SECTION 40 79 81
PUMP MANAGEMENT AND OPTIMIZATION EQUIPMENT

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, equipment, materials, and appurtenances required to deliver and install equipment and services to perform automated pump asset management and optimization for the existing Station. The asset management function shall enable routine, automated pump testing to track pump condition over time for enhanced maintenance scheduling and decision-making. The optimization function shall continually compute the most efficient combinations of pumps and speeds to maximize energy efficiency while meeting flow and pressure demands. The optimization function shall ensure that all the pumps are operated within their Preferred Operating Range (POR) to extend pump life.

1.02 MEASUREMENT AND PAYMENT

A. No separate payment will be made for work performed under this Section. Include the cost for this work in the lump sum Base Bid Item in Section 00 41 XX.

1.03 RELATED WORK

A. Instrumentation and control work, and system architecture, except as specified herein, is included in Division 25 and further defined in the Instrumentation Drawings.

B. Instrumentation and Controls Testing is included in Section 40 61 21.

C. Application Engineering Services are included in Section 25 08 XX.

D. Electrical work is included in Division 26.

1.04 SYSTEM DESCRIPTION

A. A single workstation shall be furnished by Specific Energy and installed in the main control room as the human machine interface (HMI) to serve the Specific Energy Client. The workstation shall be a Google Chromebook or Engineer approved equal.

1.05 SUBMITTALS

A. Submit to the Engineer shop drawings of all items and accessories in accordance with the requirements of Section 01 33 23.

B. Submittals shall include:

1. Product Data
   a. Submit manufacturer’s product data

2. Record Documents:

a. Shop Drawings are required, with the following:
   1) Control Panel Elevation drawings showing dimensional information.
   2) Structural descriptions showing:
      a) Enclosure ratings
      b) Other information as required for approval
   3) Power and control connection diagram(s) including conduit locations
   4) Schematic wiring diagrams
   5) A list of the recommended spare parts along with current price for each item.

1.06 REFERENCE STANDARDS

A. The latest published edition of a reference shall be applicable unless identified by a specific edition date.

B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.

C. All materials, installation, and workmanship shall comply with the applicable requirements and standards addressed within the following references:

1. ANSI/NEMA ICS 6 – Enclosures for Industrial Controls and Systems

2. NEMA 250 – Enclosures for Electrical Equipment

3. NEMA ICS 2 – Industrial Control Devices, Controllers, and Assemblies

4. NFPA 70 – National Electrical Code

1.07 VENDOR QUALIFICATION

A. Vendor Qualifications: All primary equipment and services specified in this section shall be supplied by a single vendor with a minimum of four (4) years' experience in pump optimization and asset management for water pump stations. When requested by the engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

1.08 DEFINITIONS

A. Commission – To verify that the equipment is installed correctly and able to perform the desired functions.

B. PLC – Programmable Logic Controller. A computer that may be programmed to automate electromechanical processes. A PLC may be used at a pump station to start and stop pumps based on station conditions.

C. ASD – Adjustable Speed Drive. Electrical power equipment that may be used to drive the motor of a pump. An ASD can vary the frequency of power provided to a pump's motor to vary the pump's speed.

D. SCADA – Supervisory Control and Data Acquisition.

E. PCSS – Process Control System Supplier. The PCSS is responsible for furnishing and installing all materials, equipment, labor and services, required to achieve a fully integrated and operational system.

F. AESS - Applications Engineering System Supplier. The AESS is responsible for programming the affected existing PLCs and HMI as required to implement the pumping system improvements.

G. Specific energy – A metric defined as the ratio of the units of energy required by a process to the amount of work performed by the process or the amount of product that the process produces. For water systems, it is convenient to use units of kilowatt-hours per million gallons of water (kWh/MG).

1.09 WARRANTY

A. Vendor shall replace, at no cost to owner, any physical equipment or components that fail during first 24 months of licensed service from date of Substantial Completion.

PART 2 PRODUCTS

2.01 VENDORS

A. The asset management and optimization equipment and services, as specified in this section, shall be the Dynamic Pump Optimizer (DPO) hardware, and Asset Management Suite and Optimization Suite software as supplied by Specific Energy, Inc. (specificenergy.com), Georgetown, Texas, or Engineer approved equal.

2.02 GENERAL

A. The equipment shall perform asset management and pump optimization functions.

1. The asset management function shall enable routine automated pump testing to track the plant pump condition over time for enhanced maintenance scheduling and decision-making.

