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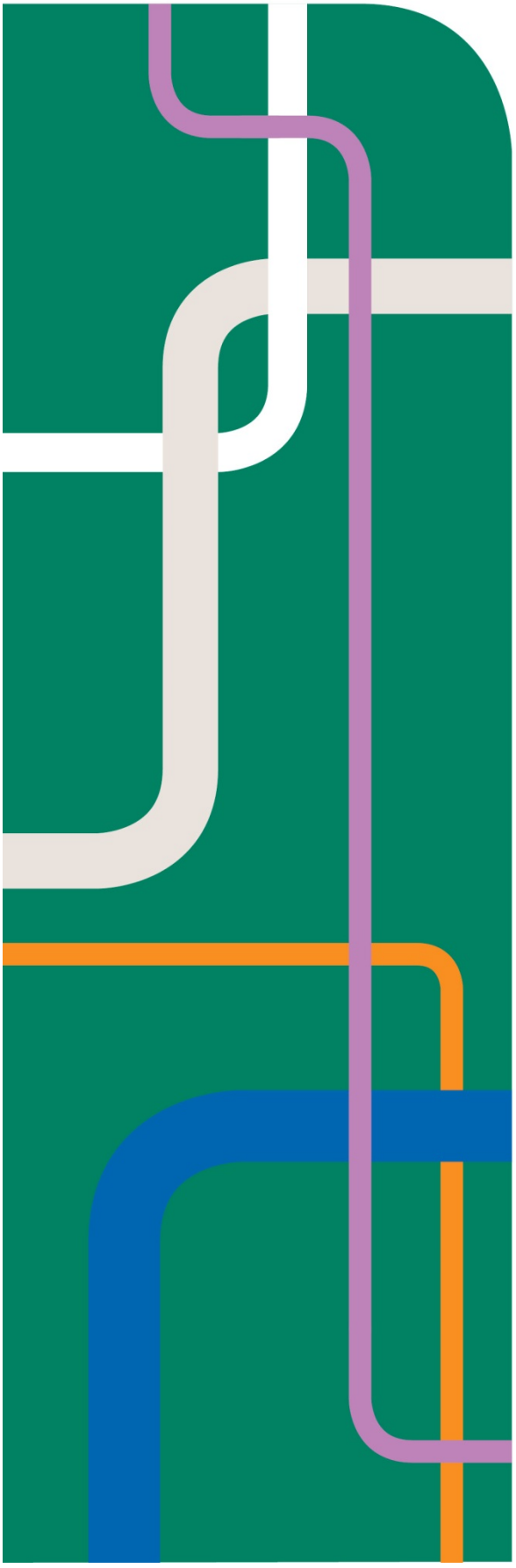

Engineering Services

Technical Standard

TS 0270

The Design & Construction of Small/Medium Gas Chlorination Systems

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Application & Interpretation of this Document

It is the responsibility of the users of this Standard to ensure that the application of information is appropriate and that any designs based on this Standard are fit for SA Water's purposes and comply with all relevant Australian Standards, Acts and regulations.

Users of this Standard accept sole responsibility for interpretation and use of the information contained in this Standard. Users should independently verify the accuracy, fitness for purpose and application of information contained in this Standard.

Only the current revision of this Standard should be used which is available for download from the SA Water website.

Significant/Major Changes Incorporated in This Edition

Nil.

This is the first issue of this Technical Standard.

Document Controls

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Contents

List of figures

List of tables

1 Introduction

SA Water is responsible for operation and maintenance of an extensive amount of engineering infrastructure.

This standard has been developed to assist in the design, maintenance, construction, and management of this infrastructure.

1.1 Purpose

The purpose of this standard is to detail minimum requirements to ensure that assets covered by the scope of this standard are constructed and maintained to consistent standards and attain the required asset life.

1.2 Glossary

The following glossary items are used in this document:

Term	Description
SA Water	South Australian Water Corporation
TG	SA Water Technical Guideline
TS	SA Water Technical Standard
HAZOP	Hazard Operability
SiD	Safety in Design
SCADA	Supervisory Control and Data Acquisition
PVC	Polyvinyl Chloride
PLC	Programmable Logic Computer
IP	Ingress Protection
RTU	Remote Terminal Unit
ELV	Extra Low Voltage
HIHI	High High (alarm set point)
LOLO	Low Low (alarm set point)

1.3 References

1.3.1 Australian and International

The following table identifies Australian and International standards and other similar documents referenced in this document:

Number	Title
AS/NZS 2927:2001	The storage and handling of liquefied chlorine gas
AS/NZS 4020:2005	Testing of products for use in contact with drinking water
AS 1680.1:2006	Interior and workplace lighting
AS 1680.2.4:1997	Interior lighting – Industrial tasks and processes
AS 4775	Emergency eyewash and shower equipment
AS 1319:1994	Safety signs for the occupational environment
AS 60529:2004	Degrees of protection provided by enclosures (IP Code)
NOHSC:3009/NZCIC	Warning signs for premises storing hazardous substances

1.3.2 SA Water Documents

The following table identifies the SA Water standards and other similar documents referenced in this document:

Number	Title
TS 0101	Safety in Design
TS 0106	Electronic Security Installation Standards
TS 0107	Physical Security Site Standards General Definitions. Includes Amendment 1 Relating to Door and Steel Cladding Thickness
TS 0204	Colour Coding Of Pipework
TS 0300	Supply and Installation of Low Voltage Electrical Equipment
TS 0350	SCADANet, SCADA and DCS Systems - Functionality
TS 0351	SCADANet, SCADA and DCS Systems – Design Philosophy
TS 0352	SCADANet, SCADA and DCS Systems - Implementation
TG 0301	Design of Low Voltage Electrical Equipment

1.4 Definitions

The following definitions are applicable to this document:

Term	Description
SA Water's Representative	The SA Water representative with delegated authority under a Contract or engagement, including (as applicable): • Superintendent's Representative (e.g. AS 4300 & AS 2124 etc.) • SA Water Project Manager • SA Water nominated contact person
Responsible Discipline Lead	The engineering discipline expert responsible for defined on page 3 (via SA Water's Representative)

2 Scope

2.1 General

This document specifies SA Water's minimum technical requirements for the design and construction of small / medium size gas chlorination stations where:

- The bulk chlorine gas storage is stored in either:
  - Drums containing up to 920 kg and a maximum of one drum is online simultaneously, or
  - Cylinders containing up to 70 kg of chlorine (G size).
- The system operates using a negative (vacuum) chlorine extraction process to supply gas to the dosing equipment.
- The site has been assessed as NOT being a Major Hazard Facility.

NOTES:

The intent of this standard is to apply to new and/or upgraded sites. This standard does not apply to existing infrastructure.

This Standard should not be applied in part or in full to the design or construction of systems beyond the scope stated in this Clause.

2.2 Options & Conditions

Options considered acceptable specified in this standard are follows:

- One, Two, and Three room building layout/arrangement (3 rooms being default, with 1 and 2 room facilities options also available). Refer to example two (2) room layout in Appendix A2. One room building arrangements should be avoided to protect equipment against gas leak damage, but can be suitable on a case by case situation and where approved by the Principal Engineer after satisfactorily demonstrating that a thorough risk assessment, HAZOP, and SiD process has been completed showing all risks have been satisfactorily managed. This risk assessment process also applies to a two room option.
- Uncontrolled release ventilation system option - (containment/controlled release is the default requirement, and a system that provides an uncontrolled release is optional).
- Extracting and manifolding of cylinders under pressure (vacuum cylinder gas draw off is the default, with pressure connection a possible option subject to all the risk considerations).

