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## SECTION 40 XX XX ELECTRO-HYDRAULIC ACTUATORS AND SMART CONTROL

### PART 1 - GENERAL

#### 1.01 DESCRIPTION

- A. Provide all labor, materials, equipment, services, and coordination necessary for the complete installation, testing, and commissioning of the Electro-Hydraulic Actuator system and associated Smart Control equipment as specified herein and as indicated on the Contract Drawings.
- B. Related Sections:
  - 1. Furnish all accessories and appurtenances required to provide a complete and fully operational system.

#### 1.02 REFERENCES

- A. AWWA C541, "Hydraulic and Pneumatic Cylinder and Vane-Type Actuators for Valves and Slide Gates."
- B. ANSI/ISA-96.06.01, "Guidelines for the Specification of Self-Contained Electro-Hydraulic Valve Actuators."
- C. ISO 9001, "Quality Management Systems – Requirements."

#### 1.03 SUBMITTALS

- A. Shop Drawings:
  - 1. Submit detailed shop drawings for all equipment specified herein.
  - 2. Shop and installation drawings shall include dimensions, weights, support requirements, clearances, electrical requirements, hydraulic connections, and installation details for each actuator and Smart Control assembly provided.
- B. Product Data:
  - 1. Submit manufacturer's descriptive literature, technical bulletins, product data sheets, and catalogs containing complete information describing the equipment furnished under this section.
- C. Operation and Maintenance Manuals:
  - 1. Submit detailed operation and maintenance manuals for all equipment specified herein. Manuals shall include operating instructions, maintenance procedures, troubleshooting guidance, parts identification, recommended spare parts, and wiring diagrams.
- D. Training Documentation:
  - 1. Submit documentation verifying the instruction and training provided to the Owner's operations and maintenance personnel in accordance with requirements if specified elsewhere in the Contract Documents.
- E. Test Reports:
  - 1. Submit factory test reports and field test reports if requested documenting all testing performed in accordance with this specification section.

#### 1.04 QUALITY ASSURANCE

- A. Single-Source Responsibility:
  - 1. The valve, Electro-Hydraulic Actuator, and associated Smart Control equipment shall be furnished as a fully integrated assembly by a single manufacturer.
  - 2. The manufacturer shall assume full responsibility for the design, integration, operation, testing, and warranty of the complete valve actuator system.



- B. Factory Testing:
  - 1. The assembled valve actuator system shall be cycled, functionally tested, and performance verified at the manufacturer's facility prior to shipment in accordance with the applicable testing requirements of AWWA C541.
- C. Manufacturer Qualifications:
  - 1. The manufacturer shall have a minimum of five years of experience in the design and manufacture of valves and Electro-Hydraulic Actuators of the type specified herein.
- D. Warranty:
  - 1. The manufacturer shall warrant the valve actuator assembly against defects in materials and workmanship for a period of twenty-four (24) months from the date of shipment.

#### **1.06 DELIVERY, STORAGE, AND HANDLING**

- A. Equipment shall be packaged to minimize damage resulting from moisture, temperature variations, impact, vibration, and normal shipping conditions. Exposed threads shall be protected with tape or caps, and all openings shall be sealed with suitable plugs or covers. Installation instructions shall accompany each shipment.
- B. Delivery, storage, and handling shall be performed in accordance with the manufacturer's written instructions.

