**General specification for fail-safe electrically operated actuators used in critical safety shutdown applications in a hazardous environment**

**General:**

* The actuator will be a compact and robust electrically operated fail safe unit, utilising an internal spring-return mechanism to provide a reliable means of positioning the valve to a safe position on loss of power supply or emergency shutdown (ESD) signal. The actuators can be fail-safe to close, or open dependent on the safety criteria of the process.
* The actuators will be self contained with an Electro Hydraulic system operating against an internal fail safe return spring. The Electro Hydraulic control module will be supplied complete with sealed hydraulic, electronic and termination compartment watertight to IP68. The electronic compartment is to be double sealed to ensure protection of internal components during installation by segregating the cable glands and termination compartment. The unit will be configured and commissioned by utilizing a non-intrusive infrared setting tool to eliminate the need for opening the enclosures.
* The integral Electro-Hydraulic power module will provide the source of hydraulic power to a single acting scotch yoke spring return drive. The hydraulic section of the control module and the scotch yoke will be hydraulic oil filled and sealed to the environment and will operate on a hydraulic pump and bleed principle.
* Lockable local controls will be supplied as an integral part of the control module.
* A Dual LCD display will be provided to display status indication and alarm with a 32 character text and multilingual capability. The display will indicate position, pressure, commands, alarms and help screens.
* LED’s will be provided to locally indicate the actuator is at the open, close or intermediate position.
* The Actuator will be suitable for use in analogue modulating or two position control - Emergency shutdown (ESD) system, configured by a non- intrusive setting tool.
* ESD control will be by independent hardware input.
* Partial stroking facility to verify the valve and actuator availability on ESD applications will be available. Setting of the partial stroking will be set by the setting tool and will be activated by a hardwired-input signal or through the setting tool. During the partial stroke test, ESD action will take priority.
* The actuator is to provide monitoring and fault alarm detection of the system and provide volt free outputs for remote indication.

**The Certification requirements are as follows:**

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**ATEX - II 2G EEx**

* de\* IIB T4 (Ta: - 40°C to + 65°C) (- 40°F to +140°F).

EN60079-0: 2004, EN 60079-1: 2004, EN 60079-7: 2003 & EN 13463-1: 2001.

* IECEx – EX de\* IIB T4 (Ta: - 40°C to + 65°C) (- 40°F to +140°F). IEC 60079-0: 2000, IEC 60079-1: 2003, IEC 60079-7: 2001.
* FM – Class I, Zone 1 AEx de\* IIB T4 (Ta: - 40°C to + 65°C) (- 40°F to +140°F).

Class 3600: 1998, ANSI/ISA – 12.00.01: 2002, ANSI/ISA – 12.22.01: 2002, ANSI/ISA – 12.16.01: 2002, Class 3810: 2005 & ANSI/NEMA – 250: 1991.

* CSA – Class I, Zone 1 EX de\* IIB T4 (Ta: - 40°C to + 65°C) (- 40°F to + 140°F).

CAN/CSA – E60079-0-02, CAN/CSA – E60079-1-02, CAN/CSA – E60079-7-03,& CAN/CSA – C22.2 No. 61010-1-04. (The approval applies only to the power unit. Full actuator assembly will need to be subjected to CSA inspection).

* GOST – Ex dme\* IIB T4 (Ta: - 40°C to + 65°C) (- 40°F to + 140°F). EN 60079-0: 2004, EN 60079-1: 2004, EN 60079-7: 2003.
* INMETRO – EEx de\* IIB T4 (Ta: - 50°C to + 65°C) (- 58°F to +140°F). EEx de\* IIC T4 (Ta: - 20°C to + 60°C) (- 4°F to + 140°F).

**Local Indication**

* A digital valve position indicator that continuously shows the valve position (0-100%), plus separate red, green and yellow LED’s to indicate valve open limit, closed limit and intermediate position shall be supplied.

On loss of power or signal the actuator will move to the desired failure position, open or closed, under the control of the spring.

* Local mechanical indication will be provided with a dial arrangement and graduated scale. **Local Controls**
* A lockable three-position selector switch shall be provided. The switch shall provide two control modes, Local and Remote. In addition, the switch shall provide a third position, which inhibits local and remote operation of the actuator. The switch shall be lockable in all three positions. The switch positions shall be marked LOCAL; STOP (OFF); REMOTE or by suitable symbols to clearly identify the function of each switch position. The selector switch will be designed in such a way as not to allow the ingress of water.

**Operating Voltages:**

* The Actuator will be capable of operating using any of the following electrical supplies:

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* Single Phase 110 Vac-120Vac 50/60 Hz +/- 10%. Or
* Single Phase 230 Vac 50/60 Hz +/- 10% Or
* 24Vdc Or
* Three Phase 380-480 Vac 50/60 Hz +/- 10% (690 Vac larger units )

**Position and Pressure Monitoring:**

* Feedback from the actuator will be obtained from a position and a pressure sensor. Position monitoring will be provided using a high-resolution potentiometer or transducer, directly mounted to the actuator drive shaft
* An analogue position sensor will measure the position within the bounds of the limits to a resolution of 0.1%. The position should read 0.0% at the closed limit and 100.0% at the open limit.
* A pressure sensor will be used to measure the force being applied to the actuator. The pressure will be used to detect obstructions in mid travel (between the two limits) and to torque seat a valve at one or both ends of travel (past the limits). When torque seating is required, an option should be included for the system to maintain pressure by re-starting the pump if the pressure drops below the desired pressure.