The implementation of one or more of these options are only acceptable when the following requirements are satisfied:

- The limitations specified for the option are not exceeded; and
- The safety and maintainability of the station shall not be compromised.
- The safety of the system at that site is demonstrated by:
  - The use of risk based processes (e.g. Project Risk Assessments, HAZOP's, SiD Risk Assessments in accordance with TS 0101 (previously TS155), etc.), and
  - The level of risk for all hazards is assessed numerically which demonstrates that the level of risk is acceptable to SA Water, and
  - All such risk processes are documented.
- The design (including all options to be implemented) is approved by SA Water's Representative prior to construction.

2.3 Compliance with Standards & Regulations

All new installations and equipment shall be installed to the current SA Water and Australian Standards and Guidelines, and in the absence of standards and guidelines, to industry best practice. In particular compliance with AS/NZS 2927 is required.

2.4 Design Criteria

All stations shall be designed and constructed to ensure that they can be safely operated and maintained and that the risk of exposure to chlorine gas to operations staff, neighbouring properties or the public is an acceptable level. This principle shall be applied irrespective of any options specified in this standard.

Stations shall be designed to minimise operator attendance or for a level of attendance that is appropriate for the location and staff operating the equipment. Equipment requiring minimal maintenance shall be selected wherever possible.

2.5 Nomenclature

For the purposes of this Standard, the following nomenclature applies:

Reference to chlorine or gas containers shall be taken as referring to both cylinders and drums. Where the words “cylinder” or “drum” are used the requirement is specific to the stated container.

The term “on-line” is the same as “duty” when used for plant and equipment.

The term “off-line” includes plant and equipment that is on standby or is in storage.

3 Building Requirements

3.1 General

Chlorine building shall have a minimum of a single room in accordance with this clause, however a three (3) room building is preferred to allow for separation between electrical controls and areas where chlorine gas can be present (cylinder storage or dosing rooms)

Buildings with three (3) rooms shall comprise the following rooms:

- Chlorine storage room,
- Chlorine dosing room,
- Switchroom.

Buildings with two (2) rooms shall comprise the following rooms:

- Chlorine room (storage and dosing equipment),
- Switchroom.

Buildings with one (1) room shall comprise the following:

- Chlorine room (which includes storage, dosing and switchboard/control equipment),

Separate external access shall be provided into each room of the building (irrespective of the number of rooms), no access shall be provided internally between rooms.

The building shall be a pre-cast or prefabricated concrete / ferro cement transportable hut type or other suitable building approved by SA Water's Representative.

The building shall be resistant to the attack of chlorine gas and shall be constructed of fire-resistant material. Stainless steel equipment and materials should be avoided where possible in dosing and gas storage rooms (there is a high corrosion rate with stainless steel products when exposed to moisture and chlorine gas).

Access shall be in accordance with AS/NZS 2927. This shall allow for pedestrian movements with self-contained breathing apparatus equipment.

Adequate space shall be provided for the required number of duty and standby chlorine containers with sufficient spares taking into consideration the need to minimise operator attendance and the frequency of chlorine deliveries.

For sites where low rates of disinfection are required to meet water quality needs, there is a choice between sodium hypochlorite and chlorine gas dosing systems. It is recommended that for sites that are designed to have a peak usage of 100 litres of sodium hypochlorite per week or more should be designed as a chlorine gas system, to reduce excessive manual handling risks. This may not be possible due to other site specific circumstances and consideration should also be given to bulk sodium hypochlorite delivery to eliminate manual handling of chemical solution. The choice between sodium hypochlorite and chlorine gas dosing system must also consider the disinfection site location and the suitably for delivery of a small or bulk delivery of sodium hypochlorite. Remote sites may not be suitable for delivery and use of sodium hypochlorite disinfection systems.

3.2 High Risk Vs Low Risk Chlorine Systems

Chlorine dosing facilities can be divided into two main groups, high risk, and low risk facilities (separate from major hazardous facilities). This classification is defined by the impact on the water supply network/system if a chlorination fault were to occur, when considering water quality, shutdown response, response times due to the facilities location, and redundancy in the system (how long after the facility faults can suitable water be provided to customers). Whether a site is high risk

or low risk should be determined on a case by case basis, through risk assessment, HAZOP, SID, process.

SA Water disinfection facilities can also be classified as primary or secondary. For the purpose of clarity, the following applies:

- A site with a 'high' risk rating shall be considered as a 'primary' disinfection station,
- A site with a 'low' risk rating shall be considered as a 'secondary' disinfection station

These classifications shall apply, unless specifically modified by the discipline Principal Engineer, or an SA Water representative.

Once a classification is determined, Appendix A1 gives the recommended minimum equipment required for a high or low risk site. Additional equipment may still be required and should be determined as part the overall system design for the chlorine station.

3.3 Lighting

Supply and installation of internal and external lights and power shall be in accordance with TS 0300.

Internal and external access way lighting shall be in accordance with AS/NZS 2927.

Lighting design shall be in accordance with TG 0301; AS 1680.1; and AS 1680.2.4.

3.4 Access Doors

All access doors and door hardware shall ensure that the requirements of SA Water Security Standards TS 106 and TS 107 can be satisfied. All access doors shall open outwards, shall be fitted with means of securing in the open position, and shall be constructed of fire proof material.

Access door locations and distances between equipment shall ensure that operators when wearing self-contained breathing apparatus can move around freely and safely. AS 2927 requires a minimum clear distance of 850mm to be provided.

3.5 Security

Physical and electronic security shall be installed in accordance with SA Water Technical Standards:

- TS 106 Electronic Security Installations.
- TS 107 Physical Security Standards.

3.6 Ventilation Systems

3.6.1 Types of Systems

Two types of ventilation system design may be acceptable:

- Gas Containment/Controlled Release,
- Uncontrolled Release (subject to certain constraints).

3.6.2 Design Methodology

The Gas Containment/Controlled Release system shall be designed to ensure that chlorine gas is contained within the building and the absolute minimum amount of chlorine gas escapes from the building in the event of a chlorine gas leak. This system is considered more suited (and more likely to be required) when the chlorine station is located in close proximity to the public, in built up areas, towns or cities (and other circumstances).

The Uncontrolled Release system is a more basic ventilation design that acknowledges there could be a limited escape of chlorine gas (but only considered when the chlorine gas will pose no, or an acceptable level of risk or danger to operations staff and/or the general public). This system is considered more suited (and more likely to be acceptable) in rural locations away from the general public, build-up areas, towns or cities.

The type of ventilation system proposed at all sites shall be recommended by designers and shall be agreed by SA Water's Representative for each chlorine installation after completing the required steps specified in Clause 3.2. Typically this shall be defined by the nomination of the risk rating of the site (high / low, primary / secondary).

