

WATER SUPPLIES DEPARTMENT
STANDARD SPECIFICATION EM-02-01
CHLORINE PLANT- GENERAL & DESIGN

1. **GENERAL**

This standard covers the general design of chlorine plant for water treatment.

2. **SYSTEM**

Two types of draw-off systems are adopted for the chlorine plant, namely the gas draw-off system and the liquid draw-off system. The type of draw-off system to be deployed will be specified in the Particular Specification.

2.1 **Gas draw-off System**

In a gas draw-off system, chlorine gas shall be withdrawn from standard chlorine container of either 50-kg cylinder(s) or 1-tonne drum. The draw-off unit of the system shall comprise two sets of container(s) in either single / twin / five 50-kg cylinders in a bank, or single 1-tonne drum with auto-changeover and shut-off control for operation in turn. The typical schematic diagram for the chlorine plant with gas chlorine withdrawal is attached at Appendix I.

2.2 **Liquid Draw-off System**

In a liquid draw-off system, liquid chlorine shall be withdrawn from standard 1-tonne drum. Evaporator shall be deployed in the system to assist withdrawal of liquid chlorine from the chlorine drum. Liquid chlorine shall be withdrawn from one drum only at a time.

Two types of feeding arrangement to the evaporator are deployed for the liquid draw-off system. They are indicated in the typical schematic diagrams for the chlorine plant attached at Appendix IIA (one draw-off unit feeding one evaporator) and Appendix IIB (one draw-off unit feeding two evaporators) respectively. The details of feeding arrangement shall be specified in the Particular Specification.

2.3 **Scope of Equipment of Chlorine Plant**

The chlorine plant shall comprise equipment from the union connecting to the cylinder / drum valve up to and including the final dosing point including the cylinder / drum weighing scale. All ancillary and protective equipment required for the proper and safe operation of the plant shall be included.

3. **CHLORINE CYLINDER / DRUM CONNECTION**

The piping arrangement for chlorine cylinders or drums in single or multiple connections are shown in Appendix III.

Flexible tubing shall be provided for connection between the container and the receiver header. The container end and the header end shall have an auxiliary valve and two line valves for isolation respectively.

4. **CONTROL**

A typical block diagram for controlling and monitoring a chlorine plant with major features is shown in Appendix IV. Mimic diagram(s) shall be provided at the operator's workstations of the DCS system for monitoring of the plant operation.

4.1 **Automatic Changeover Control**

An automatic changeover device shall be provided for change over of the draw-off from the emptying duty container(s) to the standby container(s) upon detection of a low pressure (set at 100 kPa) from the duty container. The changeover shall be actuated electrically. The low pressure detector in the chlorine supply line provides a signal to the changeover control panel to effect the operation. The changeover shall take place only if sufficient pressure is detected at the standby container. Otherwise, the changeover shall be inhibited.

A manual changeover facility in the form of a 3-position selector switch which will enable selection among "Unit 1 Duty / Off / Unit 2 Duty" shall be provided for overriding the automatic system.

4.2 **Automatic Control during Chlorine Leak**

Audible and visible chlorine leak alarms for the chlorine plant shall be activated when detection of a chlorine leak of 1ppm or above.

Upon detection of a chlorine leak of 3 ppm or above, which can be initiated either manually by pressing any of the emergency push button installed at the control rooms, manual call points provided at the strategic locations of the installation or automatically by chlorine detectors, the control functions shall be activated automatically in accordance with Clause 4.1 of WSD Standard Specification EM-02-10.

4.3 **Shutdown Control**

Upon receiving a chlorine leak signal of 3 ppm or above, automatic control shall be provided to shut off the chlorine supply from the duty container(s) and inhibit the changeover to the standby container(s), i.e. the changeover valves for both duty and standby containers shall be closed under this circumstance.

Where evaporators are involved for liquid draw-off of chlorine from drums, the chlorine supply shall be automatically shut off upon detection of a high pressure in the chlorine supply line due to the burst disc of the evaporator.