2. The optimization function shall continually compute the most efficient combinations of the plant pumps and speeds to maximize energy efficiency while meeting flow and pressure demands. The optimization function shall ensure that all pumps are operated within their Preferred Operating Range (POR) to extend pump life.

B. Results from asset management and optimization functions shall be presented via a graphical operator interface that is independent of plant’s SCADA system.

2.03 ASSET MANAGEMENT FUNCTIONS

A. Pump Monitoring

1. The graphical operator interface shall display each pump's real time flow, head, and power consumption on its tested pump curves.

2. The graphical operator interface shall display real-time operating data for each pump in the station. The real-time operating data shall include, but is not limited to the following:
   a. Shaft Power
   b. Motor Voltage
   c. Motor Current
   d. Adjustable Speed Drive (ASD) Speed
   e. Flow
   f. Head
   g. Pump Efficiency

B. Data Storage

1. The equipment shall transmit operating data to a remote, secure server in a HIPAA-compliant colocation facility to be stored in a historical database.

2. In the case that a connection is lost to the database, the equipment shall store data locally until the connection is reestablished and the data can be resynchronized.

3. The stored data shall be available to view on the graphical operator interface.

4. The stored data shall be available to download as a comma-separated values (CSV) file.

C. Reporting

1. The equipment shall produce and deliver monthly reports by email to a list of email addresses provided by the Owner.

2. The reports shall include each pump's tested pump curves, financial asset management analysis, and operational data.

2.04 OPTIMIZATION FUNCTIONS

A. Efficiency Optimization

1. The equipment shall calculate predicted flow, discharge pressure, specific energy, and power consumption for each combination of pumps over a range of operating speeds.

2. The graphical operator interface shall display the calculated total flow, per-pump flows, discharge pressure, specific energy, and power data.

3. The equipment shall determine the set of pumps and speeds that will operate the pump station at minimal specific energy while satisfying operational constraints.
   a. The equipment shall provide the PLC with recommended set of pumps and speeds that will operate the pump station at minimal specific energy for the current set of operational constraints.

b. The equipment shall display the pumps and speeds that will operate the pump station at minimal specific energy for the current set of operational constraints on the graphical operator interface.

4. The equipment shall determine if a combination of pumps and speeds will operate one or more pumps in the pump station outside of their Preferred Operating Range (POR).
   a. The equipment shall display the sets of pumps and speeds that cause one or more pumps to operate outside of their Preferred Operating Range on the graphical operator interface.
   b. The equipment shall recommend pump combinations and speeds that do not cause one or more pumps to operate outside of their Preferred Operating Range.

2.05 EQUIPMENT

A. Vendor shall furnish a controller with pre-programmed asset management software and optimization software installed.

B. Vendor shall furnish a NEMA 12 enclosure complete with required power, computation, and communication devices preconfigured on the interior panel. This enclosure shall contain a power supply, uninterruptible power supply (UPS), industrial-rated computer, adapters for site wiring and cellular modem.

C. Vendor shall furnish a communication antenna with suitable cables and connectors that will be installed by the Contractor.

2.06 SECURITY

A. The equipment shall include access control policies and procedures, including:

1. Unique user ID for each user

2. Password for each user with a system to ensure password strength

3. Certificate based authentication

B. The equipment shall encrypt all communication that extends beyond the Owner's local network.

PART 3 EXECUTION

3.01 INSTALLATION

A. Prior to providing equipment to Contractor, Vendor shall individually test each piece of equipment.

B. Contractor shall mount the Vendor's NEMA 12 enclosure at the location as shown on the Drawings.

C. Contractor shall furnish and install power and communication wiring between the Vendor's enclosure and the PLC cabinet.

D. Contractor shall furnish and install separate power and communication conduits connecting Vendor's enclosure to the PLC cabinet.

E. Contractor shall furnish and install any additional security layers between the Vendor's equipment and PLC, such as a physical Ethernet firewall or a third-party industrial communication gateway, with all necessary wiring or Engineer approved equal.

F. Contractor shall furnish and install a dedicated 15A circuit breaker wired from or through the PLC cabinet to supply power to the Vendor's equipment.

G. The Contractor shall mount the Vendor's cellular antenna on top of the NEMA 12 enclosure or on the exterior of the building as shown on the Drawings, making the connection using antenna cable and connectors provided by the Vendor.