3.6.3 System Characteristics

Gas Containment/Controlled Release System

The design and operation of this system shall provide a "chlorine containment" strategy, refer SA Water Chlorine Policy and Emergency Management Plan. Any chlorine leak in the Chlorine Dosing Room or Chlorine Storage Room (Chlorine Room for two (2) room buildings) is contained within the building and is only discharged in a controlled manner after an assessment has determined that it is safe to do so (following chlorine management/operating procedures).

The major features/characteristics of this system shall include:

- Forced air ventilation fans and inlet/outlet vents in chlorine rooms,
- Actuated louvers on all ventilation fan and vent openings,
- Initiation of a "fan off" all actuated louver closed state in the event of a chlorine leak.
- Fan and actuated louver controls (external or in switchroom) to allow manual controlled release of chlorine gas using ventilation fans.

Uncontrolled Release System

The major features/characteristics of this system shall include:

- Forced air ventilation fans and inlet/outlet vents in chlorine rooms,
- No control of natural ventilation In/out of vents,
- Initiation of a "fan off" state in the event of a chlorine leak,
- Fan and actuated louver controls (external or in switchroom) to allow manual controlled release of chlorine gas using ventilation fans.

3.6.4 Selection of System Type

The selection of the type of ventilation system to be installed shall take into account the level of risk to individuals (both within and external to the building and site) in the event of a chlorine gas leak. This process shall include the relevant risk based assessments, including Project Risk Assessments, HAZOP's, SiD Risk Assessments in accordance with TS 0101, etc. All risk assessments undertaken shall consider and include all known risks, identify and document the respective level of risk for each and be rigorously documented.

This process and documentation is especially important if an Uncontrolled Release system is to be installed in preference to a Containment/Controlled Release system.

3.6.5 Ventilation System – Requirement Equipment

This Section describes the ventilation system plant required for the two systems operation.

Gas Containment/Controlled Release System

The ventilation systems for the chlorine dosing room and the chlorine storage rooms (Chlorine Room for two (2) room designs) shall be as follows:

- A control panel adjacent to the door or the room(s) with controls in accordance with clause 6.2.13
- Air inlet actuated louver with open and closed limit switches
- Air outlet actuated louver with open and closed limit switches
- Ventilation fan
- Controls in the switchroom in accordance with clause 6.2.9
- The system shall operate in accordance with clause 6.3.8

The louver actuators shall be electrically driven open and shall fail to the closed position on loss of power. Proximity devices shall be provided on each actuated louver to monitor open and closed status.

Uncontrolled Release System

The ventilation systems for each of the chlorine dosing room and the chlorine storage rooms (Chlorine Room for 2 room designs) shall be as follows:

- A control panel adjacent to the door or the room(s) with controls in accordance with clause 6.2.13,
- Ventilation fan and inlet louvers,
- Controls in the switchroom in accordance with clause 6.2.8,
- The system shall operate in accordance with clause 6.2.8.

4 Process Requirements

4.1 Chlorine Dosing Equipment & Materials

All equipment and materials shall be compatible with the concentrations of chlorine being dosed and shall comply with the requirements of AS/NZS 2927.

Individual restraints shall be provided within the building for all containers.

4.2 Manifolding of Containers

4.2.1 General

The system shall be provided with automatic changeover of containers. Changeover shall take place when the duty container(s) reach the minimum residual chlorine gas pressure, as detected by the vacuum regulator.

Manifolding (or parallel operation) of containers shall:

- Be avoided, if possible,
- The number of containers online at any time shall be minimized,
- Be in accordance with AS/NZS 2927,
- Take into account anticipated system demand (and varying water quality and chlorine demand), site conditions and manufacturers maximum draw rate recommendations.

Manifolding shall be achieved using one of the following:

- Vacuum Manifolding (one vacuum regulator for each cylinder),
- Pressure Manifolding (one vacuum regulator for all cylinders in each).

4.2.2 Vacuum Manifolding

Vacuum manifolding shall be the default method of providing manifolding of chlorine containers.

4.2.3 Pressure Manifolding

Pressure manifolding shall only be implemented (in lieu of vacuum manifolding) under the following conditions:

- This system is considered to be safe,
- In stations where operational characteristics of vacuum manifolding (e.g. possible uneven draw rates between cylinders, etc.) will cause unacceptable operational limitations,
- When it is determined to be the most suitable alternative to vacuum manifolding.

Pressure manifolding shall only be installed when:

- 70 kg cylinders are used for chlorine storage in the installation (i.e. it shall not be used for 960 kg container installations),
- No more than two cylinders are manifolded,
- The use of pressure manifolding is approved by the discipline Principal Engineer.

Any pressure manifold installation shall be designed and installed in accordance with the following:

- The building design shall be a Gas Containment/Controlled Release design (refer to clause 3.6.3),
- Connection pipes between the cylinders shall be as short as possible to minimize the likelihood of damage and gas leaks,
- The chlorine emergency shutdown system shutdown valve shall be provided on each cylinder and shall be connected immediately at the outlet of the chlorine cylinder,
- Be manufactured from materials suitable for chlorine,
- The requirements of clause 3.6.3 are met

4.3 Storage of Containers

Adequate space shall be provided in the gas storage room for storage and handling of spare containers. The minimum storage space provided shall be that required for the number of containers that are on duty plus the number on standby, or 2 containers (whichever is greater).

The number of spare containers to be stored on site will depend on delivery quantity and frequency and will be determined by SA Water in liaison with the chlorine supplier. Storage space will need to be allocated accordingly. Some facilities may be limited by the quantity of containers that can be stored on site to prevent classifying as a Major Hazardous Facility and should be considered during the facility design stage.

4.4 Handling of Containers

For cylinder installations, a sack truck with a cylinder cradle and safety chains or clamps shall be provided. Minimising the manual handling requirement of cylinders shall be considered when designing a building and the site layout.

For drum installations, appropriately rated monorail hoists or cranes shall be provided, with appropriate lifting beams.

Adequate clearance shall be provided around equipment and in the storage room for the safe and efficient handling of containers.

4.5 Chlorinators

Chlorinators shall be constructed of materials suitable for continuous contact with chlorine.

The chlorine feed shall be designed to shut off automatically if a line fracture (downstream of the chlorinator) or a breakage of the rotameter glass occurs.

If an excessive vacuum develops, the system shall be designed to allow air only to be drawn in.

The number of chlorinators for the system shall be determined by the risk level (high / low) of the facility. While individual chlorinator systems are suitable in some systems, a single chlorinator does not provide sufficient backup when a chlorinator failure/fault occurs. A dual chlorinator system can be setup to automatically change over when a fault is detected (via actuated valves) to allow for continued process disinfection.

4.6 Vacuum Regulators

4.6.1 General

Vacuum regulators shall incorporate suitably sized drip legs and filter/heater assemblies as required (not all cylinder systems require a drip leg, but should be incorporated in drum systems).

Pipework elevations shall be such to avoid pooling and be sloped such that liquid gravitates to the drip leg.

Adjustable draw-off control shall be provided.

4.6.2 Vacuum Manifolding

Vacuum regulators shall be installed directly onto each container i.e. there will be a vacuum regulator for each container.

4.6.3 Pressure Manifolding

One vacuum regulator shall be installed and connected to the manifold connected to cylinders i.e. there will one vacuum regulator for each manifold.