### **PART 2 - PRODUCTS**

#### **2.01 ELECTRO-HYDRAULIC ACTUATOR**

- A. **General Description**
  - 1. The Electro-Hydraulic Actuator shall be specifically designed for valve automation service and shall utilize a self-contained hydraulic power system for valve operation.
  - 2. The actuator shall be suitable for open-close and modulating service as specified herein.
  - 3. The valve, Electro-Hydraulic Actuator, and Smart Control system shall be furnished as an integrated assembly in accordance with the requirements of this specification.
  - 4. Manufacturer to provide all materials required to connect between the Electro-Hydraulic Actuator and Smart Control.
  - 5. Electric gear-based multi-turn actuators and centralized hydraulic actuator systems shall not be accepted.
- B. **Performance Requirements**
  - 1. The Electro-Hydraulic Actuator shall be rated for continuous-duty open-close and modulating service. The actuator shall be capable of continuous positioning and modulation without restrictions on operating frequency, duty cycle, or the number of starts and stops. Actuators requiring thermal overload cool-down periods, maximum starts-per-hour limitations, or other duty-cycle restrictions shall not be accepted.
  - 2. The Electro-Hydraulic Actuator shall be suitable for operation on 230 VAC or 460 VAC, three-phase, 60 Hz power, or 208/230 VAC, single-phase, 60 Hz power, as specified. Where required, the actuator manufacturer shall furnish all transformers, power supplies, and ancillary components necessary for operation from the specified power source.
  - 3. Actuator position feedback shall be provided by a non-contact magnetostrictive linear position transducer integrated within the hydraulic cylinder. The transducer shall provide continuous absolute position feedback. Rotary potentiometers, shaft-mounted potentiometers, and gear-driven position feedback devices shall not be accepted.
  - 4. Actuator speed shall be electronically adjustable through the Smart Control system. Opening and closing speeds shall be independently adjustable as specified herein.
  - 5. For pump-control applications, valve opening and closing speeds shall be established based on a surge investigation performed or reviewed by the valve manufacturer. The manufacturer shall provide a basic surge investigation report with recommended actuator speed settings intended to minimize hydraulic surges and maintain stable system operation.



6. Where fail-safe operation is specified, the emergency closing rate shall be independently adjustable and shall not be affected by normal operating speed settings.
7. Actuator sizing shall be the responsibility of the valve manufacturer. Actuator selection shall be based on the specified service conditions, including maximum differential pressure, flow conditions, operating frequency, surge conditions, and other applicable dynamic loading requirements. The actuator shall be capable of operating the valve throughout its full travel under all specified operating conditions and shall be sized with an appropriate service factor to ensure reliable long-term operation.

**C. Hydraulic System Requirements**

1. The Electro-Hydraulic Actuator assembly shall consist of a self-contained hydraulic drive system that includes, at a minimum, a bi-directional hydraulic pump, hydraulic reservoir, hydraulic cylinder, and associated hydraulic controls necessary to operate the valve throughout its full travel.
2. The Electro-Hydraulic Actuator shall utilize a hydraulic cylinder as the primary force-producing element. For linear valves, the cylinder shall be directly connected to the valve stem. For quarter-turn valves, the cylinder shall drive a rotary torque unit sized to satisfy the valve operating requirements. The actuator shall be suitable for mounting in any orientation specified at the time of order.
3. The hydraulic system shall operate as a closed, pressurized hydraulic circuit designed to prevent the ingress of moisture and external contaminants. Open reservoir systems shall not be accepted.
4. The hydraulic system shall be designed to operate at an internal hydraulic pressure of 3,000 psi or less, as required for the application. Pressure-limiting devices shall be incorporated to prevent hydraulic pressures from exceeding the design operating limits of the actuator system.
5. Where fail-safe accumulation is not required, or where the accumulator is integrated into the actuator assembly, the hydraulic system shall be factory-filled, factory-sealed, and shall not require the addition of hydraulic fluid prior to commissioning.
6. Where the accumulator is provided separately from the actuator assembly, hydraulic connections shall utilize flat-faced, non-spill quick-disconnect couplings. The hydraulic circuit, including associated hoses and cylinders, shall be factory-filled, sealed, and tested to permit field installation or accumulator replacement without draining, bleeding, or refilling the hydraulic system.
7. The actuator shall utilize a compact, self-contained hydraulic system. Hydraulic fluid displaced during operation shall be returned to an integral reservoir incorporated within the actuator assembly.
8. Hydraulic fluid shall be bio-degradable and FM approved firesafe. It shall be designed specifically for protection against wear in pumps and hydraulic systems. The use of motor oil shall not be allowed because it may contain detergents and other fillers that are not beneficial to the pump and hydraulic system.
9. Hydraulic actuators that do not incorporate hydraulic oil filtration shall not be accepted. The hydraulic system shall include one or more hydraulic filtration devices designed to maintain hydraulic fluid cleanliness throughout the service life of the actuator.
10. All return oil shall pass through a filtration device prior to re-entering the hydraulic circuit. The filtration system shall be sized to maintain hydraulic fluid cleanliness levels recommended by the actuator manufacturer. Filter performance ratings shall be determined in accordance with ISO 16889.
11. For continuous modulating service, hydraulic filter elements shall provide a minimum service life of 8,000 operating hours under normal operating conditions. Smart Control shall record operating hours and provide a user-configurable maintenance notification when filter service is approaching.



