

**WATER SUPPLIES DEPARTMENT**  
**STANDARD SPECIFICATION E-11-04**  
**PUMPSET CONTROL PANEL**

1 **SCOPE**

This standard specification stipulates the requirements of the pumpset control panel for pump motors rated 70kW or above.

It shall be read in conjunction with the following WSD Standard Specifications:-

E-11-03      Electrical and Instrumentation Panels and Cubicles

E-78-04      Programmable Logic Controller

2 **GENERAL REQUIREMENTS**

An individual panel shall be provided for each pumpset for installation adjacent to the pump motor.

The design of the panel shall be compatible with the pumpset.

The panel shall form part of the Distributed Control System (DCS), where installed, of the station. The panel shall be wired to the pumpset instruments and the switchgear panel via control cables such that local manual operation of the pumpset is fully functional when the panel is not connected to the data network of the DCS. The emergency stop push-button and the “Start” and “Stop” push-buttons (for low voltage (LV) motors) or “Neutral/Start” selector switch (for high voltage (HV) motors) shall also be wired in such a way that emergency operation of the motor is permissible when the Programmable Logic Controller (PLC) is out of order.

3 **CONSTRUCTION**

The panel shall be designed in compliance with WSD Standard Specification E-11-03.

The panel shall be rectangular, free floor standing, fabricated with sheet steel of a minimum thickness of 2 mm, suitably braced to afford rigidity. It shall have a

rear hinged access door with chromium plated car-type lockable handle. The degree of protection shall be IP 54 to IEC 60529.

One undercoat and two finishing coats of colour reference 18B21 (light grey) to BS 4800 shall be applied to give a durable gloss finish. The internal finish shall be white to BS 4800 shade 00E51.

The panel shall be equipped with a detachable brass gland plate and cable glands. The gland plate shall be located at least 300 mm from the finished floor level.

A swing door with glass viewing panel shall be provided over the flush-mounted human-machine interface (HMI) described in Clause 4 below in case the display fascia of the HMI has a degree of protection lower than IP54.

## 4 EQUIPMENT DESIGN

### 4.1 General

The panel shall contain PLC, a HMI with touch screen function, flow, temperature and vibration monitoring units and other auxiliary equipment to facilitate monitoring and control of the pumpset.

### 4.2 PLC

The PLC shall be designed in compliance with WSD Standard Specification E-78-04. The PLC shall be programmed to provide the control, indication and alarm functions for HV and LV pumps as specified in the Particular Specification.

The PLC shall be suitable for connection to the DCS via dual optical fibre or Ethernet cables. All essential accessories such as I/O modules, protocol converter, if required, etc. shall be provided.

### 4.3 HMI

The HMI shall be mounted on the panel front and provide the following functions:-

- (a) To display all the status signals, alarm signals and push-buttons for the local control of the pumpset

- (b) To show the readings of all the temperature monitoring units and vibration monitoring units of the pumpset

The HMI shall conform to the following minimum requirements:-

- (a) Display: minimum 15” color active matrix TFT
- (b) Resolution: 1280 x 800/1366 x 768 or better, 18-bit color graphics, 300 cd/m<sup>2</sup>
- (c) Backlight: 50,000 hr or better – field replaceable
- (d) Real-time clock with battery-backed time clock and timestamps critical data
- (e) Application memory: minimum 512MB
- (f) Touch screen type: Analog resistive/Projected capacitive
- (g) Communication ports: Ethernet, RS 232 or RS 485 and 2 x USB

#### 4.4 Flow Monitoring Unit

Flow monitoring units shall be provided to initiate alarm and tripping of the pumpset when the water flow in the mechanical seal or water-cooled bearings (if applicable) is below its threshold value. The monitoring unit for the pump delivery no-flow switch shall also be supplied and installed in the panel.

#### 4.5 Temperature Monitoring Unit

Temperature monitoring units for the motor winding embedded temperature detectors (ETD), pump and motor bearing temperature detectors and motor exhaust air temperature detector shall be installed in the panel to provide temperature signals and initiate temperature high alarm and trip operation. The alarm and trip settings of the monitoring units shall be adjustable for individual detecting elements.

Temperatures of individual detecting elements, alarms and status signals shall be displayed on the HMI and in the control room.

The ETD monitoring units for each motor shall have the following features:

- (a) Alarm contacts shall operate and an alarm signal shall be initiated at 120°C which shall be adjustable for individual detecting elements.

- (b) Trip contacts shall operate and a trip signal shall be initiated at 140°C which shall be adjustable for individual detecting elements.
- (c) A 4-20mA output signal corresponding to the measured temperature with adjustable span and zero shall be provided.