4.7 Chlorine Residual Analysers & SCADA Alarming

4.7.1 General

The type of analyser used shall take into account any fluctuations in pH and other water quality parameters (i.e. hardness, salinity) that apply at the site. The continuous measurement of free and total chlorine using devices that do not require the use of chemical buffer solutions are preferred and shall be installed unless requested by SA Water's Representative. This will allow the analyser water to be collected and potentially re-injected into the water supply system. Where water is re-injected to supply, components of the analyser in contact with the water shall be approved for use in potable water systems and comply with AS/NZS 4020.

Where water sources and/or water quality require the use of chemical buffer solution analysers, these shall be provided. Where a chemical solution that is not approved for use in potable water systems is used in an analyser, the waste stream shall be disposed of to sewer or otherwise disposed of or collected in an appropriate manner, subject to SA Water approval. Non-return valves shall be incorporated in the design to prevent these reagents entering the potable water supply system.

Dedicated analyser sample water lines shall be located and sized to minimise the time required for water flow to reach the analysers, and shall be fitted with strainers.

The maximum residence time between the dosing location and the first sampling point shall be five minutes.

For each analyser installation a manual sample point shall be installed along the same sample water line (or as close as practical) next to the analyser to allow for manual residual comparison against the analyser reading.

Quantities of analysers is subject to system specific needs and shall be considers when designing the site. Generally, low risk systems are to have a minimum of one (1) analyser measuring after disinfection, where high risk systems may incorporate two (2) or more. Trim dose chlorination systems require at least two (2) analysers, one (1) pre dosing and one (1) post dosing, with the post dosing analyser controlling the system.

4.7.2 System Analyser Residual Alarming

High and low (HI and LO) analyser alarm set-points are to be used to warn of commencement of an out-of-standard/range operating condition. HI HI and LOLO analyser alarm setpoints are to be set based on the site reaching its critical process limits. Where a system has been setup to shutdown automatically when a critical dosing fault is experienced, the HIHI and LOLO alarm setpoints are to match the setpoints that trigger the site shutdown.

4.8 Monitoring & Sampling Equipment

Sample points shall be located to ensure the chlorine has stabilised in solution and is well mixed before reaching the sample point.

Where possible, a sample point should be located outside the building (within a tamper proof enclosure), to enable easy access for analyser verification.

For in-pipe dosing applications, the sample point shall be located downstream from the injection point at a location that is representative of the bulk water (typically an 'AC' point).

For in-tank dosing applications, the sample point shall be located to ensure that the sample is a true representative of all water in the tank. Tank mixing should be considered to avoid variability in chlorine residual readings. Consideration should be given to providing a chlorine analyser on the discharge of the tank for the purpose of trim control and/or validation.

4.9 Weighing Equipment

An electronic scale comprising a load cell and a digital readout in kilograms shall be provided for each container or drum that is on duty or standby

Scales shall be constructed of durable material to withstand the aggressive environment.

Digital readouts shall be wall mounted adjacent each container, such that it is clear which container they are each associated with, and shall be located such that they can be easily read by operations staff standing on the floor.

Weigh scale indications shall be mapped through to SCADA for verification of instrumentation / dosing calculations and water quality reporting.

4.10 Booster & Service Water Pumps

All pump materials shall be compatible with the expected chlorine concentrations and shall comply with the requirements of AS/NZS 2927.

Some systems do not require booster pumps due to having a suitable higher pressure water supply to carry out adequate injection. Where chlorine solution booster pumps are required to operate the chlorination system, a minimum of two booster pumps shall be provided and operate in an automatic duty/standby arrangement.

Any booster pump water and pressure tank supplied to the eyewash/safety shower shall be sourced upstream of chlorine gas injection and of potable quality and is to maintain the appropriate pressure at all times in accordance with AS 4775.

4.11 Pipe Works

4.11.1 General

All pipework shall be compatible with the concentrations of chlorine being dosed and shall comply with the requirements of AS/NZS 2927.

When designing pipework for chlorine, following factors (in particular) shall be considered:

- Moist chlorine is highly corrosive to most metals.
- Liquid chlorine has a high coefficient of thermal expansion.
- Chlorine gas at full container pressure may liquefy in cool sections of pipe, resulting in possible damage to the vacuum regulator.
- Plastic piping is not permitted at pressures above atmospheric.

Underground piping shall be avoided where possible, and if required, the designer shall make allowance for access to the pipe and fittings for ease of maintenance and inspection. If pipework is located underground, the use of tracer tape is required.

4.11.2 Carry Water OR Chlorine Solution Pipework

All carry water pipework shall be constructed of Class 18 PVC or an equivalent material with similar mechanical, thermal and corrosion resistant properties. The number of joints shall be kept to a minimum.

4.11.3 Chlorine Gas Pipework

Chlorine gas pipeline used to transfer chlorine gas under vacuum shall be constructed from nylon tubing or Class 18 PVC or suitable equivalent material with similar mechanical, thermal and corrosion resistant properties, in accordance with AS/NZS 2927.

4.11.4 Flexible Connections

Piping or hoses used to connect chlorine containers to the installation, shall be kept as short as possible, however sufficient length shall be provided to ensure the safe and practical connection and disconnection of the container.

4.11.5 Valves

Valve selection shall be in accordance with AS/NZS 2927. Valves for chlorine use shall be of Class 18 PVC or equivalent suitable material of similar mechanical, thermal and corrosion resistant properties.

5 Safety Requirements

5.1 Gas Leak Detection System

A gas leak detection system shall be installed, with a minimum of two sensors (one (1) in each of the Dosing and Storage Rooms. The sensors shall be located approximately 30 cm from the floor level and the sensor installed in dosing rooms where chlorinators are installed shall be located below the chlorinator(s).

The gas leak detection system shall include self-test functionality which performs self-test on a regular basis. Indication that the self-test has been undertaken shall be provided for monitoring via SCADA.

5.2 Chlorine Station Emergency Shutdown

An emergency pneumatically operated shutdown system shall be installed to automatically shut the primary isolation valves (or auxiliary valves) on the chlorine containers when a high level gas chlorine leak is detected (default 5 ppm).

The emergency shutdown system shall comply with AS 2927.

The system shall be provided with the following:

- A G-size compressed air or nitrogen cylinder with regulator, or compressed air if available on site and subject to appropriate air reserve at all times,
- A battery backup module to provide standby power to the gas leak detection and shutdown system capable of operation for a minimum of 4 hours in the event of power failure. Designers shall make allowance to establish all requirements needed to make a facility failsafe (especially a high risk / primary dosing facility). Battery back up to provide any necessary power and control signal to initiate an emergency shutdown of cylinders/drums auxiliary isolation valves, continue leak detection monitoring, chlorine analyser operation, PLC alarming, carry water valve (if not pumped) isolation, emergency lighting, RTU, ventilation and actuated louvres. Disinfection facilities should be designed to ensure the system remains safe in the event we lose power beyond the UPS supply time limit (typically 4 hours).
- An alarm to detect and alarm low battery voltage,
- An alarm to detect and alarm low air pressure,
- Upon receipt of a high gas concentration in the room, the emergency shutdown process shall be completed within fifteen seconds of initiation,
- Be provided with a bypass function which (when initiated) will prevent the shutdown system operating for a period of time to allow containers to be changed,
- Be provided with manual and automatic re-arm functions. If the system is not manually re-armed within a set time it shall be automatically re-armed.