H. Contractor shall install the Ethernet Security Module in the PLC cabinet. Contractor shall connect power to the device and connect the module's Local Area Network to an Ethernet switch in the PLC cabinet.

3.02 COMMUNICATION

A. Vendor shall configure one or both of the following, if specified:

1. Ethernet Security Module. The module shall be configured to allow no incoming connections from the Wide Area Network and shall have no configured VPN. There shall be a single permitted connection from the Local Area Network that allows the PLC's IP address on a specific port to connect to the Vendor's equipment's IP address on a specific port.

2. Third-party Industrial Communication Gateway. The Gateway shall be locally preprogrammed to relay a limited set of PLC register values between the PLC and the Vendor's equipment. There shall be two separate physical network connections – the first connection shall be used to poll the PLC's predefined set of registers, and the second connection shall relay register values to the Vendor's equipment.

B. The equipment shall communicate with the Pump Station PLC to receive real-time flow, pressure, power, and pump operation commands and speeds. Contractor's AE or AESS shall configure the PLC to establish a TCP (Transmission Control Protocol) connection to the Vendor's equipment through the Ethernet Security Module, Third-party Industrial Communication Gateway, or both.

C. Contractor's PCSS or AESS shall configure the PLC to write the following values to the Vendor's equipment at least once per second:

1. Ground Storage Tank levels or Clearwell levels

2. Pump Station Suction Pressure measured by a pressure transmitter on the common pump suction header

3. Station Discharge Pressure measured by a pressure transmitter on the pump discharge header

4. Station Flow measured by a flow transmitters on the pump discharge headers

5. Running status for each pump

6. Motor Power for each pump

7. Motor Voltage for each pump

8. Motor Current for each pump

9. For each pump with an ASD, ASD Input power

10. For each pump with an ASD, ASD Actual Speed

11. For each pump with an ASD, ASD At Speed Status

12. For each pump with an ASD, ASD Fault status

13. Discharge Pressure setpoint

D. Contractor's PCSS or AESS shall configure the PLC to read the following values from the Vendor's equipment at least once a second:

1. Start request for each pump

2. For each pump with an ASD, ASD Requested Speed

3. Current Station Specific Energy Consumption

4. Percent of Optimal Specific Energy Consumption

5. Specific Energy Deviation Cost in Dollars Per Year

E. Prior to PLC configuration, the Contractor's AE and Vendor shall conduct a workshop to coordinate data transfer and register between the PLC and Vendor's equipment:

3.03 PUMP TESTING

A. Upon completion of new pump control valves, ASDs, pump discharge piping modifications and associated improvement works, and successful demonstration of a functional pump and valve system, pump testing shall be conducted.

B. Vendor shall conduct initial pump testing to acquire pump test curves for each pump after completion of the installation. Vendor will coordinate with the Owner to generate test data suitable for calculating initial pump test curves while satisfying the station's pressure constraints.

1. Vendor will coordinate with the Owner to run each ASD pump against every other pump at three different speeds in remote manual mode. Each speed must differ by at least 5 Hz from the previous speeds.

2. The pump testing shall consist of operating a given pump at a range of operating points on its pump curve while collecting total pump station flow, suction header pressure, discharge header pressure, and per-pump power data at each operating point. The collected data shall be used to form head versus flow and efficiency versus flow curves for each pump.

3. Subsequent to pump testing, the Vendor's graphical operator interface shall display results of pump tests for each pump in the pump station.

C. Pump test curves shall be automatically recomputed every 90 days using the system operation data. If needed, the Vendor may periodically coordinate with the Owner to collect additional test data to calculate updated pump curves.

3.04 SUPPORT

A. Vendor shall provide software updates to improve asset management and optimization functions and add new features for the duration of licensed service.

B. Vendor shall provide an operator training session for a duration of 8 hours after completion of the installation.

C. The first 12 months of maintenance and support shall be included with the original installation.

D. Supervised equipment installation and provision of on-site support services for up to four (4) trips for the duration of licensed service shall be provided by Vendor under a separate agreement with the Owner if desired by the Owner.

E. Subsequent support and maintenance shall be provided by Vendor under a separate agreement with the Owner if desired by the Owner.

3.05 EQUIPMENT AND SERVICE COMMISSIONING

A. Vendor shall provide qualified and trained personnel to inspect the installed equipment to ensure the equipment has been installed properly and in accordance with Vendor's recommendations. Subsequent to a satisfactory installation, Vendor shall commission the equipment and service shall begin.

END OF SECTION

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