12. For pump-control service, the hydraulic filtration system shall be designed such that routine filter replacement is not required during the expected service life of the actuator.
13. All hydraulic control valves utilized for normal operation and positioning service shall be of metal-seat construction. Actuators utilizing soft-seated solenoid valves for hydraulic modulation or position control shall not be accepted. Soft-seated solenoid valves may be utilized solely for isolation of fail-safe accumulator systems.
14. Hydraulic accumulators shall be utilized only for fail-safe operation and shall not be used as a primary power source for normal actuator movement. Spring-opposed hydraulic actuator systems shall not be accepted.
15. When the motor and hydraulic pump are not operating, the actuator hydraulic circuit shall incorporate a pilot-operated check valve to positively lock the actuator in position and prevent unintended valve movement. A counterbalance valve shall be provided where required to prevent overrunning loads and ensure stable actuator motion throughout the full valve stroke.

**D. Construction Requirements**

1. The Electro-Hydraulic Actuator shall utilize a brushless servo motor directly coupled to the hydraulic pump within the actuator hydraulic manifold. The motor shall operate only when actuator movement is required. Actuators utilizing continuously operating motors shall not be accepted. Induction motor actuator designs shall not be accepted.
2. The actuator shall provide continuous monitoring of hydraulic oil level. A low-oil condition shall generate a diagnostic alarm at the Smart Control HMI and through all configured remote communication interfaces.
3. Where ambient temperatures are expected to fall below 20 F (-7 C), a thermostatically controlled heater shall be provided to maintain hydraulic fluid viscosity within the actuator manufacturer's recommended operating range.
4. Hydraulic seals shall be designed for a minimum service life of 1 million full-stroke cycles and 10 million dither cycles, where a dither cycle is defined as a position change of less than 1 percent of actuator travel. Hydraulic actuator designs requiring upgraded seal packages for service lives below 50,000 full-stroke cycles shall not be accepted.
5. All hydraulic tubing and fittings shall be Type 316 stainless steel.
6. All threaded hydraulic connections shall utilize straight-thread connections with elastomeric O-ring sealing, such as SAE O-Ring Boss (ORB), or Engineer-approved equal. Tapered pipe-thread hydraulic connections shall not be accepted.

**E. Environmental Requirements**

1. The Electro-Hydraulic Actuator shall be suitable for installation in outdoor and industrial environments and shall be designed to withstand exposure to moisture, humidity, temperature variations, and corrosive atmospheric conditions commonly encountered in municipal water and wastewater facilities.
2. The actuator assembly shall be corrosion protected with 2-part high-build epoxy and corrosion-resistant fasteners. Electrical connections shall be capable of withstanding low-pressure water jets and completely dust tight.

**F. Fail-Safe Operation**

1. Fail in Last Position: Upon loss of primary power, the actuator shall fail in last position and remain hydraulically locked in place until power is restored or manual operation is engaged.
2. Fail Open or Fail Closed: Where specified, upon loss of primary power or actuation of the emergency stop, the actuator shall fail open or fail closed by means of a nitrogen-charged accumulator system. The accumulator shall be isolated from the normal hydraulic circuit and shall be activated only upon a fail-safe condition.



