Requirements for electric supply (if any),
 9. Requirements for air supply (if any),
 10. Materials of component parts to be in contact with, or otherwise exposed to, process media,
 11. Reference to manufacturer's descriptive technical bulletin or brochure,
 12. References to other features so that all specified features are stated on the data sheet,
 13. Following each data sheet, a technical product bulletin, or brochure (or clear photocopy thereof) shall be inserted; this shall provide amplifying technical information on the construction, characteristics, and capabilities of the component described in the related data sheet. Elaborate and extensive technical details shall not accompany these bulletins. All bulletins shall be of the most recent issue,
 14. Part 2 of the submittal shall include outline and dimension drawings for all enclosed assemblies including cabinets, panels, consoles and the like. These drawings shall show the arrangements of panel-mounted and internally mounted components to scale and shall include enough details to clearly establish the style and overall appearance of each assembly, and
 15. Part 3 of the submittal shall consist of a series of data sheets for accessory components together with supporting catalog pages or bulletins (or clear photocopies thereof). These shall be arranged in a logical sequence and shall cover such items as:
 - a. Control circuit devices, components and wiring
 - b. Pneumatic components, fittings and tubing
 16. Operation and Maintenance Manuals
 - a. General: The System Integrator shall provide Operation and Maintenance (O&M) manuals in accordance with Section 01360-Operating and Maintenance Information.
 - b. Content: A set of manuals shall include all the drawings and required data and shall be organized and bound as specified for the review submittals. These drawings and data shall be supplemented with installation, connection, operation, troubleshooting, maintenance and overhaul instructions in complete detail. This shall provide the Owner with comprehensive information on all systems and components to enable operation, service,

maintenance and repair. Exploded or other detailed views of all instruments, assemblies and accessory components shall be included together with complete parts lists and ordering instructions.

- c. Format: In addition to the requirements set forth elsewhere, the O&M manuals shall consist of at least the following:
- 1) Table of contents,
 - 2) Manufacturer's or its representative's contact information,
 - 3) Equipment complete model number for ordering,
 - 4) Spare parts with model numbers,
 - 5) Special tools with model numbers,
 - 6) System block and schematic diagrams,
 - 7) Component schematic diagrams, and
 - 8) Written step-by-step operating, troubleshooting and calibrating instructions for each of the systems and each of the components of each system

1.05 Quality Assurance

A. Performance and Design Requirements

1. **Manufacturer's Qualifications:** The equipment furnished under this division shall be the product of firms regularly engaged in the design and manufacture of the type of item specified, possessing the required technical competence, skill, resources and ability to complete the work specified herein with the requisite degree of quality in a timely and efficient manner. The Contractor shall be prepared to adequately document the qualifications of the manufacturers nominated to provide the equipment specified under this division. All documentation shall be submitted to the Owner's Representative prior to design fabrication and shipment of any component specified herein. Nothing contained within these provisions shall be construed as relieving the Contractor of his responsibility for any portion of the work covered by this Section.
2. **Arrangement:** The drawings are generally diagrammatic and the location of instruments and control panels are approximate unless detailed or dimensioned. The exact locations and routing of cables and conduits shall be governed by structural conditions, physical interferences and the location of electrical terminations on equipment.
3. The Contractor shall examine the structural and mechanical plans and shop drawings for the various equipment to determine exact routings and final terminations for all raceways and cables. Conduits shall be stubbed up as near as possible to field instruments and shall be within the concrete base for the equipment or a separate concrete curb.
4. All conduit, instruments and control panels shall be installed in such a manner as to avoid all obstructions and to preserve head room and keep openings and passageways clear. Control Panels, metering, transmitters and similar items shall be located within finished rooms, as shown. Where the Drawings do not indicate exact locations, the Contractor shall submit proposed locations to the Engineer for review. Where equipment is installed without instruction and must be moved, it shall be moved without additional cost to the Owner.
5. All work, including installation, connection, calibration, testing, and adjustment, shall be accomplished by qualified, experienced personnel working under continuous, competent supervision. The completed installation shall display competent work, reflecting adherence to prevailing industrial standards and methods.

6. Allowance has been made in the design for the number of raceways, cables and conductors considered adequate for feeding the various instruments and control panels. These circuits and diagrams are based on available data pertaining to the particular design of equipment and portray the systems, which the owner has chosen to effect the required operation and level of control. Equipment provided by the Contractor (even though of the make and model specified) may differ in detail, arrangement, or connections from that shown. If the Contractor uses equipment which differs from the equipment shown in major aspects and requires modifications to power, control or other electrical service, the Owner's acceptance of the equipment will be based upon the Contractor providing the modifications required, and they shall be of the same quality as shown and shall be provided at no additional cost to the Owner.
7. Protection of Equipment and Materials: The Contractor shall provide adequate means for and shall fully protect all finished parts of the materials and equipment against damage from any cause during the progress of the work and until acceptable by the Owner's Representative.
8. All materials and equipment, both in storage and during construction, shall be covered in such a manner that no finished surfaces will be damaged, marred, or splattered with water, foam, plaster, or paint. All moving parts shall be kept clean and dry.
9. The Contractor shall replace or have refinished by the manufacturer, all damaged materials or equipment, including face plates of instruments and control panels, at no expense to the Owner.
10. Tests: The Contractor shall make all tests required by the Owner's Representative or other authorities having jurisdictions as per applicable standards. All such tests shall be performed in the presence of the Owner's Representative. The Contractor shall furnish all necessary testing equipment and pay all costs of tests, including all replacement parts and labor necessary due to damage resulting from damaged equipment or from test and correction of faulty installation. Operational testing shall be performed on all equipment furnished and/or connected in other Sections of Division 16. Electrical and all other divisions specifying electrical items including furnishing of support labor for testing.
11. Standard test reports for mass-produced equipment shall be submitted along with the shop drawing for such equipment. Test reports on testing specifically required for individual pieces of equipment shall be submitted to the Owner's Representative for review prior to final acceptance of the project.
12. Any test failure shall be corrected in a manner satisfactory to the Owner's Representative.
13. The Contractor shall furnish without extra charge any additional material and labor which may be required for compliance with these laws, rules, and regulations, even though the work is not mentioned in these particular specifications or shown on the drawings.
14. The Contractor shall apply and pay for all permits required by any of the legally constituted public authorities for the installation or construction of the work included under this Division. The Contractor shall arrange and pay for any inspections or examinations so required and deliver certificates of all such inspections to the Owner's Representative. When these specifications call for materials or construction of a better quality or larger sizes than required by the above mentioned rules and regulations, the provisions of the specifications shall take precedence.

