

SECTION 16901
CONTROL PANELS - INSTRUMENTS AND CONTROLS

PART 1 - GENERAL

1.1 Description

- A.** This Section includes the furnishing and installation of the Pump control panel and other control enclosures for the pumps and instruments for the pumping Project.
- B.** The SCADA System will interface with the new base system. The main operators stations for the system are located at the Island Wastewater Treatment Plant.
- C.** The Contractor shall have overall responsibility for providing a complete operable system and shall have sole responsibility for the functioning of every piece of equipment in the pump control and radio telemetry panel.
- D.** The Contractor having overall responsibility for providing a complete operable system shall have sole responsible for the following work:
 - 1.** Pump motor starting, protection, and control (motor starting to utilize Variable Speed Controllers, VFDs).
 - 2.** Provision of and installation of a PLC, with analog and digital input/output for local pump station control.
 - 3.** New SCADA telemetry equipment including equipment programming and modifications to the existing SCADA programming.
 - 4.** All necessary programming to the man machine interface (MMI) to incorporate this project into the SCADA System.
 - 5.** Pump wet well level controls for this project includes (level transmitters for control, floats for redundant high and low wet well level alarms); alarms, pump operation, and speed control for VFD drive units.
 - 6.** Integrate all motor VFD's and wet well controls into the control system.

7. Provide, install and calibrate float switches for system redundant high and low wet well level alarms and pump emergency start / stop functions. Level transducer/transmitter is required by control panel to provide VFD speed control, normal pump start/ stop functions and wet well high and low level alarms.
8. Provide, install and calibrate level transmitters in the wet well.
9. Provide, install and calibrate pressure switches on each pump discharge line.
10. Provide, install and calibrate flow transmitter.

1.2 References

1. **American Society for Testing and Materials (ASTM)**
ASTM D1248 - Polyethylene Plastics Molding and Extrusion Materials.
2. **National Electrical Manufacturers Association (NEMA)**
ICS - Industrial Controls and Systems.
3. As specified in each applicable section, this Division.
4. National Fire Protection Association
National Electrical Code, NFPA 70
Standard for Electrical Safety in the Workplace, NFPA 70E
5. National Electrical Safety Code, IEEE C2.
6. Occupational Safety and Health Administration, OSHA.
7. All electrical and control equipment and material shall bear the recognized Underwriters Laboratories, Inc. (UL) seal of approval. It is Vendor's responsibility to obtain local inspection approval for all non-UL labeled equipment and pay all fees in connection with the same.

1.3 Submittals: Submit as specified in Section 01330.

PART 2 - MATERIALS

2.1 Acceptable Manufacturers

A. Prefabricated Control Panel and Console Enclosures

1. Hoffman Engineering Company (Hoffman).
2. Engineer approved equal.

B. Wire Terminals and Connectors

1. Alpha Wire Corporation (Alpha).
2. Amp, Inc.
3. Belden Corporation (Belden).
4. General Electric Company (General Electric).
5. Thomas and Betts.

C. Wire Markers

1. Brady.
2. Electrovert.
3. Floy Tag & Manufacturing, Inc. (Floy Tag).
4. Panduit Corporation.

D. Terminal Blocks and Test Switches

1. Allen-Bradley.
2. Buchanan.
3. Marathon Special Products.
4. Phoenix Contact.

5. Weidmuller.

E. Circuit Breakers

1. Airpax.
2. Heinemann Electric Company (Heinemann).
3. Potter-Brumfield.

F. Interior Illumination (Fluorescent)

1. Day-Brite/Benjamin.
2. Lithonia.
3. Wakefield.

2.2 Control Panels

A. Pre-Fabricated Panel Design Requirements

1. Totally enclosed cabinet with front door and continuous hinge.
2. Formed and welded construction, 14 gauge minimum steel.
3. NEMA type 3R enclosure outdoors, type 4 enclosure corrosive areas.
4. Interior 12-gauge minimum steel mounting panel.
5. Sized to house all equipment and devices indicated.
6. Provide lockable design.
7. Wall-mounted or floor mounted design as required.
8. Furnish Hoffman vapor action corrosion inhibitor sized for enclosure volume
9. Prepare all surfaces and paint as specified in SECTION 09900.
10. Painting

- a. Paint system shall be manufacturer's standard system, suitable for service intended.
- b. Prepare all surfaces prior to painting.
- c. Provide special color finish of light gray.
- d. Provide one pint of touch-up paint of each color.

