Assets Planning and Delivery Group
Engineering

Design Standard DS 70-01

Chlorine Buildings Standard

VERSION 2
REVISION 0

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FOREWORD

The intent of Design Standards is to specify requirements that assure effective design and delivery of fit for purpose Water Corporation infrastructure assets for best whole-of-life value with least risk to Corporation service standards and safety. Design standards are also intended to promote uniformity of approach by asset designers, drafters and constructors to the design, construction, commissioning and delivery of water infrastructure and to the compatibility of new infrastructure with existing like infrastructure.

Design Standards draw on the asset design, management and field operational experience gained and documented by the Corporation and by the water industry generally over time. They are intended for application by Corporation staff, designers, constructors and land developers to the planning, design, construction and commissioning of Corporation infrastructure including water services provided by land developers for takeover by the Corporation.

Nothing in this Design Standard diminishes the responsibility of designers and constructors for applying the requirements of Western Australia's Work Health and Safety (General) Regulations 2022 to the delivery of Corporation assets. Information on these statutory requirements may be viewed at the following web site location:

https://www.dmirs.wa.gov.au/sites/default/files/atoms/files/overview_general_regulations.pdf

Enquiries relating to the technical content of a Design Standard should be directed to the Senior Principal Engineer, Water Treatment Advisory, Engineering. Future Design Standard changes, if any, will be issued to registered Design Standard users as and when published.

Head of Engineering

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REVISION STATUS

The revision status of this standard is shown section by section below:

REVISION STATUS						
SECT.	**VER./ REV.**	**DATE**	**PAGES REVISED**	**REVISION DESCRIPTION (Section, Clause, Sub-Clause)**	**RVWD.**	**APRV.**
A	0/0	30.11.02	All	New Version	NH	NW
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Design Standard DS70-01
Chlorine Buildings Standard

CONTENTS

1 Introduction

1.1 Scope

This Design Standard details the requirements and considerations involved in the design and construction of chlorine buildings. Section 2 applies to all chlorine buildings and Sections 3, 4 and 5 apply to chlorine containment buildings. The standard shall not be used as a substitute for AS2927. Its purpose is to highlight those aspects of AS2927 that have not generally been well adhered to by designers in the past and to highlight Water Corporation specific requirements over and above AS2927.

Note: Design requirements for chlorine modules are provided in Water Corporation's module specification PTM (Nexus #101394855, PTM - Prefabricated Treatment Module - Modular Specification).

1.2 Standards

This Design Standard makes reference (directly or indirectly) to the following current Standards:

AS/NZS

3000 Electrical Installations (known as the Australian/New Zealand Wiring Rules)

AS

1319 Safety signs for the occupational environment

1668.2 Part 2: Mechanical ventilation for acceptable indoor-air quality

1939 Degree of protection provided by enclosures for electrical equipment

2927 The storage and handling of liquefied chlorine gas

WATER CORPORATION STANDARDS

DS28	Water and Wastewater Treatment Plants – Electrical
DS30-02	General Design Criteria - Mechanical
DS35	Ancillary Plant - Mechanical
DS70-02	Chlorine Leak Detectors
DS79	Design of Chemical Systems – Legislative Requirements and General Principles
DS79-02	Emergency Safety Showers and Eyewash Stations
DS79-04	Chemical Safety Signage, Labels and Markers
EO28-70-1	Chlorine Drum Spacing - Section
16097-002-011	Chlorine Facility General Arrangement

1.3 Definitions

1.3.1 Chlorine

Elemental chlorine in its gaseous or liquid form.

1.3.2 Container

Anything, in which the chlorine is wholly or partly contained, including cylinders and drums.

1.3.3 Cylinder

A rigid container, which is designed in accordance with AS 2030.1 as a portable pressure vessel for storage of chlorine, and has only one cylinder valve, at the top, used for the withdrawal of chlorine gas.

1.3.4 Chlorine Containment

A design philosophy which aims to minimise the leakage of chlorine from a chlorine building in the event of a vessel or equipment failure.

1.3.5 Chlorine Store

An area that is used for the storage of chlorine containers and their associated connection equipment (i.e. where connection and disconnection of containers occurs).

1.3.6 Drum

A horizontal cylindrical steel container having a water capacity of 500-1000 L and which can be fitted into a protective cradle for storage and transport.

1.3.7 Installation

All those facilities on a site that are related to the storage, handling and use of chlorine, including connected and standby containers and associated piping and equipment, but not including separate storage areas (where cylinders or drums are simply stored).

1.3.8 Non-combustible

Material that does not support combustion or is deemed to be non-combustible when tested in accordance with AS 1530.1.

1.3.9 Placard

Refers to signs that provides a primary warning of the location and type of hazardous chemicals stored.

1.3.10 Self-Contained Breathing Apparatus (SCBA)

A portable respirator, which supplies air from a source carried by the user.

1.3.11 Sensitive Uses (as per AS2927 definition)

Sensitive uses include establishments and other uses where vulnerable people are concentrated such as schools, hospitals, aged persons' accommodation and child care facilities (including creches).

When considering sensitive uses, the possibility of easy evacuation by the people using the area should be considered. This might mean that for example, General Practice, dental or other medical surgeries that provide specialist care to vulnerable people should be considered sensitive uses.

When considering large establishments, the actual use of the buildings and areas within the defined separation distance should be evaluated. For example, in a large school or hospital surrounded by a garden or playing field or carpark, the required distance should be maintained from the school or hospital buildings and places of regular occupancy. However, the garden or playing field or carpark should be considered as sensitive if vulnerable people are normally present in these areas.

1.3.12 Shall

Indicates the statement is mandatory, and thus must be carried out.

1.3.13 Should

Indicates the statement is a recommendation or strong preference.

