Assets Planning and Delivery Group
Engineering

DESIGN STANDARD DS 79-05

Small Chemical Storage and Dosing Systems
Basis of Design

VERSION 1
REVISION 1

JULY 2023

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 the 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:

Overview of Western Australia's Work Health and Safety (General) Regulations 2022 (dmirs.wa.gov.au)

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

Head of Engineering

DISCLAIMER

This Standard is intended solely for application to the acquisition of water infrastructure in Operating Areas where the Water Corporation has been licensed to provide water services subject to the terms and conditions of its Operating Licence.

This Standard is provided for use only by a suitably qualified professional design engineer who shall apply the skill, knowledge and experience necessary to understand the risks involved and undertake all infrastructure design and installation specification preparation work.

Any interpretation of anything in this Standard that deviates from the requirements specified in the project design drawings and construction specifications shall be resolved by reference to and determination by the design engineer.

The Corporation accepts no liability for any loss or damage that arises from anything in this Standard including loss or damage that may arise due to the errors and omissions of any person.

REVISION STATUS

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

REVISION STATUS						
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1 INTRODUCTION

1.1 Purpose

The purpose of this document is to explain the reasoning behind the Water Corporation's design and installation requirements for its small chemical storage and dosing facilities. It provides specific information relating to the Corporation's preferences and best practices which have evolved over years of experience.

1.2 Scope

This document is primarily intended for small chemical storage and dosing facilities that are used for water and wastewater treatment or other treatment purposes. It is particularly applicable to dosing plants that have small chemical storage tanks (e.g. less than 2kL) that are filled via:

- plastic packages (20L);
- drums (200L); or
- IBCs (1,000L).

Chemical is typically delivered by flatbed truck or utility vehicles. For dosing design downstream of the dosing panel, including dosing spears, mixing of chemical and dilution/carrier water of chemical, reference should be made to design standard DS78 - Chemical Dosing.

This standard also applies to temporary and mobile installations – whilst it might not be feasible to apply all requirements to such installations, any deviations should be identified, risk assessed and recorded.

1.3 Background Information

Water Corporation currently only has chemical specific design standards for Chlorine, Fluorosilicic Acid, Sodium Hypochlorite and Lime dosing systems.

A design standard is also under development for chemical dosing systems (DS78).

Also included is this document are text boxes titled "Commissioning Plan Information", which provide non-design information relating to construction or commissioning activities. This information should be included in the Commissioning Plan.

1.4 Reference Drawings

The Piping & Instrumentation Diagrams (P&IDs) listed below are for small Sodium Hypochlorite systems, but they shall be used as a general design basis. They will need to be varied to account for the properties for the specific chemical being considered. By way of example, the automated degassing provisions in the drawings can be removed for chemicals that do not experience gassing issues.

The drawings can be found in the Corporation's Drawing Management System and have the following drawing numbers:

P&ID drawings	JD71-060-082-05 through to JD71-060-082-09

1.5 Water Corporation's Level of Service (LOS)

The required level of service shall be determined in consultation with the asset manager and operations representative to determine the need for redundancy in the design. Chemicals dosed intermittently may have lower LOS requirements.

1.6 Standards

This design standard refers (directly or indirectly) to the following standards and regulations:

Australian & International Standards:

AS 1111.1	ISO metric hexagon bolts and screws – Product grade C – Bolts
AS 1112.3	ISO metric hexagon nuts – Product grade C
AS 1170	Structural design actions – General principles
AS 1214	Hot–dip galvanized coatings on threaded fasteners (ISO metric coarse thread series)
AS/NZS 1170.1	Structural design actions – Permanent, imposed and other actions
AS 1158.3.1	Lighting for roads and public spaces – Pedestrian area (Category P) lighting – Performance and design requirements
AS 1318	SAA Industrial safety colour code
AS 1319	Safety signs for the occupational environment
AS 1345	Identification of the contents of pipes, conduits and ducts
AS 1657	Fixed platforms, walkways, stairways and ladders – Design, construction and installation
AS 1680.2.4	Interior Lighting – Industrial tasks and processes
AS 1688.2	The use of ventilation and air-conditioning in buildings – Part 2: Ventilation design for indoor air contaminant control
AS 2032	Installation of PVC pipe systems
AS 2293.1	Emergency escape lighting and exit signs for buildings – System design, installation and operation
AS 2634	Chemical plant equipment made from glass fibre reinforced plastics (GRP) based on thermosetting resins
AS 3500	National plumbing and drainage code (provision of backflow prevention devices)
AS 3780	The storage & handling of corrosive substances
AS 3879	Solvent cements and priming fluids for PVC (PVC-U and PVC-M) and ABS pipes and fittings
AS 3953	Construction of buildings in bushfire-prone areas
AS 4041	Pressure piping
AS/NZS 4087	Metallic flanges for waterworks purposes
AS/NZS 4680	Hot-dip galvanized (zinc) coatings on fabricated ferrous articles
AS/NZS4766	Polyethylene storage tanks for water and chemicals
AS 4775	Emergency eyewash & shower equipment
ASME RTP-1	Reinforced Thermoset Plastic Corrosion-Resistant Equipment
BS EN 13121-3	GRP Tanks and Vessels for use above ground. Design and workmanship.
BS 4994	Design & Construction of Vessels & Tanks in Reinforced Plastics

DVS 2205	Design Calculations for Containers & Apparatus Made of Thermoplastics
DVS 2207	Welding of Thermoplastics

Water Corporation Standards:

DS 20	Electrical Design Process
DS 22	Ancillary Plant & Small Pump Stations – Electrical
DS 24	Electrical Drafting
DS 26	Type Specifications - Electrical
DS 27	Regulating Valve Control
DS 28	Water and Wastewater Treatment Plants - Electrical
DS 30	Mechanical General Design Criteria & Glossary
DS 31-01	Pipework
DS 31-02	Valves & Appurtenances
DS 32	Pump stations
DS 33	Water Treatment Mechanical Design Standards
DS 35	Ancillary Plant Mechanical Design Standards
DS 40	SCADA Standards
DS 40-06	Software Change Control
DS 40-08	Standard for the Control of Chemical Dosing
DS 40-09	Field Instrumentation
DS 62-01	Site Security, Public Safety and Emergency Treatments
DS 78	Chemical Dosing Standard
DS 79-01	Design of Chemical Systems - Legislative Requirements and General Principles
DS 79-02	Emergency Safety Showers and Eyewash Stations Standard
DS 79-03	Chemical Barrier Protection
DS79-04	Chemical Signage Labelling and Markers
DS 80	WCX CAD Standard
DS 81	Process Engineering
DS 95	Standard for the Selection, Preparation, Application, Inspection and Testing of Protective Coatings on Water Corporation Assets
DS 100	Suspended Flooring (Grid Mesh and Chequer Plate)
SPS 497	HDPE Chemical Storage Tanks
SPS 498	GRP Chemical Storage Tanks
WS-2	Welding & Joining Specification – Thermoplastics

Strategic Products Register

Acts and Regulations:

Dangerous Goods Safety Act 2004 (Western Australia)

Dangerous Goods Safety (Storage and Handling of Non-explosives) Regulations 2007 (Western Australia).