Bearing and motor exhaust air temperature monitoring units shall have the following features:

- (a) Alarms contacts shall operate and an alarm signal shall be initiated at 10°C lower than the trip contacts/signal unless otherwise recommended by the motor manufacturer.
- (b) The alarm and trip settings shall be adjustable for individual detecting elements.
- (c) A 4-20mA output signal corresponding to the measured temperature with adjustable span and zero shall be provided.

#### 4.6 Vibration Monitoring Unit

Vibration monitoring units for the pump and motor of 750 kW and above shall be installed in the panel and shall have a continuously adjustable alarm/trip setting from 50-300% of the normal vibration amplitude. The equipment shall output a 4-20mA signal corresponding to the measured vibration level in millimetres peak-to-peak with adjustable zero and span. The vibration level shall be displayed on the HMI and in the control room. The overall error of the equipment shall not exceed 5% of the full scale reading of the instrument range.

The unit shall be fitted with an alarm reset push button and alarm indicating lights. The vibration monitoring unit and detector shall be designed to prevent false alarm due to transient shocks by incorporating a time-delay device of two seconds.

#### 4.7 Power Supply and Circuitry of Monitoring Unit

Power supply to the PLC and all the monitoring units mentioned above shall be 24V d.c.

The alarm and trip contacts shall be volt free and rated at 24V d.c. The output contacts shall be normally open and shall close on detection of an alarm condition such that tripping of motor shall not occur due to failure of the auxiliary supply.

#### 4.8 Auxiliary Equipment

The following power supply equipment and circuits shall be installed in the panel. The Contractor shall submit detailed load estimation and sizing calculations for the d.c./d.c. converter, ORing diodes and power supply unit for the Engineer's approval.

- (a) A 110V d.c. to 24V d.c. converter (where there is no 24V d.c. station battery available).
- (b) A 32A DP isolating switch for isolation of the a.c. input supply.
- (c) A 32A DPTT selector switch for selection among d.c. battery supply, rectified d.c. supply or both. ORing diodes shall be provided for connection made to both supplies.
- (d) A 24V d.c. full bridge rectifier solid state regulated power supply unit. The transformer shall be of switching type with pulse width modulation control with nominal input voltage of 220V. The output of the unit shall be maintained at 24V d.c. with ripples within 150 mV. The power supply unit shall be equipped with overload, short-circuit, over voltage and over temperature protection.

Auxiliary supply for the panel heaters and indicating instruments shall be 220V 50 Hz.

Other equipment such as emergency push-button, key-operated selector switches, indicating lamps, push-buttons, panel heater, auxiliary relays and timers, etc., as specified in the Particular Specification.

#### 5 EQUIPMENT LAYOUT

The following equipment shall be mounted in the panel:

- (a) Motor winding temperature monitoring units (six nos. at motor winding U1, V1, W1, U2, V2 and W2 for HV motors and three nos. at motor winding U, V and W for LV motors)
- (b) Motor driving end and non-driving end bearing temperature monitoring units

- (c) Pump driving end and non-driving end bearing temperature monitoring units
- (d) Motor exhaust air temperature monitoring unit (for HV motors of 1000kW and above)
- (e) Motor driving end and non-driving end bearing vibration monitoring units (for HV motors of 750kW and above)
- (f) Pump upper and lower bearing vibration monitoring units
- (g) No-flow switch monitoring units for pump delivery flow, mechanical seal water flow and water-cooled bearing water flow (if applicable)
- (h) Power supply units for the PLC
- (i) “PSU/Normal/Battery” PLC power supply selector switch
- (j) Isolation switches and protection fuses for a.c. and d.c. supply
- (k) Anti-condensation heater complete with isolation switch and humidity sensor
- (l) Sufficient terminals for external cable connections

The following control and indicating instruments shall be flush mounted with the front panel:

- (a) Emergency stop push-button with two latched change-over contacts
- (b) Key-operated “Emergency Start/HMI/Auto/Control Room” selector switch with two pairs of change-over switches at each position
- (c) Key-operated “Neutral/Start” spring-returned selector switch with two pairs of change-over switches at each position (for HV motors)
- (d) Key-operated “Start” push-button with two change-over contacts (for LV motors)

- (e) Two motor running indication beacons (green – ‘Pump On’, red – ‘Pump Off’) shall be mounted on the panel top
- (f) “Emergency Start Control Available”, “Motor Tripped on Fault” and “PLC Failed” indicating lamps

Components shall be so arranged that access for routine maintenance is not impeded.

Internal wiring shall be installed in plastic wiring channels and bundled neatly using insulated cleats. A space factor of 50% shall be used in designing wiring channels.

Terminal blocks for control wiring shall be located at least 150 mm from the gland plate. Cable cores shall be identified with PVC ferrules visible without dismantling covers or disturbing adjacent terminations.

- End of this Specification -