3. Loss of Control Signal: Upon loss of control signal, the actuator shall be capable of failing fully open, fully closed, or in the last operating position while remaining hydraulically locked in the selected fail-safe state.

**G. Manual Operation**

1. A completely independent manual hydraulic override system shall be provided when specified.
2. The manual override system shall include a hand pump and drill-drive interface capable of operating the valve throughout its full stroke.
3. Failure of the primary actuator drivetrain shall not impair the ability to manually operate the valve. Manual override systems utilizing the primary hydraulic pump or drivetrain for manual operation shall not be accepted.

**H. Surface Preparation and Coatings**

1. Actuators shall be coated with a two-part epoxy coating system suitable for corrosion resistance in municipal water and wastewater service environments.

**2.02 SMART CONTROL**

**A. General Requirements**

1. Each Electro-Hydraulic Actuator shall be furnished with a Smart Control system designed to control, monitor, diagnose, and operate the actuator throughout its full range of travel. Smart Control shall provide coordinated control of actuator operation, position feedback, diagnostics, local operation, and remote control functions as specified herein.
2. For pump-control applications, Smart Control, in conjunction with the Electro-Hydraulic Actuator, shall provide programmable valve movement profiles intended to assist in controlling hydraulic transients and minimizing system surges. Valve opening and closing speeds shall be independently adjustable.
3. Smart Control shall permit actuator speeds to be adjusted at multiple positions throughout the valve travel to provide a user-configurable motion profile tailored to the hydraulic requirements of the application.
4. Smart control shall interpret incoming command signals and direct actuator operation in accordance with configured operating parameters, valve position feedback, and programmed control logic.
5. Smart Control shall be specifically designed for use with the Electro-Hydraulic Actuator specified herein and shall provide an integrated platform for local operation, remote operation, diagnostics, alarm management, configuration, and maintenance functions.

**B. Enclosure Construction**

1. Smart Control components shall be housed in a standalone enclosure separate from the hydraulic portion of the actuator. The enclosure shall be supplied by the actuator manufacturer and shall contain all components necessary for actuator operation, control, diagnostics, and communications as specified herein.
2. The enclosure shall be constructed of Type 316 stainless steel and shall be rated NEMA 4X for protection against corrosion, windblown dust, hose-directed water, and external ice formation. The enclosure shall be suitable for installation in municipal water and wastewater environments.
3. The enclosure shall contain and protect all components required for actuator control and operation, including, at a minimum:
  - a. Variable frequency drive (VFD) or equivalent motor drive.
  - b. Internal power supply.
  - c. Programmable logic controller (PLC).
  - d. Field wiring terminals.
  - e. Interconnecting control components.



4. The enclosure shall include a PLC-based control platform and a minimum 7-inch full-color Human-Machine Interface (HMI) with 800x480 pixels minimum resolution mounted on the enclosure door.
5. The HMI display shall provide sufficient resolution to clearly display actuator status, operating information, diagnostics, configuration menus, and alarm conditions.
6. All power and control cabling between Smart Control and the Electro-Hydraulic Actuator shall be furnished by the actuator manufacturer.
7. Standard cable lengths up to 50 feet shall be supplied. Longer cable lengths shall be available when required. The Contractor shall verify cable length requirements prior to equipment shipment.

