

WATER SUPPLIES DEPARTMENT
STANDARD SPECIFICATION EM-02-08
CHLORINATION PLANT MONITORING AND CONTROL PANEL

This specification shall be read in conjunction with the following WSD Standard Specifications :

- (a) EM-02-01 for Chlorination Plant - General and Design;
- (b) EM-02-02 for Chlorinator;
- (c) EM-02-03 for Chlorine Automatic Changeover Panel;
- (d) EM-02-04 for Chlorine Gas Detection System;
- (e) EM-02-06 for Chlorine Evaporator;
- (f) EM-02-07 for Weighing Scale for Chlorine Containers; and
- (g) EM-02-09 for Chlorine Pressure Gauges.

1. **DESIGN**

1.1 **General**

The Chlorination Plant Monitoring and Control Panel (CPMCP) shall be programmable logic controller (PLC) based with power supply equipment, touch screen panels and accessories to relay all the analogue, control, alarm and status signals from the chlorination plant, chlorine gas detection system and the associated equipment. For large chlorination plant installation, adoption of a separate monitoring and control panel for chlorine gas detection system is also acceptable.

A separate monitoring and control panel shall be provided for ventilation and scrubber system as stipulated in EM-02-10 for Chlorine Room Ventilation. The monitoring and control panels for chlorination plant, chlorine gas detection system and ventilation and chlorine scrubber system shall be housed in a centralized and air conditioned chlorine control room.

The Chlorination Plant Monitoring and Control Panel shall perform all monitoring and control functions specified below.

1.2 **Monitoring and Control Functions**

1.2.1 Mimic diagram(s) shall be provided for monitoring of the chlorine system.

(a) Chlorine Storage and Dosing System Monitoring

(i) Each Draw-off Unit

- Net chlorine weight inside container (each weighing scale)
- Chlorine container nearly empty alarm (each weighing scale)
- Chlorine container empty alarm (each weighing scale)

- Duty chlorine container in operation (each container)
 - Chlorine drum outlet disc ruptured alarm (each disc, if installed)
 - Chlorine header pressure low alarm (from chlorine pressure gauge at the evaporator inlet, i.e. P3 referred in WSD Standard Specification EM-02-09, where specified.)
 - Duty and standby supply pressure low alarm (from changeover panel)
 - Auto/ Shut-off/ Manual/ All Duty operation mode (from changeover panel)
 - Open/close status of duty and standby motorized valves (from changeover panel)
 - Chlorine container changed alarm (from changeover panel and reset after empty container replaced)
 - Changeover valve emergency shut-off protection out indication
- (ii) Each Evaporator (where specified)
- Evaporator in service
 - Water bath heater On/Off status
 - Evaporator loss of power supply alarm
 - Water bath level high alarm
 - Water bath level low alarm
 - Water bath temperature high alarm
 - Water bath temperature low alarm
 - Water bath cathodic protection current
 - PRV pressure high alarm (from chlorine pressure gauge between PRV and vacuum regulator-check unit, i.e. P5 referred in WSD Standard Specification EM-02-09)
 - PRV pressure low alarm (from chlorine pressure gauge between PRV and vacuum regulator-check unit, i.e. P5 referred in WSD Standard Specification EM-02-09)
 - Evaporator gas outlet open/shut-off status (from vacuum regulator-check unit)
 - Vacuum regulator-check unit temperature low alarm
 - Evaporator liquid inlet disc ruptured alarm
 - Evaporator gas outlet disc ruptured alarm
- (iii) Each Chlorinator
- Chlorinator On/Off status
 - Manual/Automatic control mode
 - Chlorine residual set point or dosing factor (from operator input via DCS or the controller for automatic dosing)
 - Chlorine dosing set point (in kg/hr, calculated from the controller for automatic dosing)
 - Chlorine actual dosing rate
 - Chlorinator dosing point residual chlorine (each dosing point)
 - Chlorinator vacuum failed alarm (from low vacuum switch)
 - Chlorinator gas supply failed alarm (from high vacuum switch)
 - Chlorinator water supply failed alarm (from flow switch)
 - Ejector water pressure high alarm
 - Ejector water pressure low alarm

- (iv) Each Chlorinator Booster Pumpset (where specified)
 - Duty water pump in operation
 - Chlorine water supply pump failed alarm
 - Pump suction pressure low alarm
 - Motor tripped alarm

(b) Chlorine Gas Detection System Monitoring

The following monitoring functions can be implemented in a separate chlorine gas detection system monitoring and control panel for large chlorine installations, if specified in the Particular Specification.