11. Manufactured by Hoffman Engineering Company.

2.3 Control Panel and Recording and Indicating Instruments Nameplates

- A. Fabricate from laminated phenolic sheeting with white core and satin finish melamine overlay.
- B. Color shall be Manufacturers standard (if not specified designate black).
- C. Thickness: 1/16-inch nominal.
- D. Bevel edges to expose white core on perimeter.
- E. Engraved legend through overlay to expose core.
- F. Attach to panels and instruments with contact cement or double-faced tape.

2.4 Pump Control Panel and Pump Control

- A. Pump control will be implemented using the a PLC with inputs and outputs as required to complete the control system as described.
- B. The panel shall operate on a service voltage of 120VAC, 1-phase, 3-wire, 60 hertz. The pump controller will control the VFD drives (providing speed and start/stop control) operating the pumps which utilize the 480VAC, 3-phase, 3-wire, 60 Hertz system.
- C. I/O configuration and tag names shall be compatible with the existing established standards established by the City. This is necessary so as

to eliminate duplication of tag names with other existing lift stations connected to the common SCADA system.

- D.** Provide the necessary inputs/outputs as shown on the drawings.
- E.** Field calibrations of zero and span shall be programmable from the front keypad.
- F.** Backup alarm settings shall be accomplished by raising and lowering float switches in wet well. Pump start and stop elevation's settings accomplished by programming wet well level transmitter.
- G.** Provide capability to sample one to thirty readings for each input taking one reading every second. This shall be programmable from the front keypad. The number of samples averaged over a period of time shall be the basis of control.
- H.** Adjustable on-delay and off-delay timing logic shall be programmable from the front keypad. After a power failure, provide staggered pump starting.
- I.** Control and alarm setpoints shall be programmable from the keypad. They shall be furnished for each analog signal specified in this section.
- J.** The pump control scheme shall be a Triplex, variable speed, pump down configuration to maintain a desired level within the wet well. (Note that 3rd pump is treated as a redundant back-up). Incorporate the following characteristics into the pump control scheme:
 - 1.** Minimum pump speeds as recommended by the manufacturer.
 - 2.** Load sharing between pumps. Operate pumps at same speed when more than one pump is required.
 - 3.** Pump alternation.
 - 4.** Pre-Transfer Pump Shut Down. Utilize "pre-transfer" signal from Automatic Transfer Switch to initiate a shut-down a pump shut down.
 - 5.** The pump control shall include programming for a "flush" of the wet well in order to vary the flow rate in the discharge line. At set point intervals, the pump controller shall be

programmed to allow the wet well to rise above normal operating level, and then ramp both pumps up to high speed until the wet well reaches the low level shut down. Upon completion of this cycle, the pumping operation shall return to normal

- K.** The following set points shall be provided for the pumps:
 - 1.** Lead pump on.
 - 2.** Lag pump on.
 - 3.** Lag-Lag pump on. This second lag pump is to operate only in the event of a failure of another pump or in manual mode.
 - 4.** Lead / Lag pumps off.
- L.** The pump controller shall have alarm light mounted on the panel. When an alarm occurs it will flash the alarm light and display screen. The display shall indicate the alarm description, time and date it occurred. An alarm acknowledgement push button shall be provided. The alarm after being acknowledged shall still be displayed on the display until the condition clears.
- M.** The pump controller's display screen shall allow for manual scrolling through the menu. The display shall indicate the function manually entered on the keypad. The audible alarm shall chirp to indicate a selection has been executed.
- N.** The pump controller shall be mounted on the door of the pump control panel. The pump controller shall be encased in a flush-mounted, environmentally-protected assembly. The pump controller shall have a touch screen operator interface. The operator interface shall be a menu driven system. The pump controller shall have on-board power regulation and battery charging circuitry.
- O.** Provide a watchdog timer which observes the microprocessor activity. In the event of a microprocessor failure the watchdog shall reset the processor.
- P.** The controller shall have communications ports. One port shall be used for the connection to the SCADA PLC/RTU. The second port shall be used for communications with microcomputer or serial alarm and event logging printer.