2 Design and Construction Requirements - General

2.1 Generic Design Criteria

General requirements for (chlorine) buildings shall be as described in the Buildings section of the General Design Criteria – Mechanical design standard DS30-02. This standard (DS70-01) also has requirements specific to chlorination buildings, which take precedence over DS30-02.

The environmental design criteria (e.g. flood and sea levels; ambient temperature) used as basis for the design work shall include allowance for climate change impacts expected over the life of the asset.

Locate the building within site to satisfy:

a) base of building above 1:100 year[1] AEP flood level;

b) minimise bushfire attack level (refer to section 2.4);

c) proximity to dose points to minimise control loop time;

d) optimise building security (refer DS62.1); and

e) orientation of building to avoid rain ingress (refer to section 2.2).

Building, anchorage and foundation design shall be to AS 1170.2 for the wind region the building will be installed in.

Fasteners and metalwork shall be suitable for environmental conditions at the site such as humidity and corrosive atmosphere.

Supply and install vehicle bollards in circumstances where distance between building and site internal access road or load-in bay is not adequate (e.g. less than 1000 mm) to mitigate risk of accidental vehicle collision (e.g. impact by a reversing truck).

2.1.1 Building Class

By default, water treatment facilities should be considered Class 8 Buildings under the National Construction Code (NCC) unless determined otherwise during the design process.

While the buildings should comply with the NCC provisions (unless agreed otherwise by the Corporation during the design process) a Building Permit may not be required based on Section 70 of the *WA Building Act (2011)*.

2.1.2 Importance Level

For the purposes of AS1170 water treatment facilities are to be considered Importance Level 3, unless they are the sole source of water supply to a Level 4 facility (e.g. fire, rescue, police, hospitals, emergency shelters, or other designated essential facilities) in which case they too become Level 4.

[1] Acceptable flood levels depend on the asset type i.e. AEP (1:10 – onsite drainage, 1:20 - roads, 1:100 -– buildings and outdoor electrical switchboards).

Major sources for the IWSS are nominally designated Level 4 due to their importance to the IWSS and post-disaster recovery.

The Importance Level should be determined by APDG and documented in the ARB.

Some components of the treatment facility may have lower importance level if their failure would only cause inconvenience (until repaired) rather than prolonged outage of the treatment facility.

2.2 Layout

Chlorine buildings shall be internally segregated to minimise hazards to O&M personnel and to minimise risk of damage to equipment:

- They shall include a dedicated electrical room which minimises exposure to electrical hazards and protects the electrical equipment from damage by leaks of water or chlorine.
- Separate chlorine store and chlorinator rooms shall be employed. This improves asset life by reducing the exposure of chlorination equipment to the effects of chlorine gas attack caused by releases from pressurised pipework and fittings.

To avoid ingress of wind-driven rain, orient buildings so that the personnel doors with an operational requirement to be hooked open while working inside (e.g. chlorine storeroom, chlorination room) are located away from the prevailing weather direction. If this orientation is not practical, then provide an awning at roof height which projects 2 metres from the building to protect any doors vulnerable to wind-driven rain (unless agreed otherwise with the client Region e.g. the Region might not prefer awnings if low rainfall or cyclonic wind results in cost of an awning not being justified).

2.3 Accessibility

A minimum clearance of 1.0 m shall be provided around all sides of equipment that require maintenance access (i.e. the 1.0 metre clearance is only required on the sides that personnel need to be located during maintenance – in many instances this will only be on one side of the equipment), plus consideration given to a greater clearance where maintenance activities require it. Typically, this access would be from the centre of the room to equipment mounted on or against the walls. Where greater access is required than the room dimensions allow, then use alternatives such as roller doors (or double doors if they provide sufficient opening width) to provide clear access for maintenance of the equipment. Walkways shall have a minimum of 600 mm clearance which shall be available with cabinet doors open. Equipment shall have safe/ergonomic operating positions for hand wheels and controls e.g. hand wheel operating height of 900±150 mm.

The clear spacing around chlorine drums shall comply with drawing 16097-002-011 with the separation distance between pairs of drums being 150mm where it is not to be used as an access way (this distance is small enough to discourage use as a walkway but large enough to prevent a drum from striking a neighbour when being moved by crane).

Access to the head of drums (i.e. valves, ESDs, etc.) shall be in accordance with drawing EO28-70-1 to permit operational and emergency access (Note: the 2460 mm dimension in EO28-70-1 supersedes the 2450 mm dimension shown in 16097-002-011).

2.4 Fire attack – risk mitigation

The following fire control requirements apply.

a) The lining of an indoor installation shall be non-combustible;

b) The floor shall be constructed of concrete in accordance with AS 3600;

c) If heaters are contemplated, their adoption shall be subject to Cost-Benefit Assessment (whole-of-life cost of the heater system versus meeting the peak chlorine draw rate by having more cylinders/drums online). Heater options typically considered are reverse cycle air conditioning (which is the heater type with least fire risk) or yoke heaters; however, exposed heaters (e.g. electric bar heaters) shall not be employed (due to fire hazard and burns risk).

Bushfire attack level shall be assessed using AS3959. Design of the building shall comply with AS3959 and shall also be designed for any credible fire attack risk other than bushfire (e.g. proximity of building to power transformers), and propagation from external air conditioners ignited by bushfire.

Typically, the preferred method of mitigating fire attack risk is provision of a buffer clear of combustible material. Where achieving adequate buffer distance is impractical, then the fire risk shall be managed by making the building resistant to fire attack. In addition to considering cleared buffer, consider whether fire risk to the building can be further reduced when selecting the location of the building within the overall site. For example, consider any shielding opportunities provided by non-combustible infrastructure such as water tanks.

Essential services infrastructure (such as this building) requires it to be located a minimum of 20 metres (the asset protection zone) from any standing fuel load.