- (i) Each Chlorine Gas Detection Zone
 - High chlorine leak alarm
 - Low chlorine leak alarm
 - Chlorine leak detection protection in/out indication
 - Chlorine leak simulation test on/off indication
 - Chlorine call point pressed
 - Chlorine leak emergency operation alarm
- (ii) Each Chlorine Leak Detector
 - Power supply on indication
 - Detector faulty alarm
 - High chlorine leak alarm
 - Low chlorine leak alarm
 - Gas concentration display

1.2.2 Indicating lamps shall be provided for the following system overall monitoring functions :-

- (a) Chlorine leak emergency operation alarm
- (b) Chlorine leak evacuation alarm
- (c) Chlorine leak evacuation test "On" indication
- (d) Communication link to DCS healthy/failed
- (e) Communication link to Ventilation (and Chlorine Scrubber, if installed)
Monitoring and Control Panel healthy/failed
- (f) Communication link to Automatic Fire Alarm Panel healthy/failed
- (g) Communication link to other PLC systems healthy/failed (where specified)
- (h) Power supply equipment faulty alarm
- (i) Wind speed (via LED display of character height not less than 10 mm)
- (j) Wind direction (via LED display of character height not less than 10 mm)

1.2.3 Control functions

Description	Control Requirements
On/off control for booster pump	<ul style="list-style-type: none"> - By open/close illuminated push buttons at CPMCP. - By DCS at Main Control Room.
Initiation of chlorine leak emergency operation alarm and automatic control functions for the chlorine leak detection zone with chlorine leak as stipulated in Clause 4.2 of WSD Standard Specification EM-02-01	<ul style="list-style-type: none"> - By mushroom type push button at CPMCP. - Reset by a key operated selector switch only for all chlorine leak detection zones at CPMCP. - By a mushroom type push button at Main Control Room. - By chlorine manual call points at strategic locations. - Detection of chlorine leak of 3 ppm or above by chlorine leak detectors.
Chlorine leak evacuation alarm initiation	<ul style="list-style-type: none"> - By a key operated selector switch at Main Control Room. - Reset by a key operated selector switch at CPMCP only.
Chlorine leak evacuation test on/off selection	<ul style="list-style-type: none"> - By a key operated selector switch at Main Control Room.
Chlorine leak detector protection in/out selection for each chlorine leak detection zone	<ul style="list-style-type: none"> - By a separate key operated selector switch^{Note} at CPMCP.
Chlorine leak simulation test on/off selection for each chlorine leak detection zone	
Changeover valve emergency shut-off protection in/out selection	<ul style="list-style-type: none"> - By a key operated selector switch at CPMCP.

Note : Control functions shall be implemented in a separate chlorine gas detection system monitoring and control panel for large chlorine installations, if specified in the Particular Specification.

1.3 Panel Components

The Chlorination Plant Monitoring and Control Panel shall comprise PLC systems and touch screen panels as specified in this specification.

The power supply for the PLC system shall be 24V d.c. normally obtained from the station battery system. In case there is an excessive voltage drop or no sufficient capacity in the station battery system, a dedicated power supply equipment, in

compliance with Clause 1.3.3 of this specification, shall be provided if specified in the Particular Specification.

The panel shall interface with the Distribution Control System, Ventilation (and Chlorine Scrubber, if installed) Monitoring and Control Panel, Automatic Fire Alarm Panel and other PLC systems, where specified in the Particular Specification.

1.3.1 The PLC Systems

The PLC systems of the Chlorination Plant Monitoring and Control Panel shall comply with WSD Standard Specification E-78-04 unless otherwise specified. The PLC system shall meet the following particular requirements :

- (a) The PLC systems of Chlorination Plant Monitoring and Control Panel shall be of modular design including one dedicated PLC system for chlorine gas detection system; and one or more PLC system(s) for chlorination plant monitoring and control, each for chlorination plant up to 4 draw-off units.
- (b) Each PLC system shall be designed in redundant arrangement with two PLC units, one in duty and the other one in hot standby, to perform all the functions as outlined in this Specification. If the duty PLC unit fails, the hot standby one shall take up all the functions without any interrupts on the operation.
- (c) The ladder programs, set points, logged data, operation parameters shall be automatically updated between the duty and the hot-standby PLC units. The PLC System shall be programmed to perform all the required manual and automatic control and monitoring functions.
- (d) In case of a fault in the duty PLC unit, the standby PLC unit shall take over processing at the interruption point seamlessly without any data loss. The PLC units shall support online repair during operation so that any faulty modules including the CPU modules can be replaced online. The replaced CPU modules shall be automatically updated by the duty PLC unit with current programs and data.
- (e) The redundancy link between the hot-standby PLC units shall support automatic event synchronization.
- (f) The PLC systems shall be microprocessor based with sufficient system and storage memory capacity to fully support the required number of process input and output channels as well as the 20% readily available spare channel without modification and additional modules and with a maximum capacity for 4096 input and 4096 output points.
- (g) The PLC systems shall report the status of its input/output points to and accept control from a third party Distributed Control System (DCS) using OPC, Modbus or any other protocol as specified in the Particular Specification.