**C. HMI Requirements**

1. Smart Control shall include a minimum 7-inch full-color Human-Machine Interface (HMI) mounted on the enclosure door and directly connected to the Smart Control platform.
2. The HMI shall provide a graphical operator interface for actuator operation, configuration, diagnostics, maintenance, and system monitoring.
3. The HMI shall provide continuous display of actuator position, operating status, control mode, active alarms, and diagnostic information. Information shall be displayed in a clear and easily understandable format suitable for operation and maintenance personnel.
4. The HMI shall permit local actuator operation through a touchscreen interface.
5. At a minimum, the operator shall be capable of:
  - a. Opening the valve.
  - b. Closing the valve.
  - c. Stopping valve movement at any position.
  - d. Viewing actuator position and status.
  - e. Accessing diagnostic information.
  - f. Accessing configuration menus.
6. The HMI shall provide a user interface for actuator configuration and adjustment.
7. At a minimum, the HMI shall permit configuration of:
  - a. Valve travel limits.
  - b. Speed settings.
  - c. Analog input scaling.
  - d. Analog output scaling.
  - e. Relay setpoints.
  - f. Deadband settings.
  - g. Temperature alarm settings.
  - h. Other configurable actuator operating parameters as provided by the manufacturer.
8. The HMI shall provide multi-level password-protected access to prevent unauthorized changes to operating parameters.
9. At a minimum, the following access levels shall be provided:
  - a. Operator.
  - b. Customer Administrator.
  - c. Factory Service Technician.
10. Each access level shall be configurable to restrict access to functions appropriate to the user's authorization level.
11. The HMI shall provide access to electronic operation manuals, troubleshooting information, and diagnostic guidance to assist operating and maintenance personnel. Documentation shall be viewable without the use of external software or devices.



#### **D. Operating Modes**

- a. Smart Control shall provide three selectable operating modes: LOCAL, REMOTE, and SETUP. The active operating mode shall be continuously displayed on the HMI.
- b. Transfer between operating modes shall be accomplished through authorized operator actions and shall prevent conflicting control commands between local and remote sources.
- c. In LOCAL mode, actuator operation shall be controlled exclusively by Smart Control.
- d. LOCAL mode shall permit the operator to:
  1. Open the valve.
  2. Close the valve.
  3. Stop valve movement at any position.
  4. View actuator position and status.
  5. Access diagnostic information.
  6. Access operating and maintenance documentation.
- e. Remote control commands shall be inhibited while LOCAL mode is active.
- f. In REMOTE mode, actuator operation shall be controlled from external control systems, including SCADA, DCS, PLC, or other approved supervisory control systems.
- g. REMOTE mode shall permit:
  1. Open and close commands.
  2. Modulating control.
  3. Position feedback transmission.
  4. Alarm and diagnostic status reporting.
  5. Remote monitoring of actuator operation status.
- h. Local manual movement commands shall be disabled while REMOTE mode is active, except as required for emergency operation.
- i. SETUP mode shall provide access to actuator configuration and commissioning parameters.
- j. At a minimum, authorized users shall be permitted to configure:
  1. Valve travel limits.
  2. Actuator speed settings.
  3. Motion profiles.
  4. Control deadband settings.
  5. Analog signal scaling.
  6. Temperature alarm settings.
  7. User-configurable relay functions.
  8. Other manufacturer-provided operating parameters.
- k. Actuator configuration changes shall be restricted to authorized users through password-protected access controls.
- l. Following restoration of power, Smart Control shall return to the operating mode that was active immediately prior to the power interruption unless otherwise configured by the user.
  1. Priority is given to operating the valve to required position.
  2. If a fail-safe operation is used, once the valve operation is complete, the accumulator shall be automatically recharged.

#### **E. Communication Requirements**

1. Smart Control shall provide communication interfaces suitable for integration with plant control systems, including SCADA, DCS, PLC, and other supervisory control platforms. Communication interfaces shall support actuator control, position feedback, status indication, alarm reporting, and diagnostic information as specified herein.