5.3 Signage

The following signage shall be provided as a minimum:

- NOHSC:3009 /NZCIC *Warning sign for premises storing hazardous substances* and
- AS 1319 *Safety signs for the occupational environment* and
- AS 2927.

In addition to signs specified above, a minimum of one warning sign at each vehicle or personnel access gate to the chlorine station site and at the specified spacing along all fences in accordance with clause 3.4 and 3.5.

Figure 5.1 Signage Example

5.4 Pipework Labelling & Colour Coding

Pipe labelling and colour coding shall be in accordance with TS 0204 (formally TS 159b).

5.5 Emergency Eyewash & Safety Shower

Eyewash and safety shower shall be provided and installed in accordance with AS 4775 Emergency Eyewash and Shower Equipment.

The safety eyewash/shower shall be located in an easily accessible location directly outside the chlorination station. The location shall be determined by a Safety in Design Workshop undertaken as part of the design process by the designer in consolation with Operations staff.

Plumbed eyewash units shall have an uninterruptible flushing fluid supply of 1.5 L/min at 210 kPa. A 'Maric' flow control valve, or equivalent -flow control device, limiting the flow to the accepted AS 4775 requirement, is required. The flow control shall be installed on the supply line to the safety shower/eyewash. The flow control valve shall be installed downstream of an isolation valve on the branch supplying works water to the safety shower/eyewash

A disinfected potable water supply shall be used to provide water to the eyewash/safety shower. A mechanism to discharge heated water from the shower/eyewash unit shall be installed which shall ensure that water in the system does not exceed acceptable temperatures at all times.

5.6 Fire Protection

A fire protection system shall be provided where required by any building regulations, statutory requirement, or AS 2927.

Any smoke detectors or other equipment installed shall be suitable for exposure to chlorine gas and shall be installed hard-wired in all rooms of the building. The detectors shall be fitted with rechargeable batteries. The alarm output shall be hard wired to the telemetry.

5.7 Wind Direction Indicator

A wind direction indicator(s), in the form of a yellow wind sock/weather vane, shall be provided in a clearly visible location. A stainless steel weather vane can be used in high wind areas. The position of the indicator shall be selected to provide an indication of wind direction and wind strength from all normal directions of approach.

5.8 Manifests

A clearly marked manifest shall be located in a secure, weatherproof holder adjacent to the main access gate to the site where the chlorination station is located. It shall be located such that emergency services personnel can access the manifest if required.

6 Electrical Requirements

6.1 Switchboards & Control Panels

All Electrical installations shall comply with TS 0300 and TS0301 and all relevant Australian Standards. The electrical switchboard shall be installed in the Switchroom.

All controls and indications and HMI shall be mounted on the front of the switchboard.

Switchboards and electrical panels located in the Dosing and Storage Rooms (Chlorine Room for two (2) room designs) shall be IP 56 rated and in accordance with TS 0300.

Adequate de-rating of equipment and/or ventilation (forced or otherwise) of the switchboard cubicles shall be provided to protect the equipment against the effects of excessive temperatures within the cubicles. Any ventilation shall not compromise the IP (Ingress Protection) rating and form of segregation of the cubicles. Light fittings, switches and socket outlets in the building(s) shall have a degree of protection of not less than IP 56 in accordance with AS 60529. All other electrical equipment, including pump and fan motors, shall have a minimum IP 54 rating.

Minimum backup power supply shall be in accordance with TS 0300. An uninterruptible power supply (UPS) or battery backed ELV supply shall be provided to maintain operation of critical instruments; including PLC and associated control equipment, emergency lighting, gas leak detectors, telemetry unit SCADA RTU (Remote Terminal Unit) and to enable controlled shutdowns as necessary.

6.2 Controls & Indications

Controls and indications shall be provided in the chlorination station in accordance with TS 0301 and this clause.

Indications and controls shall be provided using pilot lights and control selectors unless otherwise indicated_*, which indicates an indication/control that can be provided via common control system HMI.

6.2.1 Common Controls & Indications

GENERAL CONTROLS

- Power supply available indication
- Fault reset pushbutton
- Lamp test pushbutton (one for each panel door)
- * PLC fault
- * PLC/RTU communications failure alarm
- * Security alarm
- Smoke alarm (if installed)
- * Service water pump running (if provided)
- * Service water pump fault (if provided)
- * Drainage sump high level (if provided)
- Booster pump duty selector 1-2 / 2-1 (where more than one pump required)
- Booster pump duty 1-2 selected
- Booster pump duty 2-1 selected
- * In tank mixer running (if applicable)
- * In tank mixer fault (if applicable)

DOSE MODE CONTROLS

Dosing modes and controls shown here are indicative/typical of those required and may vary for a particular site when approved by the Responsible Discipline Lead.

- * Chlorine residual setpoint digital display (mg/l)
- * Dose mode selector flow / flow+residual / Tank Trim
- * Dose mode flow selected indication
- * Dose mode flow+residual selected indication
- * Dose mode Tank Trim selected indication

6.2.2 Process

- * Water flow (L/s) (one for each flowmeter installed)
- * Chlorine residual setpoint (mg/l) (one for each dose point installed)
- * Chlorine residual (mg/l) (one for each analyser installed)
- * Chlorine analyser fault (one for each analyser installed)
- Dosing system shutdown (high or low residual fault) – where applicable

6.2.3 Chlorine Storage (Each Container)

- * Chlorine container status indication on-line
- * Chlorine container status indication off-line
- * Chlorine container weight digital display (kg)
- Chlorine container change required

6.2.4 Chlorinator (Each Chlorinator)

- Fault reset pushbutton
- Mode Auto/Off/Manual selector
- * Auto dose mode selected
- * Off dose mode selected
- * Manual dose mode selected indication
- * On-line indication
- * Off-line indication
- High vacuum alarm indication
- Low vacuum alarm indication
- * Plug positioner position indication (0-100%)
- Gas inlet valve Auto/Off/Manual selector
- * Gas inlet valve Auto selected indication
- * Gas inlet valve Off selected indication
- * Gas inlet valve Manual selected indication
- Open gas inlet valve pushbutton
- Close gas inlet valve pushbutton
- Gas inlet valve open indication
- Gas inlet valve closed indication
- Gas inlet valve fault indication
- Water valve Auto/Off/Manual selector
- * Water valve Auto selected indication
- * Water valve Off selected indication
- * Water valve Manual selected indication
- Open water valve pushbutton
- Close water valve pushbutton
- Water valve open indication
- Water valve closed indication
- Water valve fault indication

6.2.5 Gas Alarm System

3 Room Designs

- Fault reset pushbutton
- Siren mute pushbutton
- * Chlorine storage room gas level (ppm) indication – at minimum visible by personnel on the outside of the room in a suitable location
- Chlorine storage room gas leak warning alarm indication
- Chlorine storage room gas leak alarm indication
- * Chlorine dosing room gas level (ppm) indication – at minimum visible by personnel on the outside of the room in a suitable location
- Chlorine dosing room gas leak warning alarm indication
- Chlorine dosing room gas leak alarm indication
- Gas level (ppm) indication for SCADA and site display needs to have a minimum range of 0-20ppm