2.4.1 BAL-40 and above

Where bushfire attack level is BAL-40 and above, in addition to compliance with AS3959 the minimum requirements for the building include:

a) Protect any non-metallic aboveground outdoor pipework with metallic sheath.

b) Any wall penetrations (e.g. for pipes and air-conditioner hoses) that have gaps (where a circular probe of 3 mm diameter is capable of being passed through) shall be screened.

c) The roof/wall junction shall be sealed.

d) Note that roof design with Trimdeck steel sheeting over Anticon (glass wool adhered to foil sheet) provides suitable resistance to bushfire attack.

e) If using non-masonry construction, external walls shall have non-combustible core (e.g. mineral wool fibre) whereas materials relying upon fire retardant are not acceptable (since their insulating properties may degrade with heat exposure). Bondor Flameguard panels (minimum 75 mm thickness) or an approved equivalent are preferred when “insulated panel” type of construction is adopted.

2.5 Floor

All services less than or equal to 100 mm diameter shall enter and exit the building through the floor only. The holes (and any conduits) shall be fully sealed after installation of the service on site (even if this service installation is by others). Electrical cable entries shall be provided in the floor for all cables entering or leaving the building.

Provide sufficient DN100 floor drains in wet rooms (i.e. chlorination room) to prevent flooding from pipe leakage.

The concrete floor of wet rooms shall be sealed by:

a) A hard-wearing fire-resistant linoleum covering; or

b) Painting or spraying with a suitable material to provide some wear resistance and waterproofing.

2.5.1 Cylinder weigh scales flush with floor

For buildings with upright gas cylinders, a recess shall be provided in the floor so the top of the weigh scale is flush with the floor - this ensures that operators do not need to lift cylinders onto or off the scales. The recess may be cast-in or achieved by building-up the floor level of the cylinder room. The built-up floor shall use termite-resistant materials and be sealed the same as described in section 2.5.

To minimise the bump/step across the door threshold, the cylinder load-in bay (footpath) level shall be as close as practical (while still allowing the doors to open outwards) to the base of the anti-jemmy lip on the door frame. Ramps may be considered, as an alternative to building-up the entire floor area in the cylinder room, if their slope does not exceed 1:20 (i.e. rise = weigh scale height; run = full room depth between door threshold and front of cylinder weigh scales). Ramps (e.g. FRP) shall have non-slip tread and shall not have open mesh (as this results in increased cleaning requirement).

2.6 Chlorination room – wall space

This room is usually dedicated for the chlorinators, although ejector pumps are frequently also co-located.

The wall space in this area shall be designed to allow:

a) uncluttered positioning of instrumentation (e.g. analysers);

b) the operator to have a full range of motion;

c) effective ventilation (the configuration of the room will usually dictate mechanical ventilation due to an inability to get good cross draught through the room); and

d) Installation of future equipment (e.g. additional equipment and/or replacement equipment with different dimensions) i.e. locating equipment to one side of a wall panel provides opportunity to locate equipment next to it, whereas mounting equipment in the centre of the wall panel may not leave space for easy/efficient installation of future equipment.

2.7 Personnel and Vehicular Doors

Normal entry to each room shall be by personnel doors, which will provide access to open any roller doors from the inside wherever practical. This is to avoid having external locks on roller doors.

Doors for gas storage and gas dosing rooms (i.e. with potential for gas fumes) shall normally be held open with hooks for the duration of personnel working inside, and therefore do not require crash-bar emergency exit hardware. Switchboard/control rooms shall have crash-bar emergency exit hardware fitted to all hinged doors.

Personnel doors shall be designed to meet the required fire rating. They shall open outwards, and the travel path of the doors shall not be restricted by external features on the building (e.g. overhanging eaves/roof) or any other structure. A hydraulic-operated door anti-slam closer/dampener shall be provided for each door leaf.

When determining the location of personnel access doors to the storage/dosing room, the required separation and segregation distances outlined in AS 3780 must be maintained. If the room floor area is greater than 25m^2 then two means of access/egress are required.

Each personnel door is to be a structurally reinforced, steel sheet faced, waterproof security door with three heavy duty hinges, either recessed or with non-knockout pins, and security hinge bolts. Provide a leading edge for entire height of door for protection of the tongue and strike plate, plus to exclude opportunity to use a lever to force the door open (i.e. anti-jemmy edge).

The door shall be fitted with a heavy-duty stainless-steel dead-latch keyed to the Water Corporation's specification, and catches for holding the door in the open position. Rebound rubbers shall be provided externally to prevent the doors swinging fully open and knocking the walls.

Each door shall have a single action stainless steel (Lockwood 002) door handle on the inside, which shall be lever action for safe egress purposes. Flush-mounted keying cylinders shall be used to open the doors from outside. Any external pull handles (e.g. if required to pull door open against a prevailing wind) shall be located to minimise opportunity for leverage against the door frame (due to risk the handles may be used by unauthorised intruders to lever open the door).On double-doors, there needs to be a strap bolt or top bolt top and bottom of the fixed leaf. With over-sized doors there needs to be a single bolt mechanism that simultaneously engages top and bottom on the fixed leaf.

Personnel doors shall be Lietzke Security 1 Door or equivalent approved with Colorbond finish to match external and internal wall panels.

Door framing shall be Lietzke Flange Fit Steel Frames or similar approved, finished to match wall panels.

The travel of vehicular doors shall consider the prevailing wind conditions.

Note: Containment Buildings have additional requirements – see Section 2.14.

2.8 Sealing of buildings

Sealing of buildings is required to prevent leaked chlorine gas spreading between rooms, which mitigates extent of equipment damage and danger to personnel. The following requirements apply to all buildings:

(a) Flooring shall not include pits, ducts, sumps or machinery wells; and

(b) There shall not be any unsealed openings between rooms (e.g. cable ducts, conduits etc.).