4.4 Automatic Proportional Control

Automatic proportional dosing control if required for the chlorinators shall adopt one of the following means as specified in the Particular Specification :-

- (a) Flow proportional control shall be effected according to a 4-20mA signal from the flowmeter(s) of the installation to a controller.
- (b) Direct residual control achieved by a three-term P+I+D controller receiving a 4-20mA signal from the chlorine residual analyzer. This signal shall be used for comparison with the set point on the controller so as to produce the appropriate control output.
- (c) Compound loop control comprising both (a) and (b) above.

The controller shall be mounted at the Chlorine Plant Process Control Panel with the necessary output signal to the chlorinators. It shall be equipped with a manual override facility and an indication of both the input and control signals.

5. EMERGENCY ALARM

The Contractor shall provide and install the following emergency alarms for chlorine plant :-

- (a) High Chlorine Leak Alarm – (i) Visual and audible buzzers alarms in the Emergency Control Panel of Main Control Room; (ii) Red light boxes with "Chlorine Leak" labels and buzzers at the entrances of chlorine rooms; (iii) Red flashing light at the top of the entrances to chlorine rooms; and (iv) Sirens at strategic locations near the chlorine rooms as required by Fire Services Department.
- (b) Evacuation Alarm – (i) Siren and (ii) amber-rotating-warning lamps at various buildings that covering the whole Water Treatment Works.

The alarm circuits shall be hardwired with 220V, 50Hz 1-ph electricity supply for the Siren.

5.1 High Chlorine Leak Alarm

In addition to the equipment specified in Clause 4.2 of WSD Standard Specification EM-02-10, the following equipment shall also be provided for the initiation of "High Chlorine Leak" alarm :-

- (a) A stay-put (press-to-lock and turn-to-release) type push button the Chlorine Control Room.
- (b) A stay-put (press-to-lock and turn-to-release) type push button with protective cover molded from thick polycarbonate in the Main Control Room.

- (c) Manual call points at the entrance of chlorine rooms and other strategic locations.

5.2 Evacuation Alarm

The following equipment shall be provided at the Main Control Room for the handling of the "Evacuation" alarm :-

- (a) A stay-put (press-to-lock and turn-to-release) type push button with protective cover molded from thick polycarbonate in the Main Control Room.
- (b) A wind speed indicator (via LED display of character height not less than 10 mm).
- (c) A wind direction indicator (via LED display of character height not less than 10 mm).

6. EQUIPMENT CONSTRUCTION

Components of chlorine equipment shall be housed in an enclosure made of reinforced fibre plastic. The gas inlet and water piping shall be readily accessible for cleaning, inspection and maintenance without the need to disturb the adjacent parts.

Components shall be fully resistant to the prolonged corrosive attack of chlorine, inclusive of leakage in the installation. Metal parts normally in contact with chlorine shall be monel or Hastelloy C or equal. External metallic parts such as nameplates, bolts and nuts shall be made of stainless steel.