1 and 2 Room Designs

- Fault reset pushbutton
- Siren mute pushbutton
- * Chlorine room gas level sensor 1 (ppm) indication – at minimum visible by personnel on the outside of the room in a suitable location
- * Chlorine room gas level sensor 2 (ppm) indication – at minimum visible by personnel on the outside of the room in a suitable location Chlorine room gas leak alarm indication
- Chlorine room gas leak alarm indication

6.2.6 Emergency Gas Shutdown System

- Fault reset pushbutton
- Bypass pushbutton
- Normal pushbutton
- Bypass Active indication
- Air pressure low indication
- Power supply low voltage alarm indication

6.2.7 Emergency Shutdown Manual Controls (On Internal Wall Adjacent to Door)

- Gas storage room pushbutton (mushroom head, latch in, twist release)
- Gas dosing room pushbutton (mushroom head, latch in, twist release)
- Switchroom pushbutton (mushroom head, latch in, twist release)

6.2.8 Chlorinator facility shutdown – Prevention of Water Quality Incidents

- Where possible, a chlorination system should be designed so that in the event of a dosing fault (over or under dosing) it will automatically shutdown the system to prevent a water quality incident occurring.
- This should include automatic stop of the system from dosing when the critical control point (analyser) chlorine residual is less than 0.25ppm or greater than 4.8ppm for greater than 10 minutes.
- These shutdown limits should be adjusted within this range where possible to suit a particular system to further minimize the impact of a system dosing fault where deemed appropriate.
- Where a chlorination system shutdown is possible, the shutdown residual setpoints are to match the systems HIHI and LOLO analyser residual alarm setpoints.

6.2.9 Ventilation System (Chlorine Dosing & Storage Rooms or Chlorine Room)

The controls specified in this clause shall be provided for both the chlorine dosing and chlorine storage rooms (Chlorine Room for 2 room designs) and shall be located either in the switchroom or other suitable location external to the building approved by SA Water's Representative.

Gas Containment/Controlled Release System

- Fault reset pushbutton
- Controlled release Enable/Disable selector (with locking in disabled position)
- Controlled release enabled
- Mode Off/Manual selector
- * Off mode selected indication
- * Manual mode selected indication
- Start ventilation fan pushbutton
- Stop ventilation fan pushbutton
- Ventilation fan running indication
- Ventilation fan fault indication
- Inlet louver open indication
- Inlet louver closed indication
- Inlet louver fault indication
- Outlet louver open indication
- Outlet louver closed indication
- Outlet louver fault indication

Uncontrolled Release System

- Fault reset pushbutton
- Controlled release Enable/Disable selector (with locking in disabled position)
- Controlled release enabled
- Mode Off/Manual selector
- * Off mode selected indication
- * Manual mode selected indication
- Start ventilation fan pushbutton
- Stop ventilation fan pushbutton
- Ventilation fan running indication
- Ventilation fan fault indication

6.2.10 Switchroom Ventilation Fans

- Fault reset pushbutton
- Mode Off/Manual selector
- * Off mode selected indication
- * Manual mode selected indication
- Start switchroom ventilation fan pushbutton
- Stop switchroom ventilation fan pushbutton
- Switchroom ventilation fan running indication
- Switchroom ventilation fan fault indication

6.2.11 Chlorine Analyser (For Each Chlorine Analyser Installed)

- Fault reset pushbutton
- Chlorine residual digital display (mg/l)
- Chlorine low low (LOLO) residual alarm indication – to match chlorinator shutdown where applicable
- * Chlorine low residual alarm indication
- * Chlorine high residual alarm indication
- Chlorine high high (HIHI) residual alarm indication – to match chlorinator shutdown where applicable
- Chlorine analyser low flow alarm indication
- Chlorine analyser fault indication
- All chlorine analysers should have a minimum range of 0-10ppm

6.2.12 Booster Pumps (For Each Booster Pump)

- Fault reset pushbutton
- Mode Auto/Off/Manual selector
- * Auto mode selected
- * Off mode selected
- * Manual mode selected indication
- Start booster pump pushbutton
- Stop booster pump pushbutton
- Pump running indication
- Pump fault indication
- Pump no flow indication
- * Hours run indication

6.2.13 The Following External to the Building:

- Beacon lights (2 off minimum) – (on wall or under eves)
- Sirens (2 off minimum) – (on wall or under eves)
- Lamp/Alarm test pushbutton (adjacent door)
- Gas Alarm acknowledgement button (adjacent door)

3 Room Designs

- Chlorine storage room gas level indication (ppm) (adjacent door)
- # Start chlorine gas storage room ventilation pushbutton
- # Stop chlorine gas storage room ventilation pushbutton
- Chlorine dose room gas level indication (ppm) (adjacent door)
- # Start chlorine dosing room ventilation pushbutton
- # Stop chlorine dosing room ventilation pushbutton

2 Room Designs

- Chlorine room gas level 1 indication (ppm)
- Chlorine room gas level 2 indication (ppm)
- # Start chlorine room ventilation pushbutton
- # Stop chlorine room ventilation pushbutton

Optional control, if also provided in switchroom, refer to clause 6.2.8.

6.3 Control System

6.3.1 Design

The control system shall be designed in accordance with TS 0301.

6.3.2 Chlorine Dosing Systems

System controls shall include the following for each dosing system:

- Dosing shall be inhibited when flow falls below a minimum flow or dose threshold (this shall be risk assessed for each system case – should water flow to customers then dosing will need to occur over the full range of network demands),
- Where more than one dosing system and/or component is installed (duty/standby), automatic changeover shall be provided on fault or low chlorine residual in the duty system,
- When the duty system has been faulted and the fault has been cleared the previously faulted system shall return to duty status,
- A dosing system shall be unavailable when any component of that system becomes unavailable.

Equipment controls shall include the following:

- Manual control to allow each item of equipment (e.g. gas container, chlorinator, booster pumps, etc.) to be operated individually if required,
- Automatic control to allow the system to operate under the control of the common control PLC.

6.3.3 Gas Delivery Systems

Gas delivery system controls, alarms and warnings shall be provided as follows:

- Indication shall be provided for each gas container to indicate when it is online,
- When a duty gas container or manifolded containers are empty (determined by pressure controls) they shall be automatically taken offline and replaced by the stand-by containers,
- A “container change required warning” shall be provided when the stand-by containers are placed online,
- A reset shall be provided to allow the alarm to be reset when the empty containers are replaced.

6.3.4 Chlorinators

Chlorinators shall operate as follows:

- Required dose rates shall be set via the PLC control system and shall be set locally. The ability to change the dose rate setpoint via SCADA shall be provided unless deemed not required.
- The control system shall be designed to allow for different flow tubes to be fitted to the chlorinator when determining dose rates (e.g. a flow tube range input parameter shall be provided via the local control system for each chlorinator),
- Flow paced dosing control shall be provided as a minimum. Flow+residual trim control mode shall be provided where a chlorinated water chlorine analyser is installed or where specified in the project specification,
- The chlorinator should have a 'prestart' function programmed into the PLC, ensuring the chlorinator is online and measuring a correct residual prior to any flow commencing. This prevents under dosed water entering the distribution network on each start up event.
- Controls shall ensure that a quantity of chlorine equal to the "residual setpoint" is dosed for every litre of water being dosed (flow pacing) and the desired free chlorine residual is achieved in the water being dosed (residual trimming). Other control methodologies (e.g. feed-forward) may be used to achieve the desired chlorine where specified in the project specification or approved by SA Water's Representative / Responsible Discipline Lead,
- A "chlorinator fault" shall be provided for each chlorinator. Chlorinator fault shall be activated when that chlorinator is operating and either a low or high vacuum is detected. Suitable time delays shall be provided to inhibit alarms during system start-up.