Note: An exception to (a) would be the installation of cast in conduits in the floor of the chlorine storeroom between the drum head position and adjacent walls for the purpose of routing the cabling and vacuum lines associated with vacuum regulators (refer drawing 16097-02-12 as an example).

2.9 Ventilation

2.9.1 Ventilation of chlorine stores

Mechanical ventilation shall be provided (in accordance with AS2927) to provide substantial flow through the chlorine containment building, across the header arrangement. Ducting for ventilation shall exit the building through the ceiling rather than via wall penetration, in order to ensure the safe dispersal of chlorine vapours.

Note: Containment Buildings have additional requirements – see Section 2.14.

2.9.2 Ventilation of chlorination rooms

Mechanical or natural ventilation shall be provided for the chlorinator rooms in accordance with AS2927.

Ventilation design shall consider the internal heat loads (i.e. heat produced from equipment) and external heat loads (i.e. environmental) with the requirement to limit maximum temperature to suit the equipment within the room and to provide a comfortable work environment for operators and maintainers.

The wall vents shall be heavy duty steel louvres with weather lips, powder coat finish to match the wall sheeting. Provide ember screens on all vents. All vents shall have insect proof mesh. Wall vents large enough for a person to enter shall have security grilles fitted on the outside. Clearshield security screen with concealed tamperproof fastening shall be used for all security grilles. Where ventilation fans are required, they shall be designed to automatically operate whilst the security system is deactivated (and to cease when it is activated).

Note: Chlorine buildings that are identified as "Containment Buildings" have additional requirements – see Sections 2.14, 4 and 5.

2.10 Windows

For security reasons, external windows shall not be provided. A viewing window should be provided with suitable size and location to allow an adequate view from the **control room** into the chlorine storeroom so that a general view of the chlorine store is possible without personnel having to enter the storage room. The Operator Interface Panel shall be located such that an operator can make control operations using the OIP then with a turn of their head observe the equipment through the viewing window. If an electrical/control room is not a viable location for the window, then the chlorination room is an adequate alternative. The window shall be made of glass, such that it is not discoloured by trace amounts of chlorine (as can happen with plastic materials).

2.11 Roof

The roof shall consist of minimum 0.48 mm BMT steel sheeting with the type selected to suit the environment such as proximity to coast and any other sources of corrosive atmosphere (such as hydrogen sulphide). Below the roof sheeting install foil-faced glass-wool blanket Rooms with a ceiling shall have it coloured white. The minimum total R rating for the chlorinator room and switch room roof shall be at least 3.82.

Roof shall be a light colour (the standard colour SurfMist is preferred) to minimise heat absorption without excessive glare.

The roof shall not have gutters. Pitch of the roof should preferably grade one way to direct rainwater to whichever side of the building has no doors or otherwise the side with the least frequently accessed doors, in order to minimise inconvenience of being splashed with roof discharge during access/egress of the building.

Roof design shall be suitable for the mounting (such as retro-fitting) of a solar panel array with dimensions covering the entire roof area.

2.12 Safety showers and eyewash stations

Chlorine building installations shall be designed with fixed safety shower and eyewash stations in accordance with Water Corporation's DS79-02 Emergency Safety Showers and Eyewash Stations standard and regulatory requirements.

2.13 Footpaths

Reinforced concrete footpaths (1,500 mm wide, 100 mm thick, SL72 mesh, saw cut groove every 3 metres) shall be constructed for the entire length of the building exterior on any side that contains doors (except for Regions that require footpaths on all sides of the building). The footpath shall be at the same finished surface level as the personnel door base (i.e. this minimises the change of level between the outside and inside of the building) and be graded away from the building to shed rainwater (grade at 1:60 i.e. a fall of 25 mm over a run of 1,500 mm).

If there is no footpath on the side(s) of the building that receive(s) rainwater discharge from the roof, then provide a bed of crushed 19 mm granite aggregate or equivalent granular material (1,500 mm wide and 100 mm thick) to receive the rainwater discharge. Consideration shall be given to improving sustainability outcomes (e.g. minimising extraction of virgin materials and/or minimising haulage distances) if granular materials with similar drainage performance to 19 mm granite aggregate are available, for example:

- Crushed recycled brick & tile, at locations where Construction & Demolition waste recycling facilities are available.
- Mine waste (i.e. surplus overburden).
- Locally-sourced gravel.

2.14 Signage/Placarding

Chlorine installations shall be clearly marked (i.e. equipment, pipework and signage) in accordance with DS79-04 Chemical Safety Signage, Labelling and Markers and regulatory standards. Signage requirements include warning signs for hazardous chemicals, security, safety notices, locations of safety equipment, and safety shower/eye wash facility.

2.15 Electrical

Electrical design of chlorination buildings shall be in accordance with the "Water and Wastewater Treatment Plants – Electrical" design standard DS28.

2.15.1 Power supply

Except for critical safety equipment which is not permitted to be unplugged at any time (e.g. leak detectors or ESDs), provide GPOs or decontactors for all equipment plus provide a spare single phase double GPO in each room; this provides maintenance efficiency because it avoids the need for an electrician to attend during removal/replacement of equipment. All general purpose outlets shall be RCD protected surface mounting combination switch sockets with degree of enclosure of at least IP56.

Unless risk assessment indicates otherwise (such as site-wide backup power arrangements), provide a quick connection point to allow use of a portable generator as an emergency/contingency power supply. Location of this connection point to suit available laydown area for a portable generator.

2.15.2 Uninterruptible Power Supply (UPS)

The UPS shall be capable of providing back up power to critical components (e.g. PLC, communications, security, automatic isolation valve) in accordance with the requirements in appendix of DS42-04.

The UPS shall be configured so that it can be disconnected without interrupting the power supply to the module.