2.5 Intrinsic Safe Barriers

- A.** Provide intrinsically safe barriers in the pump control panel for the float switch connections into the panel.

2.6 Radio Telemetry SCADA

- A.** Provide extension of existing SCADA System. Provide new Remote Telemetry Unit. See Sections 16924-2.5.

2.7 Electrical System

A. Wiring

- 1.** Alpha or Belden 600V, 105°C, UL style 1015 wire or Houston Wire and Cable SI-57275, SIS Vulkene insulated switchboard wire. Dc signal wiring shall be as specified in this Division.

2. Wire Sizes

- a.** No. 14 AWG, 41 strand, for all convenience outlets, interior lighting, and other similar loads.
- b.** No. 16 or 18 AWG, 16- to 41-strand, for low power loads of 115V or lower voltage.

3. Wire Markers

- a.** Hot-stamped tube-type, Brady Ty-grip, Electrovert slip-on Type Z, or Floy Tag FT200C wire markers sized for snug fit for wire size.
- b.** Identify both ends of wire with the same unique wire number.
- c.** Assign wire numbers where specific designations are not indicated.

4. Wiring Methods

- a.** Route main groups of wires in plastic nonflammable wiring duct.

- b. Smaller groups of wire shall be cabled and secured with nylon cable clamps and ties or plastic spiral wraps.
- c. Route instrument dc signal wiring in separate ducts or groups from ac power and control wiring.
- d. **Equipment and Terminal Block Connections**
 - (1) Make all connections with insulated locking spade lug terminals except where devices specified are available only with solder type terminals, or tubular clamp terminals.
 - (2) Install terminals with tool as recommended by manufacturer to apply required amount of pressure correctly.
- e. **Solder Connections:** Soldering iron used shall not exceed 100 W.
- f. Provide terminal blocks for all external connections.

B. Terminal Blocks

- 1. 600V, sectional type nylon polypropylene blocks.
- 2. Tubular clamp contacts.
- 3. Slide-in vinyl marking strip for terminal identification.
- 4. Provide a minimum of 10% spare terminals.

C. Switch Action Fuse Blocks

- 1. Rated 600V, 30-A.
- 2. Sectional type nylon or polypropylene blocks.
- 3. Tubular clamp contacts.
- 4. Pressure sensitive marking tape for terminal identifications.

D. Circuit Breakers

1. Heinemann Series CF, Curve 2, E-frame breaker for each instrument system, annunciator, lighting circuit, control system or similar major device requiring 24 Vdc or 115Vac power.
2. Heinemann Series CF, Curve 3, for devices or systems requiring 26V, dc power.
3. Trip rating as indicated or recommended by manufacturer of equipment being protected.
4. Necessary space on panel for a minimum of three future circuit breakers.
5. Mounted on a panel inside control panel in a readily accessible location.

E. Push Buttons and Selector Switches

1. Heavy-duty oiltight units with contacts rated 10-A continuous at 120Vac.
2. Provide the number of contacts and contact development as indicated.
3. Start or On push buttons shall have a black operator.
4. Stop or Off push buttons shall have a red operator.

F. Illuminated Push Buttons

1. Heavy-duty oiltight units with contacts rated 10-A continuous at 120Vac.
2. Provide the number of contacts and contact development as indicated.
3. Transformer type.
4. Color caps as indicated above.

G. Multilight Oiltight Controls

1. Honeywell Type CMC.
2. Provide with four lighted quadrants.
3. Provide number of contacts, arrangements, and positions as indicated.
4. Provide cover plates, legend plate and color inserts; color and engraving to be Manufacturers Standard.
5. Provide with four transformers and No. 755 lamps.
6. Provide all mounting hardware and mount on the control panels as indicated.