Hysteresis adjustment for over and under pressure will be enabled, to compensate for hydraulic expansion or contraction due to ambient temperature changes at the open and closed limits.

* Alarms to be displayed on the LCD display. **Hard Wired Control**
* To allow remote digital control of the actuator, opto-isolated remote inputs should be included. These should have the following characteristics:

 Open, Close, Maintain, ESD and Partial Stroke:

* 20 to 60V DC, 5mA, minimum duration 300ms
* 60 to 120VAC, 5mA, minimum duration 300ms
* An ESD signal will indicate a healthy system. Loss of ESD signal will represent a fail-safe condition.
* In Hardwired Remote mode, the actuator will be controlled via the switched remote input signals. These can command the actuator to open or close by controlling three signals: ROPEN, RCLOSE and RMAIN. The actuator will then continue to move in the commanded direction until a limit is reached or the opposite direction of travel is selected

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* On Critical safety shutdown applications dual ESD solenoids will be used to provide redundancy and will be hardware configured connecting the ESD input direct to the solenoids through hardware components only.
* ESD input will have an independent circuit and will take priority over all other control commands. Microprocessors will **not** be used to control the ESD solenoids but can monitor the status of the ESD circuit.

**Optional ESD Manual reset**:

After an emergency shutdown the actuator will return to the pre determined safe position and will be ready to operate on the next command when the ESD signal is reinstated. An optional ESD manual reset can be enabled to restrict the actuator from operating until locally reset at the actuator or through an externally mounted switch.

**Partial Stroking:**

Partial stroking allows the actuated valve to be functionally tested without affecting the process.

Confirms availability and minimise plant shutdowns for maintenance. A test is to be initiated remotely or locally through a non intrusive setting tool

The partial stroke test will be based on moving the actuator to a preset position; the travel time will be logged and compared to the original time recorded at the commissioning stage. A pass or fail will de displayed and the alarm will be activated.

* The partial stroking settings should be user definable and the setting should be adjustable through the non- intrusive setting tool.
* Actuators with dual redundant ESD solenoids will undertake the two independent tests to prove each solenoid circuit is functioning correctly.
* During a partial stroke, any other control signals should take precedence so that the partial stroking function does not interfere with normal operation.

**Data logger:**

A data logger internal to the actuator will record configurations and settings. With the last 1024 events with 32 bits of status for each event, along with analogue traces for demand, position and pressure.

**Infrared / Bluetooth Setting Tool :**

An intrinsically safe non intrusive infrared / Bluetooth setting tool will be provided to allow for:

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* The operator to view the settings , alarms and help screens using the infrared part of the setting tool
* View and change the configurations, settings and to interrogate the actuator via a password protected menu using the infrared setting tool
* Downloading or uploading of data from the actuators using the blue tooth setting tool. The blue tooth is to operate within a range of 10 meters of the actuator and will transfer the data for a number of actuators to a Bluetooth enabled PC running InSight II software.

**PC Software:**

Software is to be provided to allow the actuator files to be uploaded on to a PC with Insight II software for review of the settings and analysis of events and trends.

**Fieldbus Compatibility:**

The electronic system must be capable of interfacing with any of the following optional field bus

systems

Pakscan.

Devicenet.

Modbus.

Profibus.

Foundation Fieldbus.

**Alarm and Limit relays:**

* The actuator will provide the following volt free normally open or normally closed output contacts rated 5mA to 5A 120/230vac, 30Vdc
* Alarm Monitor relay will be provided to de-energise on loss of mains power, hardware, local controls, position sensor fault, and EEPROM error.
* Three ( one only on larger units ) output relays are to be provided and can be configured for specific alarms to suit the application.

The options are to be as follows:

|  |  |  |
| --- | --- | --- |
| Closed Limit  Open Limit Position % Open Motor Running Closing  Opening  Moving  Stall (mid-travel) Stall (end of travel) Stall (any position) | Over pressure (mid-travel)  Over pressure (end of travel)  Over pressure (any position)  Stop Selected Local Selected Remote Selected Control Alarm ESD Active | Monitor  Fault Alarm  Temperature % Trip Manual override switch External manual reset switch  Acc. pressure switch Motor thermostat switch Partial stroke passed Partial stroke failed |

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**Electro Mechanical Limit Switches**

* The actuator should be supplied with a minimum of two adjustable volt free SPDT switch contacts rated 5A at 250V AC, as an independent means of indication on critical loops.
* Position limit switches shall be fully adjustable over the full range of valve travel. When

mechanical limit switches are used for external indication, the appropriate contacts shall open at their pre-set limits of travel. They shall also function when the actuator is operated by a manual override.

**Analogue Control:**

Under analogue control, the controller should position the actuator to match an analogue demand signal. This can be either a 4-20mA current or 0-10V voltage, configurable as a software setting. Selectable slowband, deadband and hysteresis values will be used to determine how closely the actuator position should match the process variable, thereby preventing the system from hunting. The actuator should be capable of continuous duty and provide a resolution < 0.25%. The analogue input should be powered by an isolated control signal and calibration of the inputs should be performed within the microcontroller software

* **CPT:**

Current transmitter output can be configured to provide a 4-20mA output signal for valve position or actuator hydraulic pressure. The transmitter can be internal or externally powered.

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