2.15.3 Chlorine leak detectors

Chlorine buildings shall have leak detection in both the chlorine store and chlorinator rooms.

Two leak sensors/cells shall be provided as a minimum for the chlorine store as the risk of a chlorine gas leak/release in this room is relatively high and sensor redundancy is an ALARP consideration. Some very large stores may require as many as four leak sensors/cells to detect leakage from header pipework in a timely manner.

One leak sensor/cell shall be provided for the chlorination room as the risk of a leak in this room is relatively lower with a chlorine **solution** leak/release being the most likely risk scenario.

Locations and other requirements of chlorine leak detectors and sensors shall comply with DS70-02 Chlorine Leak Detectors and AS2927.

Gas leak sensors shall be installed where they will not get wet; otherwise, they shall be installed under a shield that keeps them dry.

The mounting height for the leak sensors/cells shall be 300 mm above floor level (i.e. balancing the considerations of chlorine buoyancy and a practical height for maintenance).

2.15.4 Electrical equipment

Electrical equipment:

a) Shall not be installed in either the chlorine store or chlorinator rooms unless its location in these rooms is essential for the operation of the chlorination system.

   Instrumentation such as chlorine and fluoride analysers may be located in the chlorinator room. Chlorine leak detector control units should be located in the electrical/control room.

b) That is in either the chlorine store or chlorinator room shall have a rating of at least IP 54 in accordance with AS 1939.

2.15.5 Lighting

Provide internal lighting with minimum lux levels to Australian standards plus arrange light fitting location to minimise shadow of operators/maintainers on each item of equipment.

Where possible, cabling for lighting shall be run in the roof space to provide a neater internal finish.

The building shall have internal and external lighting. The emergency light fittings for each exit door of the building must have enclosures suitable for the corrosive atmosphere inside the building and with rating of IP65. The emergency lighting level shall be in accordance with AS2293. Additionally, security (flashing blue) lights (and for chlorine: chlorine leak lights) shall be positioned in such a way as to be visible from the site's entry gate.

The internal fluorescent light fittings for the building (i.e. chlorinator and switchrooms) shall be 36W fluorescent fittings (twin or single as required) and they shall have enclosures suitable for the corrosive atmosphere inside the building and with rating of IP65. The average illumination level on the floor of the building shall be in accordance with AS1680. Additional light fittings shall be located where necessary to ensure the inside of the switchboard is reasonably illuminated when open for maintenance. High bay lighting shall include provision for safe maintenance (e.g. suspended luminaires that can be lowered for maintenance).

External lighting shall not normally be illuminated when the site is unattended. This is to avoid attracting insects when site unattended. External lighting (during periods of low ambient light) shall be both activated by building internal light switch and movement sensor switched to key access areas with short strike rate (quick illumination).

Emergency light over each emergency shower shall be activated in accordance with DS79-02 (unless risk assessment indicates that the site requires the safety shower light to always be ON).

External Lighting fixtures shall have grilles or be rendered vandal resistant in an alternative manner.

2.15.6 Air-conditioning

Air conditioning shall be provided to the switchroom and for any room containing water quality analysers (an alternative is to use a smaller cooling unit for an analyser cabinet, while the room normally relies on natural ventilation). The outdoor air-conditioner unit shall be mounted on wall brackets, and be situated at a location that minimises obstruction of access along the footpath to doorways.

The air conditioning unit shall be a refrigerative model that re-starts automatically at restoration of power (such as following a power outage).

The external components of the air conditioning unit must be vandal proof.

The indoor part of a split-system air-conditioner unit shall not be mounted directly above switchboards. This is due to risk of water dripping onto the switchboards if the drain in the condensation tray gets blocked.

2.15.7 Lightning Protection and Earth Bonding

Provide a minimum (number to be determined based on building size) of two buried electrodes bolt connected to the building frame to provide a path for lightning strike on the building to go to ground. Design shall be in accordance with the Electrical Earthing and Bonding section of DS28.

The building shall be earth bonded to the (neighbouring building if present) building to ensure that a potential difference cannot occur between the two structures – this is critical due to their proximity and the ability for someone to come into contact with both structure as the same time.

2.15.8 Surge arresters

Surge arresters shall be provided for all analogue signals originating/terminating external to the building and on all digital signals which originate/terminate external to the building. Critect UTB-36 surge arresters shall be used, where required, on 4-20mA loop signals and on 24V DC digital signals.

2.16 Building security system

Provide an integrated building security system compliant to AS2201.1 and DS 62. The scope shall include:

a) An Intruder Alarm System (Tecom Challenger Series – Security Control Panel);

b) Magnetic reed switches (Sentrol 2507AH or approved equivalent);

c) Adaptive volumetric motion detectors (Takex PA-4810 or approved equivalent);

d) Fire detectors (combination thermal (rate-of-rise)/smoke detectors);

e) Internal piezo siren and External satellite strobe light;

f) HID MinProx card reader; and

g) Door locking hardware including strike protection plates; hinge bolts and secure keying systems.

3 Chlorine Containment – Design and Construction Requirements

3.1 Containment Building Size

Dispersion modelling studies undertaken for chlorine drum releases have demonstrated that chlorine buildings around 1000m^3 in volume provide significantly greater reduction in offsite risk than those of 400m^3 (which was the old minimum volume for chlorine containment buildings). A building volume of 1000m^3 shall therefore be the base case against which other chlorination options are assessed against in terms of financial and community risk, bearing in mind the Regulator's requirement for risk to be reduced as low as reasonably practicable (ALARP).

Dispersion modelling studies undertaken for chlorine cylinder releases have demonstrated that chlorine buildings around 40m3 in size provide only a small offsite risk reduction. A building volume of 100m^3 shall therefore be the base case against which other chlorination options (including mitigation options such as gas scrubbers) are assessed against in terms of financial and community risk, bearing in mind the Regulator's requirement for risk to be reduced as low as reasonably practicable (ALARP).