H. General-Purpose Control Relays

1. Potter & Brumfield Series KRP or Struthers-Dunn Series 219.
2. Provide with coil voltage as indicated with a neon coil energization indicator on 120Vac coils.
3. Number of contacts required rated at 10-A at 120VAC.
4. Provide plug-in relay with socket.

I. Time Delay Relays

1. Agastat SSC Series.
2. Solid-state timing relay, plug-in type with matching socket.
3. Time range and voltage as required or indicated.
4. Contact rating of 10-A at 120Vac.
5. Contact action as required or indicated.

J. Pilot Lights

1. Heavy-duty oiltight units.

2. Transformer type.
3. Color caps as follows:

Red – motor running
Green – motor stopped
Amber – motor overload
4. Push-to-test type.

K. Interior Illumination

1. Two-foot fluorescent strip light and 20-W cool white lamp.
2. Single-pole switch mounted in handy box.
3. Includes the following panels
 - a. Pump Control Panel.

L. Mounting of Relays and Control Devices

1. Complete accessibility to all terminals, relay sockets, and other devices without dismantling of panel equipment.
2. Do not block access to any instruments or control devices mounted on face sheet.
3. Installed on swing-out panels if necessary.
4. Mount all diodes, resistors and similar equipment between terminal points on terminal blocks.

N. Electronic Filters – Provide Electronic Filters on incoming power to prevent local harmonic currents from effecting panel instrument operation.

O. Float Switches

1. Rigid high-density polypropylene tear-drop-shaped float.

2. One internal mechanical tilt switch, with two sets of contacts, one NO and the other NC, rated 10 amps at 120 VAC, noninductive load.
3. Furnish with necessary length of cable and weight kit for cable suspension.
4. Model LS, Consolidated Electric Co. or Engineer approved equal.
5. Interface with intrinsically-safe relays in the duplex pump control panel.

PART 3 - EXECUTION

3.1 Installation

A. Control Panels

1. Seal all unnecessary openings in enclosures and cast or drilled in the housekeeping pad.
2. Mount to equipment rack as indicated using compatible metal nuts and bolts.
3. Shim plumb and level.
4. Install all electrical connections to remote mounted controls as specified in DIVISION 16.
5. Close all unnecessary and unused openings in the enclosures with Dow Corning 3-6548 silicone RTV or General Electric RTF762 foam after piping and wiring are installed to prevent dirt from entering the panel.

B. Electrical Connections

1. Install wire and cable as specified in Section 16120.
2. Install circuits to field-mounted equipment as indicated and required.
3. Connect all lightning and surge arresters to panels and ground system.

C. Commissioning and Start-Up Services

1. Install and program the pump control panel, PLC, and connection to the new SCADA RTU per the design requirements. Coordinate the programming of the Engineer and Owner.
2. The system manufacturer's factory trained representative shall personnel attend all Start-Up and Commissioning Procedures and operational tests. This individual shall adjust time delays, setpoints, and make PLC program adjustments as deemed necessary and as directed by the Engineer.
3. At a minimum, provide 4 days of Field Commissioning Services under 2 separate trips. Failed start-up procedures shall be corrected, re-tested at no additional costs, and shall not count towards the minimum field commissioning days.

D. Training of the Owner's Personnel The system manufacturer's factory trained representative shall provide start-up services and training for the Owner's personnel. Provide a minimum of One day for instructing the Owner's operating personnel in the operation and maintenance of the control equipment

3.2 Field Quality Control

- A. **Manufacturer's Field Services:** Provide as specified in Section 01750.
- B. **Factory Tests:** Specified in Section 16900.
- C. **Field Tests:** Specified in Section 16902.

PART 4 MEASUREMENT AND PAYMENT

4.1 Measurement

A. No measurement will be made for this item.

4.2 Payment

A. Payment will be made at the contract lump sum price bid and shall be considered full payment for providing labor and materials to perform this work.

**** END OF SECTION 16901 ****