Chlorinator shall have the on-line status when the following is true:

- The Gas inlet Valve is not closed (e.g. partially open),
- The water inlet valve is not closed (e.g. partially open),
- Plug positioner is > 0% open.

6.3.5 Chlorine Gas Detection System

The Chlorination equipment room and Gas Storage room shall each be monitored for the presence of chlorine gas, indicating gas leakage.

The functionality described in this clause shall be provided as a minimum:

- A chlorine gas level of 1 ppm to 5 ppm generates a **Gas Warning Alarm**,
- A chlorine gas level of 1 ppm to 5 ppm sustained for 10 minutes or a chlorine gas level of over 5 ppm generates a **Gas Shutdown Alarm**.

Gas Warning Alarm

In the event of a Gas Warning Alarm the following shall occur:

- Room ventilation system (fans and actuated louvers, if installed) shall remain in their current position,
- Beacons shall illuminate,
- Sirens shall pulse (1 second on / 5 seconds off) for 5 minutes, then stop,
- Sirens shall stop if alarm is cleared or acknowledged during this time.

The Gas Warning Alarm shall remain active until:

- The gas level falls below 1ppm, and
- The system is reset.

Gas Shutdown Alarm

In the event of a Gas Shutdown Alarm the following shall occur:

- Ventilation fans shall stop, if running
- Actuated Louvers (both inlet and exhaust, if installed) shall close, if open
- Beacons shall illuminate,
- Sirens shall activate for 5 minutes continuously,
- Sirens shall stop if alarm is cleared or acknowledged during this time.

The Gas Shutdown Alarm shall remain active until:

- The gas level falls below 1ppm, and
- The system is reset.

6.3.6 Emergency Shutdown System (Normal Operation)

The emergency shutdown system shall be provided with the following features:

- Fail safe operation to shutdown in the event of a wiring open circuit or control failure,
- Be hard wired and independent of the electrical control system to ensure that it will continue to operate when the control system or PLC fails,
- Interface to the control system to provide indication and alarm functionality.

The emergency shutdown system shall be initiated by one of the following:

- A gas leak is detected in any room (from the gas leak detection system),
- Any of the emergency shutdown pushbuttons are activated.

The Emergency Shutdown shall remain active until:

- There are no gas alarms active,
- All emergency shutdown pushbuttons are released,
- The system is reset using the fault reset pushbutton,
- The emergency shutdown system shall be interlocked with the ventilation system to ensure that the ventilation system is stopped, refer to clause 6.3.8 for details.

Shutdown system alarming shall be provided as follows (unless otherwise agreed by the Responsible Discipline Lead):

- A “low air pressure alarm” shall shut down the chlorination system if pressure in the shutdown system cylinder or receiver falls to a minimum level for safe operation of the shutdown system,
- A “low battery alarm” shall shut down the chlorination system if battery voltage falls to a minimum level for safe operation of the shutdown system.

6.3.7 Emergency Shutdown System Bypass Operation

A shutdown system by-pass control shall be provided to prevent the Emergency Shutdown system shutting off the chlorine system for a 10 minute period during changeover and to prevent false alarm call outs during container change. All alarms shall remain active to SCADA during this period.

When the Emergency Shutdown system by-pass pushbutton is actuated, the associated indication shall be illuminated (both locally and on SCADA) and the shutdown system shall be inhibited from operating for 10 minutes. After 10 minutes the Emergency Shutdown by-pass shall be de-activated and normal operation of the Emergency Shutdown system shall resume.

6.3.8 Ventilation System Operation

Gas Leak or Emergency Shutdown Override Controls

The override controls (provided to allow a controlled release of chlorine gas during a gas leak or ESD has been actuated, under strict administrative controls).

The Controlled Release Enabled controls shall operate as follows:

- Become activated when the Controlled release Enable/Disable selector has Enable selected
- The Controlled Release Enabled indication/status shall be initiated when Enable is selected
- Manual operation (only) of the ventilation system is possible when Controlled Release Enabled status is active
- The gas alarm shutdown interlocks are overridden in this state to allow the ventilation system to be operated using the Start/Stop controls when manual control mode only selected.

Gas Containment/Controlled Release

Ventilation fans will normally be left in the Manual control mode (i.e. not in Off mode), controls described in this clause assume the Manual control mode is selected.

NORMAL OPERATION

In normal (unattended) operation (i.e. site running, unattended and no gas leak alarms):

- The actuated louvers shall be closed
- The fans shall not run.

When Building (room) entry is required, the ventilation system for a room shall operate as follows:

- The ventilation system shall be activated using the start ventilation fan pushbutton for the required room
- The inlet and outlet actuated louvers shall open and the required position validated by proximity switches
- This status shall be maintained until the stop ventilation fan pushbutton is operated

To return the facility to normal (unattended) operation:

- The stop fan pushbutton shall be operated
- The fan shall be stopped
- The ventilation actuated louvers (inlet and fan) shall be closed (validated by proximity switches)

GAS LEAK OR EMERGENCY SHUTDOWN OPERATION

The ventilation system shall be interlocked with the gas leak and emergency shutdown systems to ensure that ventilation ceases and actuated louvers are closed when a gas leak alarm is detected or the emergency shutdown system is activated. When either of these occurs:

- Ventilation actuated louvers shall be closed immediately
- Ventilation fans shall be stopped immediately

When a gas leak or emergency shutdown is active, this shutdown status shall be maintained until:

- Controlled Release Enabled indication/status is initiated, and
- The ventilation system is initiated using manual control mode (automatic operation remains inhibited).

A fan fault shall be initiated when a fan overload is detected.

A SCADA alarm shall be raised if the fan remains in operation for a period of time greater than 5 hours.

Uncontrolled Release

NORMAL OPERATION

In normal (unattended) operation (i.e. site running, unattended and no gas leak alarms):

- The fans shall not run.

When Building (room) entry for a room is required, the ventilation system shall operate as follows:

- The ventilation system shall be activated using the start ventilation fan pushbutton for the required room
- This status shall be maintained until the stop ventilation fan pushbutton is operated

To return the facility to normal (unattended) operation:

- The stop fan pushbutton shall be operated
- The fan shall be stopped

GAS LEAK OR EMERGENCY SHUTDOWN OPERATION

The ventilation system shall be interlocked with the gas leak and emergency shutdown systems to ensure that ventilation ceases when a gas leak alarm is detected or the emergency shutdown system is activated. When either of these occurs:

- Ventilation fans shall be stopped immediately.

When a gas leak or emergency shutdown is active (and the ventilation stopped), this status shall be maintained until:

- Controlled Release Enabled indication/status is initiated, and
- The ventilation system is initiated using the start ventilation pushbutton.

A fan fault shall be initiated when a fan overload is detected under any mode.

A SCADA alarm shall be raised if the fan remains in operation for a period of time greater than 5 hours.

7 Telemetry

7.1 General

Telemetry is to be installed on a separate panel as per TS 0300 and TS 0350, 03051 and 0352 (formally TS1000).