2. Smart Control shall be capable of supporting the following communication protocols:
  - a. 4-20 mA analog control and feedback.
  - b. Modbus TCP/IP.
  - c. PROFINET.
3. Optional communication protocols shall be available when specified:
  - a. EtherNet/IP.
  - b. HART.
  - c. Other communication protocols supported by the manufacturer.
4. A continuous valve position feedback signal shall be provided for remote monitoring and control system integration. Position feedback shall be available through the applicable communication interface and shall accurately represent actuator position throughout the full range of valve travel.
5. Smart Control shall support configurable analog input and output signals, including 4-20 mA and 20-4 mA signal ranges as specified. Analog signal scaling shall be adjustable through the Smart Control configuration interface.
6. Smart Control shall provide discrete status outputs for remote monitoring.
7. At a minimum, discrete outputs shall be available to indicate:
  - a. Valve fully open.
  - b. Valve fully closed.
8. Additional user-configurable status outputs shall be available when required.
9. Smart Control shall provide two configurable relay outputs for remote fault monitoring.
10. The first relay shall provide a trouble indication identifying a condition requiring investigation while actuator functionality remains available.
11. The second relay shall provide an alarm indication identifying a condition that prevents normal actuator operation.
12. Communication loss, interruption, or protocol failure shall not result in unintended actuator movement. Actuator response to communication failure shall be as specified under Fail-Safe Operation requirements.

**F. Diagnostics and Alarms**

1. Smart Control shall continuously monitor actuator operation and system health and shall perform automatic diagnostic checks during operation.
2. Diagnostic functions shall be capable of identifying abnormal operating conditions and providing notification to operating and maintenance personnel through the HMI and remote communication interfaces.
3. Smart Control shall continuously monitor operating parameters associated with actuator performance, hydraulic system condition, electrical system status, position control, and fail-safe operation.
4. Diagnostic information shall be accessible through the HMI and shall remain available for troubleshooting and maintenance activities.
5. At a minimum, Smart Control shall be capable of detecting and annunciating the following alarm or fault conditions:
  - a. Variable Frequency Drive (VFD) Fault.
  - b. Accumulator Fault.
  - c. Emergency Stop Activated.
  - d. Low Hydraulic Oil Level.
  - e. Hi Hydraulic Oil Temperature.
  - f. Position Error.
  - g. Low Accumulator Gas Pressure, for fail-safe actuator configurations.
6. Additional alarms and diagnostic conditions provided by the manufacturer shall also be available through the Smart Control system.



7. When a fault or alarm condition occurs, Smart Control shall provide a clear visual indication on the HMI identifying the active condition.
8. Alarm descriptions shall be presented in plain language sufficient to assist operating and maintenance personnel in identifying the source of the condition.
9. Active alarms shall remain visible until the alarm condition has been corrected or acknowledged in accordance with the manufacturer's operating philosophy.
10. Clearing an alarm indication shall not automatically restart actuator operation or override required safety functions.
11. Alarm and fault conditions shall be available for transmission to remote monitoring and supervisory control systems through the communication interfaces specified herein.
12. Alarm status reporting shall not interfere with normal actuator operation or control functions.
13. Smart Control shall provide maintenance notifications for monitored service items when maintenance intervals or operating-hour thresholds have been reached. Maintenance notifications shall be configurable by authorized users through the Smart Control interface.

#### **G. Safety Features**

1. Smart Control shall incorporate safety features designed to protect operating personnel, equipment, and the process system from unsafe operating conditions.
2. Safety features shall remain functional regardless of the selected operating mode and shall not be bypassed through normal actuator control functions.
3. An Emergency Stop (E-Stop) device shall be provided as a standard feature and shall be mounted externally on the Smart Control enclosure.
4. The E-Stop device shall comply with the intent of NFPA 79 and ISO 13850 and shall incorporate a mechanical reset function requiring deliberate operator action prior to returning the actuator to service.
5. Smart Control shall include a rotary disconnect switch suitable for lockout/tagout (LOTO) isolation of incoming electrical power.
6. The disconnect switch shall be capable of being secured in the OFF position using a user-supplied lock.
7. Smart disconnect switch shall be capable of being secured in the OFF position using a user-supplied lock.
8. Circuit protection devices shall be accessible for maintenance and troubleshooting purposes.
9. Electrical surge protection shall be provided on incoming power circuits and on external control and communication connections.
10. Surge protection devices shall be designed to protect Smart Control electronics from transient voltage events commonly encountered in industrial and municipal installations.
11. Activation of any safety function shall not result in uncontrolled actuator movement.
12. Safety system operation shall place the actuator in the response condition specified by the applicable fail-safe operating mode.
13. Automatic restoration of power shall not cause unintended actuator movement.