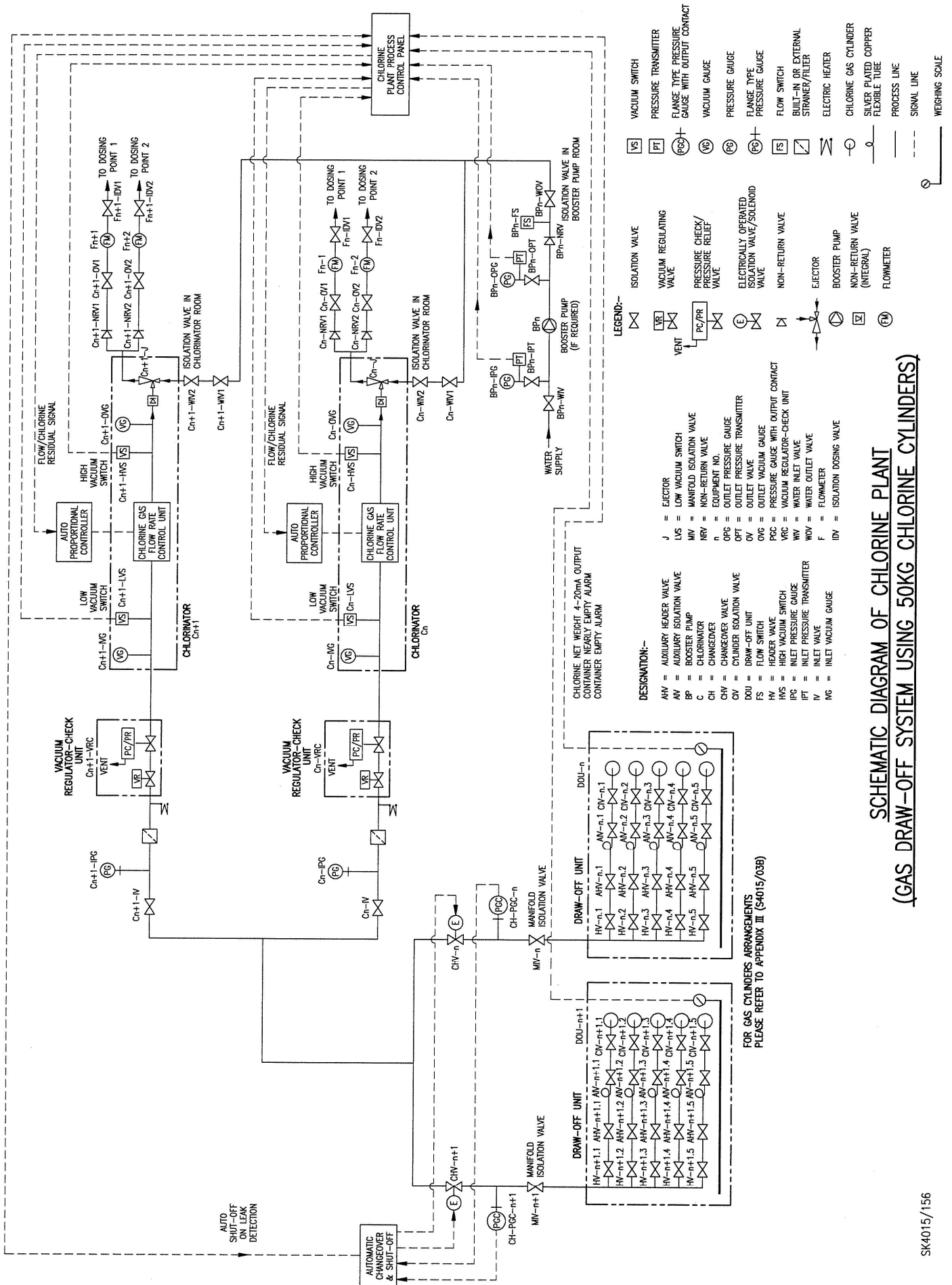
Parts not designed to be in contact with chlorine shall be totally enclosed, with the degree of protection of IP54 to IEC 60529.