Operational Information from the site and some remote control of the chlorine system equipment shall be provided via the SA Water SCADA system at sites connected directly to the system in order to allow the modification of operational parameters to be set both remotely (in addition to locally).

The telemetry system installed shall be compatible with the existing SA Water SCADA network and be in accordance with TS 0350, 0351 and 0352.

The signals listed below shall be interfaced to the SA Water SCADA system via the site RTU. Signal shall be hardwired or via communication network in accordance with TS 0350, 0351 and 0352. Hardwired signals shall be terminated in accordance with TS 0300.

The signals described here are the minimum alarms required and may be supplemented as considered necessary during development or design of the system.

7.2 Signals to Be Monitored

The signals described in this clause shall be monitored on SCADA as a minimum.

NOTE: ** denotes “hard-wired” signals

7.2.1 Common Controls & Indicators

- ** Mains power failure
- ** PLC fault
- PLC/RTU communications failure alarm
- ** Security alarm
- ** Smoke alarm (if installed)
- Service water pump running (if provided)
- Service water pump fault (if provided)
- ** Drainage sump high level (if provided)

7.2.2 Process Related

- ** Water flow (L/s) (one for each flowmeter installed)
- Chlorine residual setpoint (mg/l) (one for each dose point installed)
- ** Chlorine residual (mg/l) (one for each analyser installed)
- ** Chlorine analyser fault (one for each analyser installed)
- Flow dose mode selected (if selection provided)
- Flow+residual dose mode selected (if selection provided)
- ** In tank mixer running (if provided)
- ** In tank mixer fault (if provided)
- Dosing system shutdown (high or low residual fault) – if applicable

7.2.3 Chlorine Storage (each container)

- Chlorine container status on-line
- Chlorine container status off-line
- Chlorine container weight (kg)
- Chlorine container change required

7.2.4 Chlorinator (Each Chlorinator)

- Auto dose mode selected
- Off dose mode selected
- Manual dose mode selected
- ** On-line
- Off-line
- ** Vacuum alarm
- Plug positioner position (0-100%)
- Dose rate (kg/h)
- Gas inlet valve Auto selected
- Gas inlet valve Off selected
- Gas inlet valve Manual selected
- Gas inlet valve open
- Gas inlet valve closed
- Gas inlet valve fault
- Water valve Auto selected
- Water valve Off selected
- Water valve Manual selected
- Water valve open
- Water valve closed
- Water valve fault

7.2.5 Gas Alarm System

- ** Gas Detector System Fault
- ** Chlorine storage room gas level (ppm)
- ** Chlorine storage room gas leak warning alarm
- ** Chlorine storage room gas leak alarm
- ** Chlorine dosing room gas level (ppm)
- ** Chlorine dosing room gas leak warning alarm
- ** Chlorine dosing room gas leak alarm

7.2.6 Emergency Shutdown System

- ** System fault
- ** Bypassed
- ** Re-arm alarm
- ** Air pressure low
- ** Power supply low voltage alarm

7.2.7 Emergency Shutdown Manual Controls (On Internal Wall Adjacent To Door)

- ** Gas storage room activated
- ** Gas dosing room activated
- ** Switchroom activated

7.2.8 Ventilation System (Chlorine Dosing & Storage Rooms or Chlorine Room)

- ** Controlled release Enabled
- Off mode selected
- Manual mode selected
- ** Ventilation fan running
- Ventilation fan fault
- Inlet louver open (if installed)
- ** Inlet louver closed (if installed)
- Inlet louver fault (if installed)
- Outlet louver open (if installed)
- ** Outlet louver closed (if installed)
- Outlet louver fault (if installed)

7.2.9 Switchroom Ventilation Fans

- Off mode selected
- Manual mode selected
- Switchroom ventilation fan running
- Switchroom ventilation fan fault

7.2.10 Chlorine Analysis (For Each Chlorine Analyser Installed)

- ** Chlorine residual (mg/l)
- ** Chlorine low low residual alarm
- Chlorine low residual alarm
- Chlorine high residual alarm
- ** Chlorine high high residual alarm
- Chlorine analyser low flow alarm
- ** Chlorine analyser fault

7.2.11 Booster Pumps (For Each Booster Pump)

- Auto mode selected
- Off mode selected
- Manual mode selected
- Pump running
- Pump fault

Appendix A

A1 High Risk Vs Low Risk Chlorine Stations – Minimum Equipment Recommendations

Table A1.1 High Risk Vs Low Risk Chlorine Stations – Minimum Equipment Recommendation

Item	Quantity		Comments
	Low Risk OR SECONDARY	High Risk OR PRIMARY	
Chlorinator	1	2 – with auto changeover setup	Some low risk sites may warrant a second chlorinator (e.g. if gravity fed, low storage capacity, long travel time)
Injector	1	Two (2) – one (1) per chlorinator	
Vacuum regulator	2	2+	Additional minimum regulators may be required based on cylinder/drum quantities for the site
Scales	1 each online		
Analyser	1	Site Specific	Min. 2no if trim dosing, all installations to have separate manual sample point installed
Leak Detector	1 per room where gas leak possible (i.e. dosing room, gas storage room		
Auto Shutdown for gas	1 set for online/standby connected gas cylinders/drums		
Air conditioning	1		(For drum/cylinder rooms)
External leak detector screen	1		For each detector installed, up to 20ppm
Exhaust fan/ventilation system	1		Controlled or uncontrolled based on risk assessment, SID, HAZOP
Emergency Lights (internal/external)	1 set		
Siren	1		
Wind sock	1		
Storage (anything specific)	Size suited to site demand and delivery frequency	Size suited to site demand and delivery frequency	
Charcoal canister	1		

Continued on Table A1.2

Table A1.2 High Risk Vs Low Risk Chlorine Stations – Minimum Equipment Recommendation (Continued)

Item	Quantity		Comments
	Low Risk OR SECONDARY	High Risk OR PRIMARY	
Booster pumps (or higher pressure supply than dose point)	1 duty, 1 standby/spare	2no connected, 1 duty and 1 standby	Option to have on both connected or just 1 spare stored on site
Actuated valves	Site specific	-Site specific, -For chlorinator changeover	-To stop syphoning -Select between cylinder banks
Flow metre (for dose control)	1		
PLC/HMI/SCU controls	1		
SCADA monitoring	1		
Backup Power source/Genset (is this actually a requirement??)	0	1	Only for high risk sites hard wired. Genets' may not be required based on system supply conditions and if it can be shutdown safely – this should be risk assessed on a case by case basis.
Genset connection plug etc.	1	(backup hard wired in)	For simplified temporary genset connection
UPS/comms battery backup	1		Minimum run time site dependant -
Sample return point	1		(back into system) unless using analyser buffers
Vacuum switches	1	2	(1 per chlorinator)
Water on floor sensor	1		
Security	As per security requirements		
Chlorine drip heaters	1 – drums only*		* Can apply to cylinders in site specific cases
Capping equipment	1 set available		
Eyewash, fire hose, shower	1 set		
Carry water flowmeter	1		Used for dosing fault finding
Sample tap	1		1 per analyser install, directed outside of the building for sampler ease of access.

A2 Typical Two Room Chlorine Building Layout

Figure 7.1 Typical Two Room Chlorine Building Layout