1.06 Delivery, Storage, and Handling

- A. Throughout this Contract, provide protection for materials and equipment against loss or damage in accordance with provisions elsewhere in these Contract Documents. Throughout this Contract, follow manufacturer's recommendations for storage. Protect everything from the effects of weather. Prior to installation, store items in clean, dry, indoor locations. Store in clean, dry, indoor, heated locations items subject to corrosion under damp conditions, and items containing electrical

insulation, such as instruments, conductors, and control panels. Energize all space heaters furnished with equipment. Provide temporary heating, sufficient to prevent condensation, in control panels which do not bare space heaters.

B. Shipment: The major equipment items listed in this provision and furnished under this contract shall be shipped in sealed, weather-tight, enclosed conveyances in a manner designed to protect the equipment against damaging stresses during transport.

C. Inspection

1. The Contractor shall cooperate with the Owner's Representative and shall provide assistance at all times for the inspection of the electrical work. Remove covers, operate machinery, or perform any reasonable work which, in the opinion of the Owner's Representative, will be necessary to determine the quality or adequacy of the work.

2. If any material does not conform to these specifications, the Contractor shall, within three days after being notified by the Owner's Representative, remove the materials from the premises.

3. Work shall not be closed in or covered before inspection and approval by the Owner's Representative. Cost of uncovering and making repairs where un-inspected work has been closed in shall be borne by the Contractor.

1.07 Project/Site Conditions

A. The ICS shall be installed in a Wastewater Treatment Plant which will be subjected to environmental conditions where temperatures may vary from 10 degrees F and 115 degrees F; relative humidity may vary from 10 to 100 percent; and trace quantities of moisture and dust may be present.

1.08 Warranty

A. Refer to Section 17506 – Extended Warranty and Maintenance

PART 2 - PRODUCTS

2.01 Manufacturers

A. Refer to Division 17 specifications.

2.02 Equipment and Materials

A. Refer to Section 17110-Instrumentation and Control Systems.

2.03 Components and Accessories

A. Refer to Section 17110-Instrumentation and Control Systems.

2.04 Fabrication

A. Refer to Section 17110-Instrumentation and Control Systems.

2.05 Source Quality Control

A. Refer to Section 17110-Instrumentation and Control Systems.

PART 3 - EXECUTION

3.01 Examination

A. Refer to Section 17110-Instrumentation and Control Systems.

3.02 Preparation

A. Refer to Section 17110-Instrumentation and Control Systems.

3.03 Installation

A. Refer to Section 17110-Instrumentation and Control Systems.

3.04 Field Quality Control

A. Tests and Instrument Calibration

1. **General:** All tests shall be in accordance with the requirements of Sections 17510-Factory Acceptance Tests and 17512-Site Acceptance Tests of these Specifications.
2. **Individual Component Calibration:** Each instrument and final element shall be field calibrated in accordance with the manufacturer's recommended procedure.
3. **Loop Tests:** Each instrument loop shall be treated as an integrated system. This test shall be designed to verify that all components within the loop operate correctly and that the loop functions correctly.

B. System Start-Up

1. **General:** When all systems and components have been successfully calibrated and tested, a date for the Plant start-up involving the Owner's Representative shall be scheduled and agreed upon.
2. **Procedure:** The ICS shall be rechecked to verify proper operation. Final adjustments shall be made as required.
3. **Report:** Provide a written report to the Owner's Representative verifying the operation of the ICS. Note any problems or concerns in this report.

C. Operator Training

1. **General:** Operator training shall be provided for the ICS after the System Startup has been successfully executed.
2. **Format:** The Plant operating personnel shall be instructed in the functions and operation of each system and shall be shown the various adjustable and set point features which may require readjustment, resetting, or checking and re-calibration by them from time to time. The O&M manuals in addition to the System Integrator's prepared materials shall be used for this training.

D. **Duration:** The training shall consist of a two (2) day course, a minimum of 16 hours total instruction, for up to five (5) students. This course shall be conducted at the jobsite on an agreed upon date independent of any testing or startup dates. A detailed outline of this course shall be submitted to the Owner's Representative at least 10 days in advance of the training start date. The class shall be scheduled a minimum of 2 weeks in advance of the week it is to be held. Submit a course syllabus.

3.05 Adjusting / Cleaning / Protection

A. Refer to Section 17110-Instrumentation and Control Systems.