7. ELECTRICAL EQUIPMENT

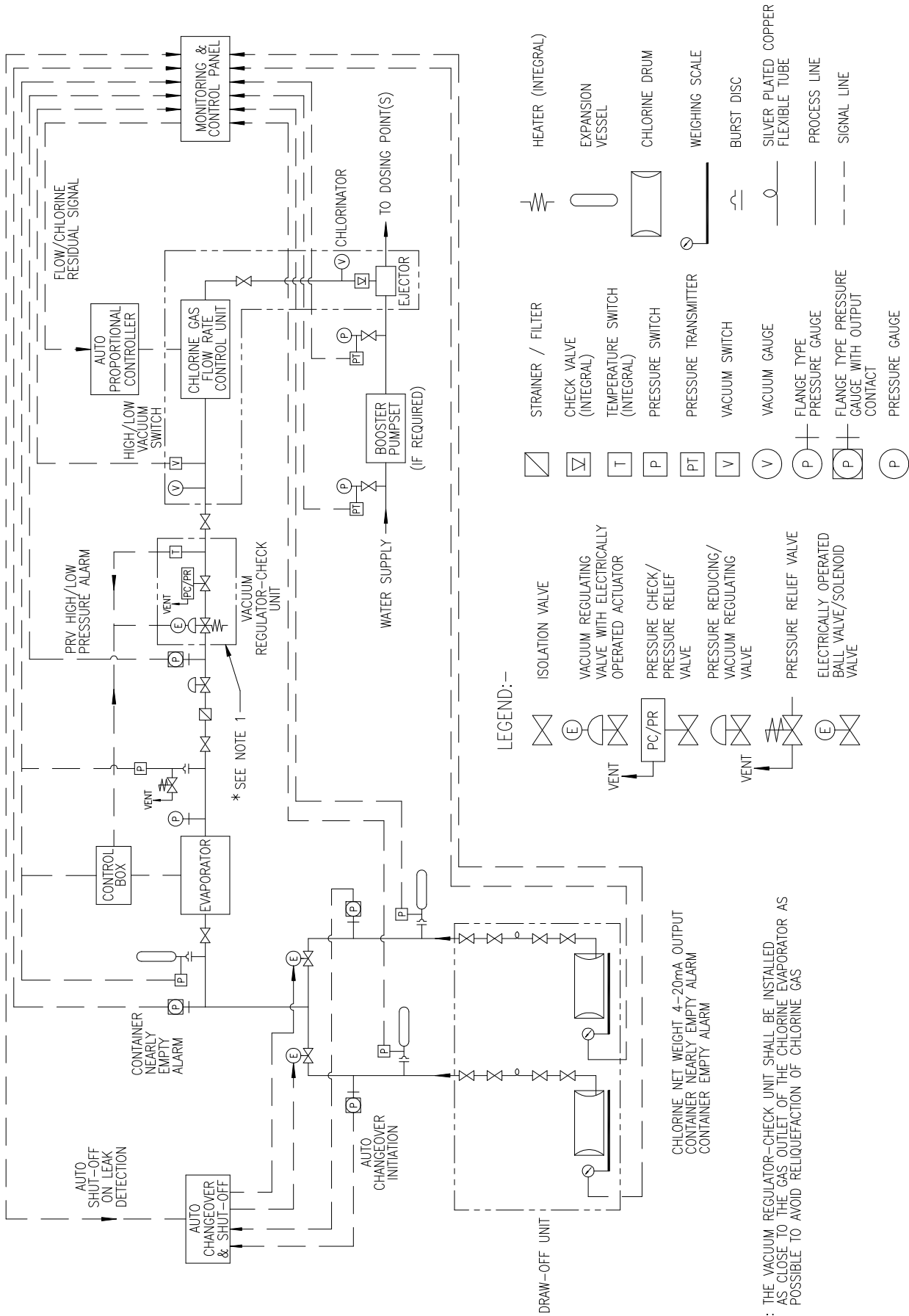
Power supply transformers, where fitted, shall be of totally encapsulated type. Indicating instruments which are surface mounted shall have a degree of protection of IP54 to IEC 60529.

Electrical equipment shall operate on 220V a.c. 50 Hz or 24V d.c. as specified. Switch contacts of instruments shall be of changeover type rated at 2A 220V a.c. 50 Hz and 3A 24V d.c.