1.7 References

Criteria for Drinking Water Supply, Release 3 (Nexus # 58615523)

Australian Drinking Water Guidelines, National Water Quality Management Strategy, National Health & Medical Research Council

KWS Investigation Report – Hypo Dosing Faults, Service Reservoir Chlorination and Independent Artesian GWTP, July 2005 to January 2006, P. Hanley, 7 March 2006 (with installation standard drawing and notes Rev 8, 25 August 2008)

1.8 Terminology & Abbreviations

ADWG	Australian Drinking Water Guidelines
Corporation	Water Corporation
DG Regs	Dangerous Goods Safety (Storage and Handling of Non-explosives) Regulations 2007 (Western Australia)
EPDM	Ethylene Propylene Diene Monomer (a synthetic elastomer)
FRP	Fibre Reinforced Plastic
GRP	Glass-fibre Reinforced Plastic
HDPE	High Density Polyethylene
HMI	Human Machine Interface
OIP	Operator Interface Panel
PE	Polyethylene
UPVC	Unplasticised Polyvinyl Chloride

1.9 Units

Dose Rate	mg/L
Chemical Flow Rate	L/hr
Water Main Flow Rate	kL/hr

2 CHEMICAL BUILDING

2.1 General

The storage and dosing system shall be constructed within a building such as a Prefabricated Treatment Module (see modular specification PTM - 45650529 for requirements). The function of the building is:

a) To shield the stored chemical from heat and UV light, thus minimising its degradation rate;

b) To protect the equipment inside from UV degradation and excessive temperature;

c) To exclude rainfall and debris such as fallen leaves from the bund;

d) To provide an additional level of separation of the chemical from staff and visitors to site; and

e) To safeguard the assets in line with the Corporation's security principles[1].

2.2 Layout and Design

The internal layout shall be as uncluttered as possible with all piping located around the periphery of the room to give a tidy arrangement with good access to all components for operation and maintenance. The internal walls of the room shall be designed to minimise the number of protrusions and thereby provide as much flush wall space as possible to facilitate wall-mounted equipment, instruments, minor switchboards, control panels and simplify pipe and cable routing. The piping shall also be appropriately located to allow easy access to equipment and valves, and facilitate unobstructed cleaning of the work areas. It is preferred to design layout to avoid ramps; however, where this is not practical then include ramps at changes in floor level for easy moving of equipment in and out of the building. Where ramps are used, they must have gentle grade to minimise manual strain risk during moving of equipment.

The design and layout of the facility shall include consideration of section 7.2.1 of AS 3780. This shall include sufficient space between bund walls, storage areas and other structures to allow access for maintenance and during emergencies. Specifically, for maintenance access, an unobstructed clearance of not less than 1.0 m shall be provided in front of the dosing pump/panel and other equipment, with a minimum 2.1 m head clearance.

The building, inclusive of doors, windows and ventilation openings shall be designed to withstand bushfires in accordance with AS 3959.

The building shall also be designed to exclude wildlife, insects, and vermin. Measures shall include door seals, tropical midge mesh on ventilation openings, and brushware around the edges of roller shutters to impede the ingress of vermin.

The building shall be designed so that the storage tank(s) can be removed and replaced through a doorway (e.g. roller door for large tanks). For facilities with two or more storage tanks, the design shall allow for replacement of any tank while the others remain in operation.

2.3 Materials of Construction

Various materials of construction may be appropriate for the chemical room e.g. metal clad, concrete, or masonry walls. Choice of building materials will need to consider the corrosive properties of the chemical (including fumes), as well as architectural and security requirements at the site. Consideration should be given to materials of wall panels, roof and doors including their insulation features and seals to minimise transfer of outdoor heat into the storage and dosing room.

2.4 Lighting

Internal lighting and external entry lighting shall be provided, all with easy and safe access for lamp maintenance. These lighting levels and other characteristics shall be designed to conform to the

[1] DS62 Site Security, Public Safety and Emergency Treatments.

requirements of DS 28. The building shall be equipped with internal emergency lighting with battery backup.

2.5 Ventilation

Ventilation shall be accomplished in accordance with the Water Corporation's mechanical standards (refer DS30-02) which references AS 1668.2 or greater if required to address risks such as accumulation of flammable atmospheres or asphyxiation hazard. Natural ventilation is preferred over mechanical ventilation as it does not require redundancy considerations, nor does it incur running costs. Some chemical fumes, however, are considered as Type A effluents[2], as defined in AS 1668.2. If no leaks are present in the system and any spills are cleaned up thoroughly, then natural ventilation complying with AS 1668.2 will be sufficient to manage chemical fumes and corrosion within the chemical storage room. However, switchable mechanical exhaust[3] shall be provided (for facilities with Type A effluents) and used when personnel are in attendance.