#### **H. Pump Control Functions**

1. Where pump startup and shutdown sequencing is not provided by the pump station control system, Smart Control shall be capable of providing pump control functions and valve sequencing as specified herein.
2. Smart Control shall coordinate pump operation and valve movement to minimize hydraulic transients and maintain stable system operation.
3. Normal Status Sequence:
  - a. Upon receipt of a command indicating that pumping is required, Smart Control shall initiate the programmed startup sequence.



- b. The startup sequence shall, at a minimum, perform the following functions:
        1. Initial the command to start the pump.
        2. Verify establishment of pump discharge pressure or other configured startup confirmation criteria.
        3. Open the pump control valve in accordance with the programmed valve movement profile.
        4. Continue valve movement until the commanded operating position has been achieved.
      - c. Valve movement during startup shall be controlled in a manner intended to minimize hydraulic transients and pressure surges.
    4. Normal Operation:
      - a. During pumping operation, Smart Control shall continuously monitor actuator position, operating status, and programmed control requirements.
      - b. Valve movement shall be controlled in accordance with the configured motion profile and operating parameters established for the application.
    5. Normal Shutdown Sequence:
      - a. Upon receipt of a normal shutdown command, Smart Control shall initiate the programmed shutdown sequence.
      - b. The shutdown sequence shall, at a minimum, perform the following functions:
        1. Close the pump control valve in accordance with the programmed closing profile.
        2. Verify that the valve has reached the required closed position.
        3. Issue a command to stop the pump.
      - c. Valve closure during normal shutdown shall be controlled to minimize hydraulic transients and pressure surges.
    6. Alarm Response:
      - a. When a configured alarm condition requiring pump shutdown is detected, Smart Control shall automatically initiate the alarm shutdown sequence.
      - b. The alarm shutdown sequence shall, at a minimum,
        1. Remove the pump run command.
        2. Close the pump control valve using the programmed emergency closing profile.
        3. Generate local and remote alarm indications.
    7. Power Failure Recovery:
      - a. Following restoration of power after a power interruption, Smart Control shall not automatically resume pump startup and valve operation until the programmed restart delay has elapsed.
      - b. The restart delay shall be configurable and shall be provided to prevent unintended valve movement and system instability following power restoration.

**I. Logging and Data Recording**

1. Smart Control shall provide onboard logging and data recording functions for operational, diagnostic, and maintenance-related information.
2. Recorded information shall be accessible through the Smart Control HMI and shall be retained following loss of power.
3. Smart Control shall maintain an event log capable of recording operator actions, actuator operating events, configuration changes, and alarm conditions.
4. At a minimum, event records shall include:
  - a. Date and time of occurrence.
  - b. Event description.
  - c. Alarm or diagnostic condition identification, where applicable.
  - d. User identification, when initiated through a password-controlled function.



5. Smart Control shall maintain a history of alarm and fault conditions to aid in troubleshooting and maintenance activities.
6. Alarm history shall include active alarms, acknowledged alarms, and cleared alarms, together with corresponding date and time information.
7. Smart Control shall record selected operating information for maintenance and performance evaluation purposes.
8. At a minimum, recorded operating data shall include:
  - a. Actuator operating hours.
  - b. Number of valve cycles.
  - c. Maintenance notification events.
  - d. Other operational parameters provided by the manufacturer.
9. Changes to user-configurable operating parameters shall be recorded within the Smart Control event history.
10. Configuration records shall include the date and time of the change and identification of the authorized user making the modification, where available.
11. Recorded logs and historical information shall be accessible through the HMI without requiring external software.
12. Where supported by the selected communication interface, logged information shall also be available for retrieval through remote monitoring systems.
13. Logged information shall be stored in non-volatile memory and shall not be lost following normal power interruptions.
14. System restart following restoration of power shall not require re-entry of retained historical records, configuration information, or maintenance data.