–End of this Specification –

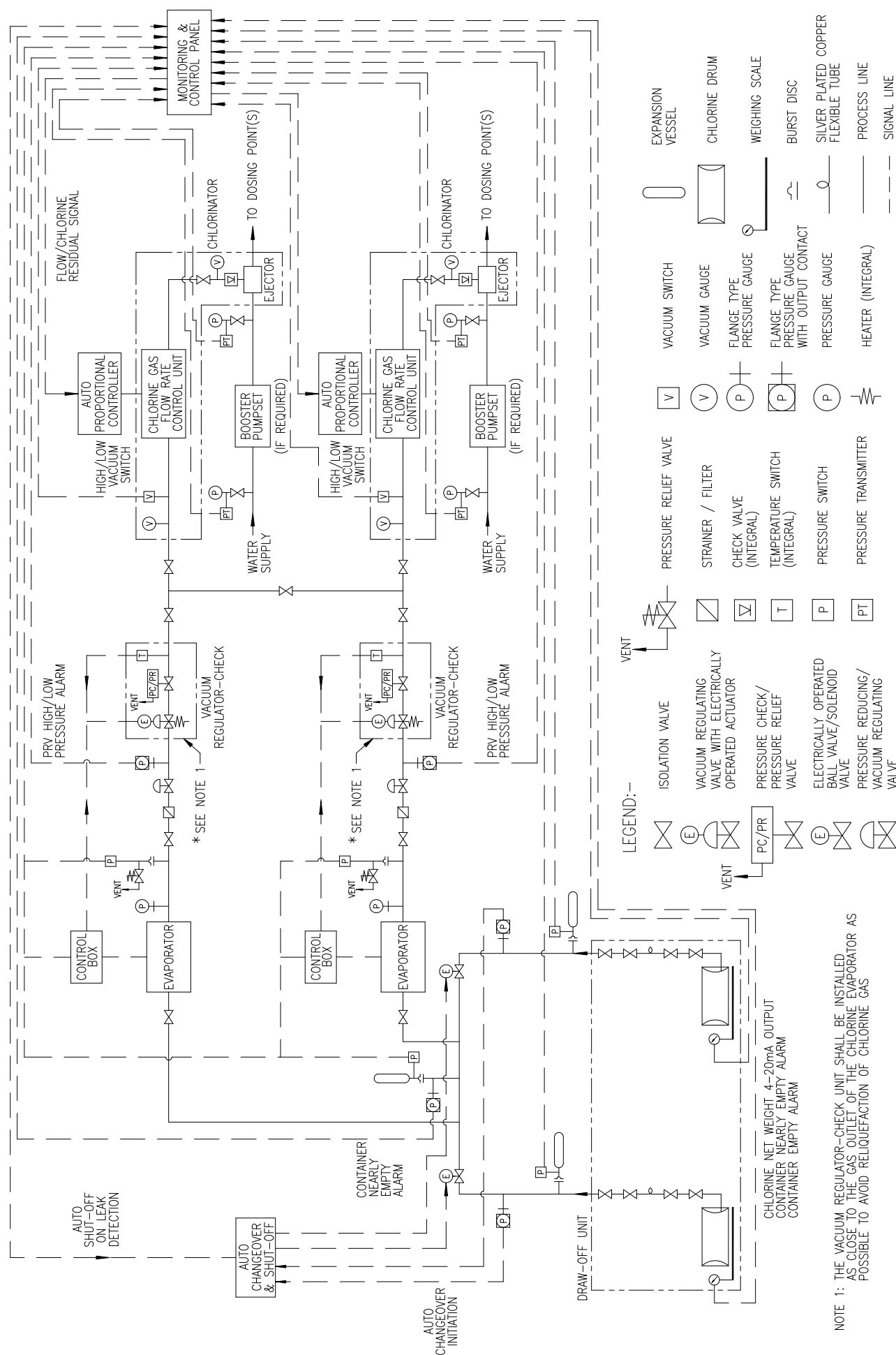


**SCHEMATIC DIAGRAM OF CHLORINE PLANT
(GAS DRAW-OFF SYSTEM USING 50KG CHLORINE CYLINDERS)**



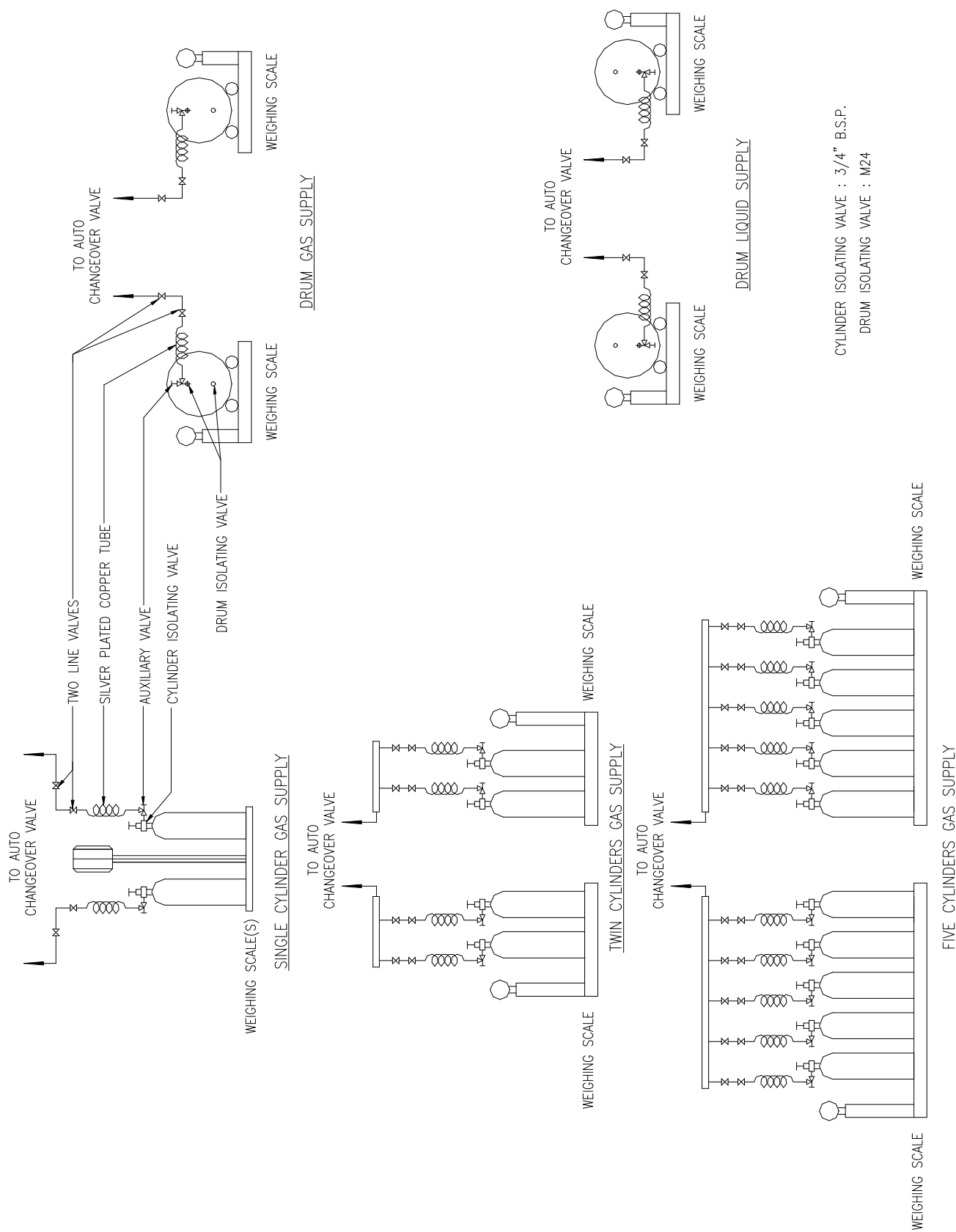
NOTE 1: THE VACUUM REGULATOR-CHECK UNIT SHALL BE INSTALLED AS CLOSE TO THE GAS OUTLET OF THE CHLORINE EVAPORATOR AS POSSIBLE TO AVOID RELIQUEFACTION OF CHLORINE GAS

SCHEMATIC DIAGRAM FOR CHLORINATION PLANT
(LIQUID DRAW-OFF UNIT FOR FEEDING ONE EVAPORATOR ARRANGEMENT)