3.2 Truck drive-in bays

Containment buildings shall be designed to allow delivery trucks to drive in to the chlorine storeroom and unload chlorine containers with all external doors and roller doors closed. The "truck bay" area shall be at least 14m in length and the roller door shall possess a width of at least 3.6m and a height of at least 4.3m.

Truck unloading should be accomplished using a "gantry" type crane that allows non-restrictive movement during loading and unloading of chlorine containers from the truck, thereby reducing the need for drums to be moved over the top of one another.

3.3 Ventilation of chlorine stores – additional requirements

Dampers shall be provided on fan inlet and outlet ducts to minimise air passage whilst fans are not operating.

Ventilation fans shall be interlocked with the 5ppm alarm signal from a chlorine leak detector such that they lose their permission to run signal. Fans shall also be equipped with a 55 minute (of continuous

operation) onsite warning alarm and a 60-minute automatic shutdown interlock in accordance with Water Corporation standard design drawings (drawing series EO28).

Ventilation fans shall be interlocked with the 5ppm alarm signal such that they will not operate, except via use of an approved emergency over-ride system, e.g. a password protected OIP start button or key start.

3.4 Personnel and Vehicular Access Doors

Personnel doors shall be equipped with a 55-minute door open onsite warning alarm and a 60-minute offsite alarm in accordance with Water Corporation standard design drawings.

Vehicular access doors shall be of a roller type and be fitted with plastic or alloy runners to reduce the risk of corrosion. The door(s) shall have rubber seals on the bottom to minimise air movement.