## **PART 3 - EXECUTION**

### **3.01 INSTALLATION**

- A. Mechanical installation of the Electro-Hydraulic Actuator on the valve shall be performed by the valve manufacturer at the manufacturer's facility prior to shipment.
- B. The valve manufacturer shall be responsible for the design, integration, assembly, and performance of the complete valve actuator system.
- C. All mounting brackets, adapter plates, couplings, hardware, and other components required for attachment of the actuator to the valve shall be designed, furnished, and installed by the valve manufacturer.
- D. Field installation shall be performed in accordance with the manufacturer's written installation instructions.
- E. The Contractor shall verify that the equipment has been installed, connected, and adjusted in accordance with the manufacturer's recommendations prior to placing the equipment into service.

### **3.02 TESTING**

- A. The valve and Electro-Hydraulic Actuator shall be tested as a complete, integrated assembly at the valve manufacturer's facility prior to shipment.
- B. Testing shall verify proper operation of the actuator, Smart Control system, position feedback system, fail-safe functions, where specified, and all associated controls.
- C. Factory testing shall verify proper valve operation throughout the full range of travel and confirm satisfactory operation.
- D. Factory test results shall be documented and made available upon request in accordance with the submittal requirements of this specification.



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### **3.03 CLOSEOUT**

- A. Submit Operation and maintenance manuals, factory test reports, and other closeout documentation in accordance with the requirements of Section 1.03 Submittals.
- B. Operation and maintenance manuals shall be complete and shall include installation instructions, operating procedures, maintenance requirements, troubleshooting information, parts identification, wiring diagrams, and recommended spare parts information.
- C. Documentation verifying instruction and training of the Owner's operations and maintenance personnel shall be furnished as part of the project closeout package.
- D. Training documentation shall identify the equipment covered, date of instruction, and personnel who received training.
- E. Final actuator and Smart Control configuration settings shall be documented and included with project closeout documentation.
- F. Configuration records shall include where applicable:
  - 1. Operating mode settings.
  - 2. Valve travel limits.
  - 3. Speed settings.
  - 4. Motion profiles.
  - 5. Communication settings.
  - 6. User-configurable alarm and notification settings.
- G. Warranty documentation shall be submitted as part of the project closeout package.
- H. Warranty information shall identify warranty coverage, duration, and procedures for obtaining warranty service.
- I. Equipment shall be considered ready for final acceptance following completion of installation, testing, documentation submittals, and delivery of all required closeout materials specified herein.

### **3.04 MAINTENANCE**

- A. The Electro-Hydraulic Actuator and Smart Control system shall be designed to permit routine inspection, maintenance, and service without removal of the actuator from the valve.
- B. Maintenance activities shall be capable of being performed using standard industry tools and procedures unless otherwise specified by the manufacturer.
- C. Inspection, maintenance, and service activities shall be performed in accordance with the manufacturer's written recommendations and documented maintenance procedures.
- D. Smart Control shall provide maintenance reminders and notifications for service items monitored by the system.
- E. The hydraulic system shall be designed to minimize routine maintenance requirements.
- F. Where hydraulic filters require periodic replacement, Smart Control shall provide maintenance notification prior to the recommended service interval.
- G. Hydraulic service points shall be readily accessible for inspection and maintenance activities.
- H. Diagnostic information, alarm history, operating records, and maintenance notifications shall remain accessible through the Smart Control HMI to assist troubleshooting and preventive maintenance activities.
- I. Replacement components required for normal maintenance shall be commercially available from the manufacturer.
- J. The manufacturer shall identify recommended replacement components and maintenance intervals within the operation and maintenance manuals.

**END OF SECTION**