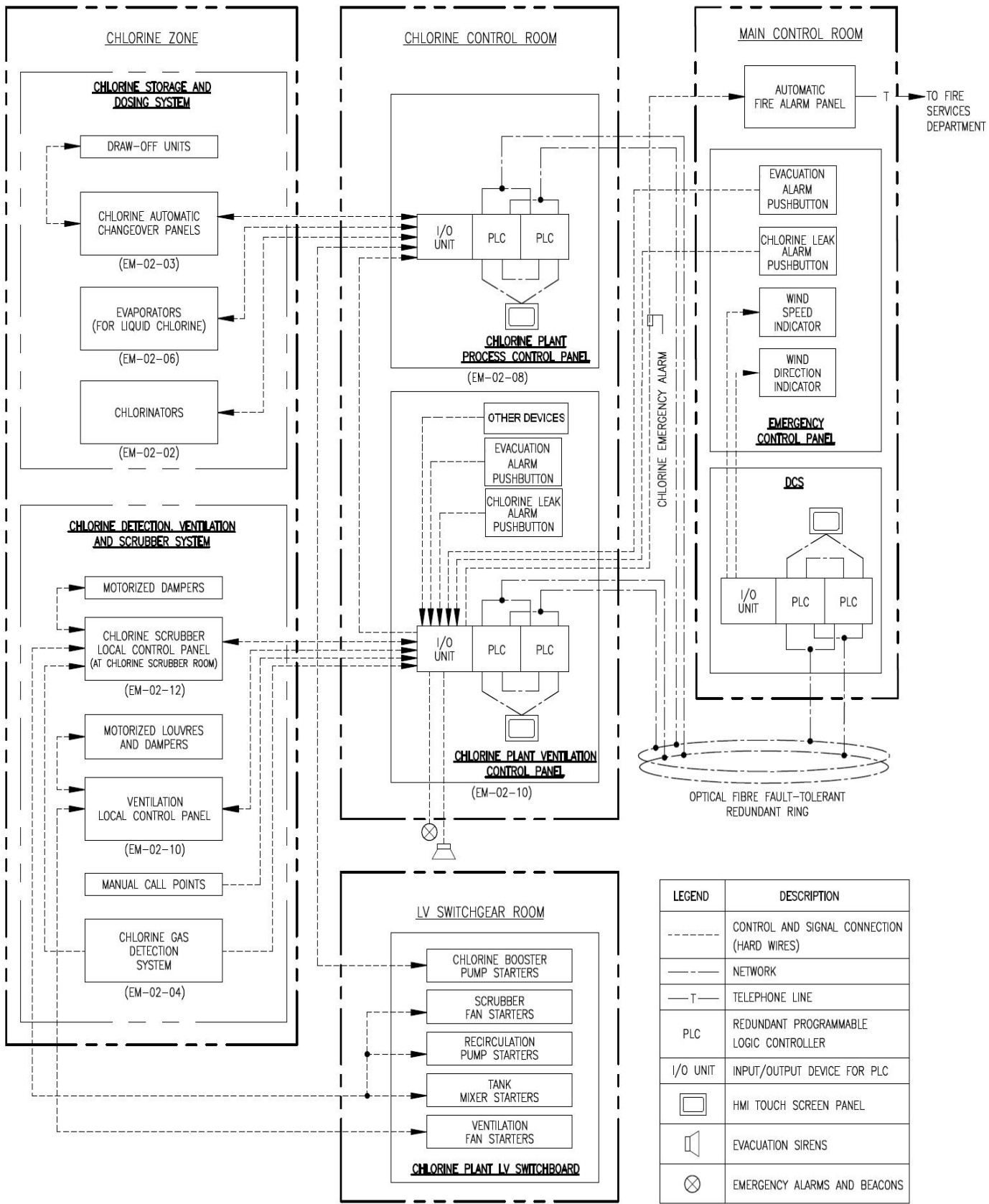


NOTE 1: THE VACUUM REGULATOR-CHECK UNIT SHALL BE INSTALLED AS CLOSE TO THE GAS OUTLET OF THE CHLORINE EVAPORATOR AS POSSIBLE TO AVOID RELIEF OF CHLORINE GAS

SCHEMATIC DIAGRAM FOR CHLORINATION PLANT
(LIQUID DRAW-OFF UNIT FOR FEEDING TWO EVAPORATORS ARRANGEMENT)



TYPICAL CONNECTION OF CHLORINE CONTAINER(S)



CHLORINE PLANT MONITORING AND CONTROL SYSTEM BLOCK DIAGRAM