The ventilation system design shall comply with the requirements of AS 1668.2 and should incorporate the following key features:

a) The minimum total area of natural ventilation openings shall be 5% of the floor area.

b) Openings for natural ventilation should be positioned on opposite sides of the room to maximise cross-draught.

c) Openings for natural ventilation should be provided at high and low levels to maximise the benefits of thermal effects.

d) The mechanical exhaust system shall be designed to achieve 20 L/sec per m^2 of floor area.

e) The exhaust fans shall be located near the floor and air shall be discharged vertically at a high level above the building with a discharge velocity not less than 5m/s to prevent further contamination of the storage areas.

The mechanical exhaust system shall be activated by a switch located in the entry vestibule/electrical room. Consideration should be given for the exhaust fans to be controlled by a temperature switch located inside the building so that the fans would automatically operate to cool down the chemical storage tank area when a temperature set-point is reached.

At sites where ambient temperature and/or solar irradiance is normally high, the use of air-conditioning shall be considered for the amenity of operations and maintenance personnel. This is especially relevant where the chemical SDS requires the wearing of a full chemical suit. Air conditioning shall be provided at those sites where temperature related chemical degradation is a concern. However, this will have to be considered with whole-of-life cost analysis on a project-by-project basis. Ventilation requirements would then be determined (and deviate from above) based on the temperature management strategy. To minimise whole-of-life costs, air conditioning must be thermostat controlled.

2.6 PPE and First Aid Storage

The facility shall include generous room to store the PPE and first aid equipment that is required for use in the chemical store and/or dosing room. This space may be provided in a room such as a control or switch room, but it shall be near the chemical store and/or dosing room to facilitate ready access to PPE by personnel. An exception to this requirement may be granted for systems located in operating regions where operators carry chemical PPE and first aid kits in their vehicles.

[2] Type A effluents are toxic, irritant, asphyxiant, offensive, flammable or explosive gases, dusts, fumes or vapours
[3] AS 1668.2-2002 Cl 5.3.1 defines a Type A effluent & Figure 5.1 provides general guide for the application of exhaust systems.

2.7 Personnel Doors

Personnel doors shall be designed to meet the required fire rating. Where air conditioning is installed then the doors shall be fitted with crash-bars for use as emergency exits. They shall open outwards and the travel path of the doors shall not be restricted by external features on the building or any other structure. External doors shall be metal-faced to provide weather resistance and also insulated to prevent heat transmission into the storage/dosing room. They shall have pull handles and retaining hooks for holding in the open position. A hydraulic-operated door anti-slam closer/dampener shall be provided for each door leaf. Appropriate signs shall be fitted on the doors.

The location of access doors to the room shall be selected to maintain the required separation and segregation distances outlined in the Western Australian Dangerous Goods Safety Act 2004 and its associated regulations and codes of practice. Consideration should be given to the potential inclusion of exit only doors where personnel undertaking activities may not be able to access the usual route of entry/exit. If the floor area is greater than 25m^2 then two means of access/egress are required[4].

2.8 Door to Storage/Dosing Room

Door access shall be provided to allow chemical deliveries to the storage/dosing room. The doorway width shall be sufficient to also allow movement of equipment (i.e. including tank replacement) into and out of the storage/dosing room.

Where used, roller shutters (rather than single curtain sheet roller doors) shall have thermal insulation in the interlocking slats. The operation of these doors shall use heavy duty motors and they shall be equipped with manual override. These doors shall be industrial strength with galvanised or 316 stainless steel fixtures and guides.

2.9 Platforms and Stairways

Platforms and stairways shall comply with DS30-02, DS100, AS 1170, and AS 1657 and be constructed from FRP when present in the storage/dosing room.