4 Chlorine Containment - Photographs of features (taken at Mirrabooka GWTP)

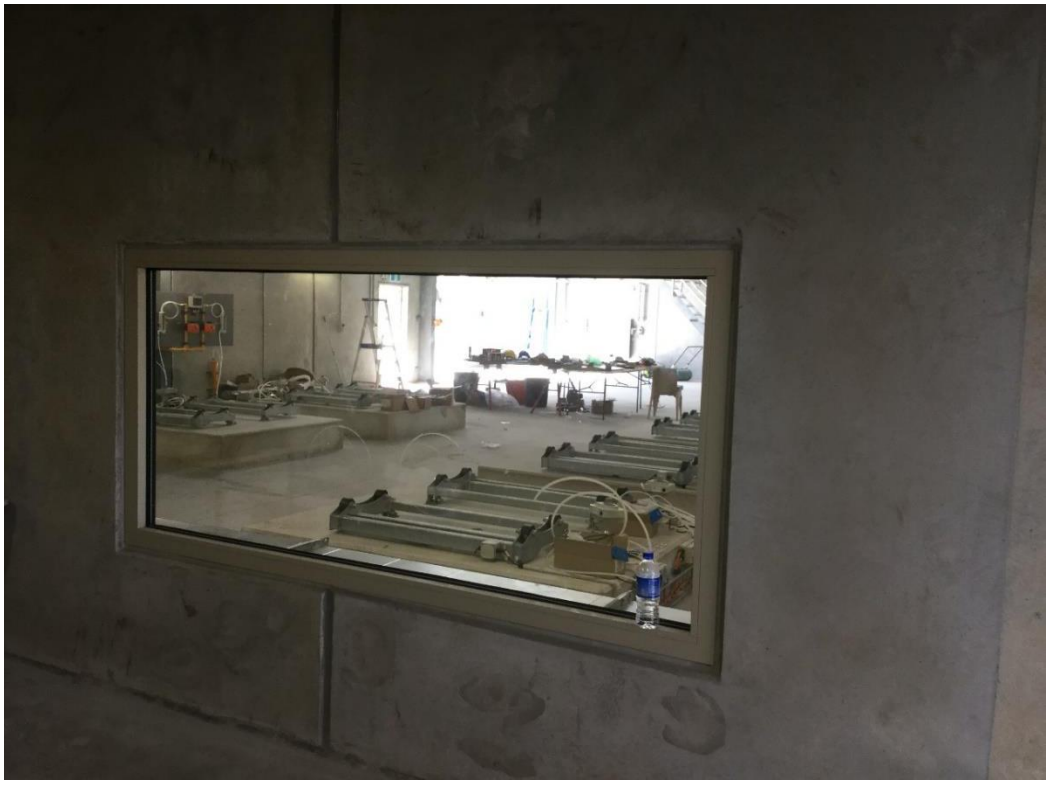

Figure 1: View of drum room from control/electrical switchroom

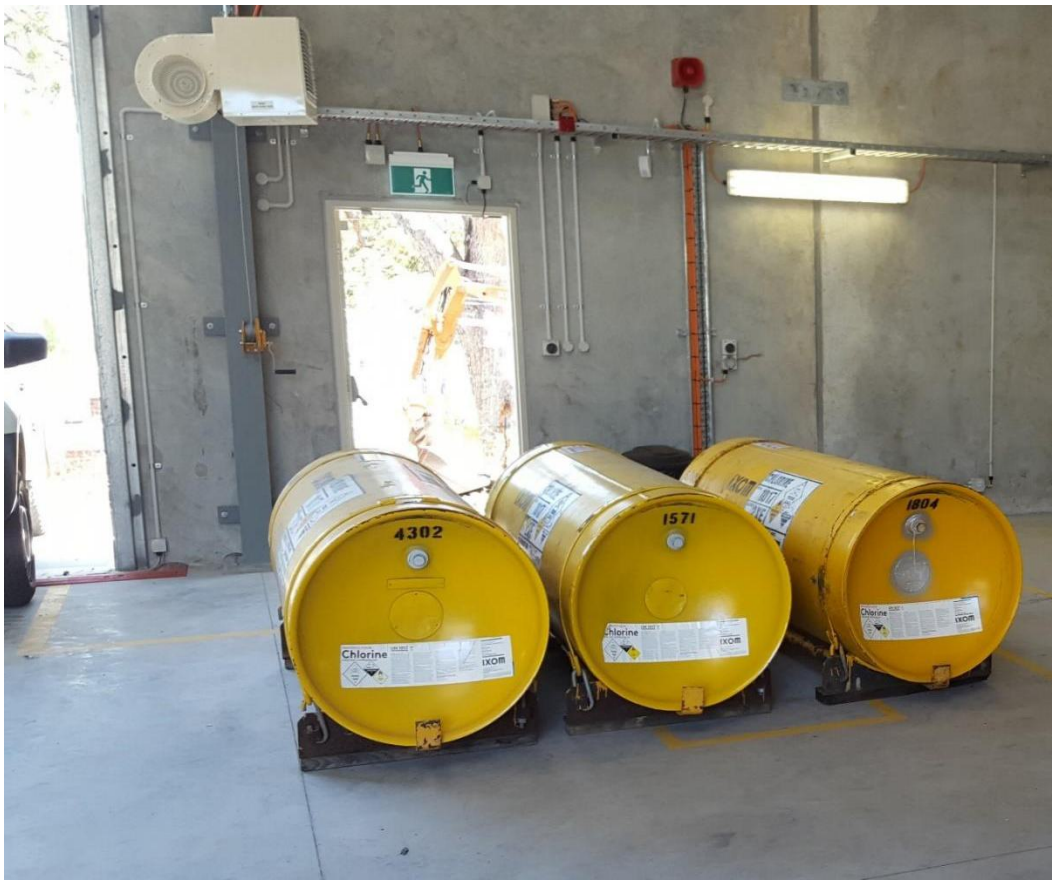

Figure 2: View of emergency exit door/doorway

Figure 3: View of chlorine drum room ventilation (extraction) system

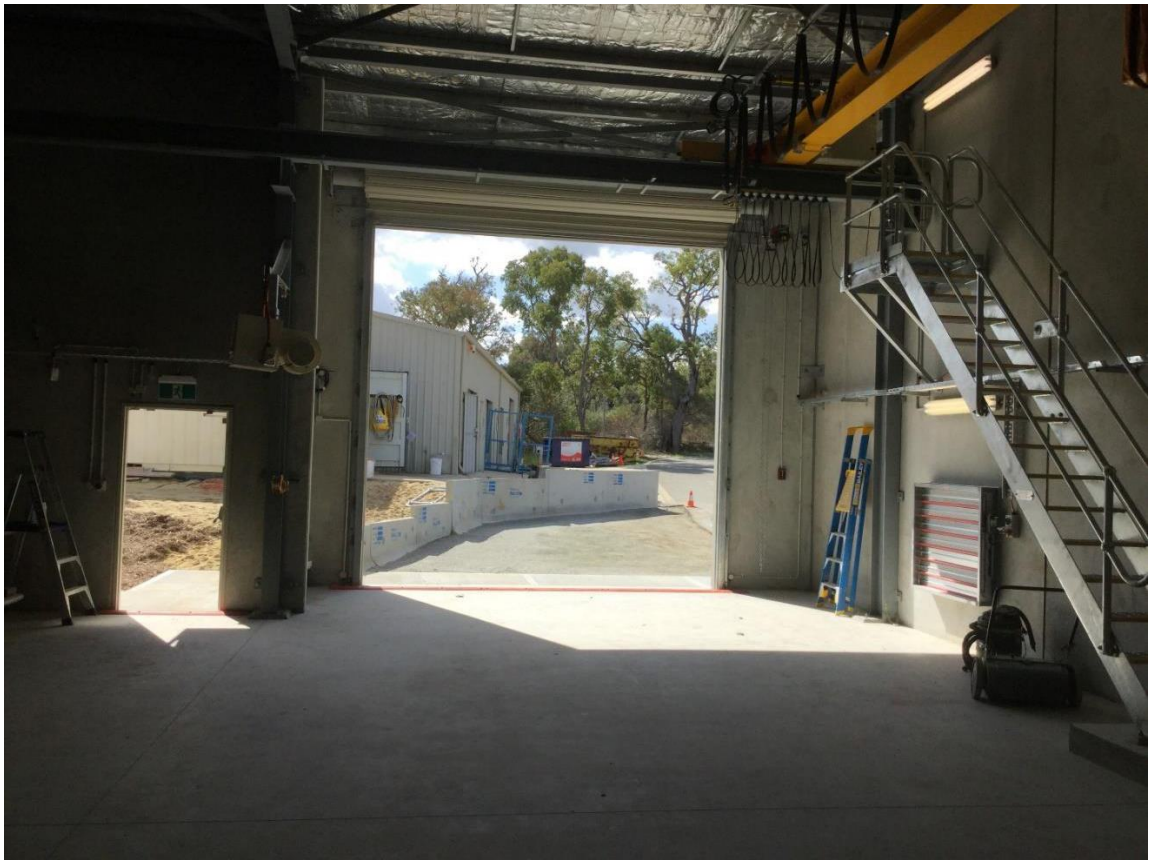

Figure 4: Truck drive-in facility roller door and gantry crane access

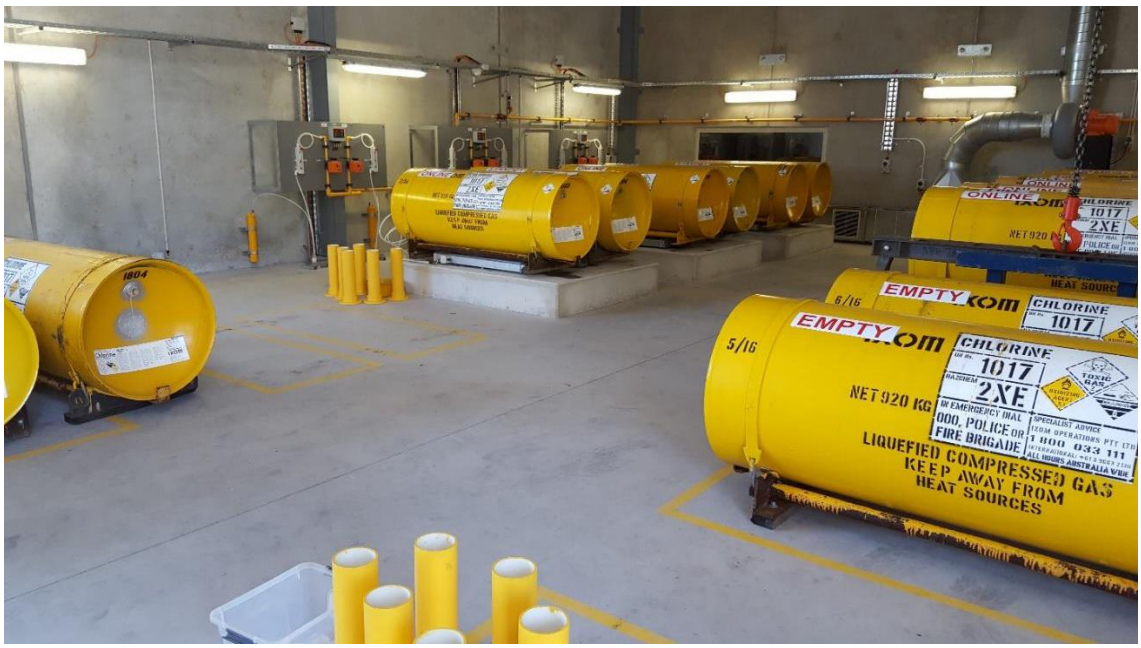

Figure 5: Full view of chlorine containment room (taken from the truck drive through bay)

5 Chlorine Containment - Building Philosophy

5.1 Chlorine Containment Building Design Requirements

5.1.1 Application

This section outlines the key conceptual design issues for chlorine containment buildings and provides a rationale to the Water Corporation's philosophy.

5.1.2 When to use Chlorine Containment Buildings

The Dangerous Goods Regulations (Storage and Handling) and OSH Regulations require organisations to reduce risk to as low as reasonably practicable (ALARP)".

Where chlorine drum facilities are to be located within 400m of Sensitive Uses or residences then consideration shall be given to the use of a chlorine containment building.

Where chlorine cylinder facilities are to be located within 100m of Sensitive Uses or residences then consideration shall be given to the use of a chlorine containment building if other forms of risk mitigation are not considered to be adequate to minimise off-site risk.

Factors to be considered include population density, type of land use, chlorine consumption rate and the amount of chlorine to be stored. The rationale for adoption/non-adoption of a chlorine containment building shall be documented (e.g. in the Concept Design Report).

Studies undertaken by consultants on the Water Corporation's behalf have demonstrated the beneficial effects of the use of chlorine containment buildings in mitigating the consequences of a chlorine release. Containment's primary advantage is that it is an inherently reliable method of mitigating the effects of a chlorine leak (no power required, no moving parts etc.) but unlike measures such as gas scrubbing, does not actually eliminate the chlorine.

The decision whether to utilise a Chlorine Containment Building or not shall be made in consultation with a Water Corporation Dangerous Goods advisor from the Engineering Business Unit, Water Treatment Advisory.

5.1.3 Ventilation