- (h) The PLC Systems shall have provisions for communicating with the DCS or other PLC Systems specified in the Particular Specification on a report-by-exception manner in order to reduce network traffic and shall be capable of stand-alone operation in the event of communication link or DCS failure.
- (i) The PLC systems shall be supplied with removable memory card for uploading and downloading programs and applications.
- (j) All analogue, status and alarm signals available on the PLC systems shall be displayed on the associated touch screen panel/ panel indicating equipment and remotely on a third party SCADA or DCS if specified in the Particular Specification.
- (k) The PLC systems shall be solid state, modular, and field expandable design allowing the system to be tailored to meet the application. The design shall have the capacity to allow for the expansion of the system by the addition of hardware and/or software.
- (l) PLC modules shall be plugged into a chassis. The modules and connectors shall be keyed to safeguard against the insertion of a wiring into the wrong module. All modules and power supplies shall be capable of insertion and removal under power. The chassis shall be mounted on a rack or panel.
- (m) The PLC systems shall include, but not limited to, the following :
 - (i) I/O chassis
 - (ii) Local I/O modules
 - (iii) Power supply
 - (iv) Processors
 - (v) Computer cables
- (n) Power supplies to PLC systems shall be 24V d.c.
- (o) Where the I/O must be placed remotely from the processor's chassis, the I/O connection shall be made in the form of redundant Fieldbus complying with IEC 61158.
- (p) The maximum response time for each of the following events shall be met and verified during testing/commissioning of the Chlorination Plant Monitoring and Control Panel :-
 - (i) Updating time for digital and analogue value changes within 1 sec;
 - (ii) Execution of a control shall be effected within 1 sec; and
 - (iii) Calling a mimic with up to 30 dynamic values shall be completed within 3 sec.

1.3.2 Touch Screen Panels

- (a) The touch screen panel hardware shall be of industrial grade and shall conform, but not limited, to the following :

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|-------|----------------------|--|
| (i) | Display: | 19" color active matrix TFT |
| (ii) | Resolution: | 1280 x 1024 18-bit color graphics, 300 cd/m ² |
| (iii) | Backlight: | 50,000 hr – field replaceable |
| (iv) | Touch screen type: | Analog resistive |
| (v) | Communication ports: | Ethernet, RS-232 and 2 x USB |
| (vi) | Rating: | IP54 |

- (b) Visual and Audible Alarms

A special area on the touch screen panels shall be maintained to display all active alarms including those displayed in the indicating lamps. The area shall not be covered by other data or windows i.e. always on top. When an alarm is detected, the audible alarm shall be appended to the alarm queue. The alarm shall be acknowledged by clicking a screen button. Upon acknowledgement, the audible alarm shall be silence, the acknowledged entry removed from the alarm area and the next unaccepted alarm shows up and the audible alarm.

- (c) Number of Touch Screen Panels Required

- (i) One dedicated touch screen panel shall be provided for chlorine gas detection monitoring, if implemented in the chlorination plant monitoring and control panel.
- (ii) For chlorine plant monitoring and control, if the number of draw-off unit(s) of the chlorination plant is not more than four, one touch screen panel shall be provided; otherwise two touch screen panels shall be provided. Each touch screen panel shall communicate with all PLC systems for chlorination plant monitoring and control.

1.3.3 Power Supply Equipment

The power supply equipment, if specified in the Particular Specification shall be capable of powering the monitoring and control panel including the PLC system for continuous operation for 5 hours with a 20% safety margin, taking into account all various derating factors. The sizing calculation for the power supply equipment shall be submitted for approval. The power supply equipment shall comply with WSD Standard Specification E-88-05.

2. CONSTRUCTION

The Panel shall have a degree of protection of IP 54 to IEC 60529 and comply with WSD Standard Specification E-11-03.

3. AUXILIARIES/ACCESSORIES

The following auxiliaries/accessories shall be provided with the Panel :-

- (a) One PLC programming tool in the form of a notebook computer with the required software.
- (b) Panel heater and associated wiring.
- (c) Internal Telephone.

- End of this Specification -