Chlorine containment buildings need to minimise natural ventilation and hence require mechanical ventilation to meet the requirements of AS2927. However, the design of the mechanical ventilation components such as intakes and outlets needs to minimise natural ventilation when the fans are not in use (e.g. through use of dampers, etc.).

A well-sealed chlorine containment building typically experiences 1 to 3 air changes per hour (ACH). Risk modelling work undertaken by consultants suggests that reduction of air changes below 1 ACH does not yield any significant benefit as the reduction in chlorine leak rate appears to be offset largely by the higher concentration of gas leaking from the building (due to the decreased air dilution). Hence, unless the building is completely sealed, 1 to 3 ACH is an effective target for natural ventilation.

5.1.4 Drive in Delivery Bays and Gantry Cranes

The use of gantry cranes and drive in delivery bays has been shown in risk modelling to make significant reduction in risk levels.

The benefit is threefold:

1) The use of gantry cranes eliminates the need to move drums over one another, thereby eliminating the drum (edge) penetrating another drum scenario.

2) The inclusion of a drive-in delivery bay results in a larger containment volume being available and this has a notable risk reduction effect on all types of chlorine facilities (from small drum vacuum systems through to large drum liquid systems).

3) The inclusion of a drive-in delivery bay results in drum drop scenarios (apart from catastrophic rupture) being modelled as contained chlorine leaks rather than as uncontained (outdoors). This has a notable effect on risk for small drum facilities that have high delivery frequencies.

Design requirements for the crane including maintenance access are defined in the Ancillary Plant – Mechanical design standard DS35. Note that fixed ladder access to the maintenance platform is required whereas normal frequency of maintenance access does not justify the expense of a stairway.

5.1.5 Extra Large Buildings, Catastrophic Rupture Proof Buildings and Scrubber Systems

Where further additional risk reduction is warranted, the use of Extra-Large Buildings (>4x min containment volume), Catastrophic Rupture Proof Buildings and/or Scrubber Systems are options to be considered. Given their expense, however, the use of an alternative disinfectant/ oxidant (such as electrolytic chlorination, sodium hypochlorite, etc.) shall be examined to determine whether elimination of the risk altogether is practicable.

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