Any cut-outs provided to allow operation of valves below the platform shall not create a tripping hazard or obstruct access/egress ways. Where cut outs are required in the FRP grating, for access to equipment such as valve spindles or for intersection of pipework, proper strengthening and support of the modified grating shall be carried out by qualified designers and installers to ensure its integrity is not undermined. Any open holes in the grating as the result of the cut out shall be covered with a removable cut-to-shape FRP grating panel securely supported and clipped. All modification work to the grating shall comply with the OSH requirements for safe access of Grid Mesh Landings. Equipment and valve spindle end shall not protrude out of the FRP grating where it could cause a tripping hazard.

Various grades of FRP grating are available, so it is important to ensure that the FRP grating selected and supplied for the chemical storage room is chemical resistant and suitable for the chemical(s) being stored. As each manufacturer has its own means of designating grating types and grades (e.g. colour identification), suitability of a proposed FRP grating will need to be confirmed with the respective FRP manufacturer.

2.10 Accessibility

A minimum clearance of 1m shall be provided around all sides of equipment that require maintenance access, with consideration given to a greater clearance where maintenance activities require it. All valves, pumps, ancillary equipment, and instruments shall be accessible without having to enter the bund, and they shall be located above bund wall height unless designed for immersion. This requirement has an additional benefit of allowing the bund integrity to be tested through filling of the bund to wall height.

[4] General requirements for storage areas in AS 3780.

3 CHEMICAL STORAGE BUNDING

Although some Dangerous Goods may qualify as minor storages according to AS 3780 (depending on their packaging group and quantity), Water Corporation requires all small chemical systems to have bunds designed and constructed in accordance with the bunding requirements of AS 3780, including the associated dosing equipment. There shall be no penetrations through the bund wall, other than the drain pipework for the bund. The bund shall be separated from protected places in accordance with the DG Regs and AS 3780. To prevent the introduction of incompatible dangerous goods, no other goods shall be kept within the bund.

3.1 Bund Capacity and Design

The minimum bund volume must be 110% of the largest tank in the bund.

The bund volume is the net available containment capacity and shall not include the volume occupied by foundations and other items within the bund. Bund drainage to site drainage and tan theta / crest locus limits apply to tank bunds. Tanks may be located close to the building walls provided that:

- there are no maintainable items located between the tank and wall; and
- the wall is protected with chemical resistant panels to direct any leakage down into the bund.

3.2 Bund Construction Materials

Bunds shall be constructed from compatible plastic materials (e.g. polyethylene, PVC, etc.).

Commissioning Plan Information
A 24-hour hydrostatic leak test shall be conducted on a bund prior to the filling of its associated storage tank(s) with chemical.

3.3 Bund Valve

The bund outlet shall be designed to achieve complete drainage of the bund sump; hence, the preferred outlet location is through the base of the bund sump. A bund outlet pipe shall lead to site drainage outside the chemical building. The manually operated lockable bund drain valve shall be left locked in the closed position until drainage is required.

3.4 Bund Leak Alarm

A bund leak alarm is not necessary for small systems in circumstances where the consequences of a leak are minor (e.g. if no environmentally sensitive waterway is put at risk and the leaked chemical does not cause corrosive or hazardous fumes in the room), and where the tank low level alarm would alert an operator to the potential loss of chemical inventory / dosing.

Where a bund leak alarm is considered necessary, or where the possibility of a significant water leak exists (i.e. service water pipe failure), a conductivity sensor (toroidal-type) installed at the lowest practical level in the bund is appropriate. In such cases the alarms shall be linked to the plant control system and SCADA. A high conductivity alarm shall be configured to indicate water in the sump (since conductivity of water is high relative to air), and a high high conductivity alarm to indicate chemical is in the sump.

Suggested high conductivity alarm setting = 0.2 ms/cm (suitable for approx. 150 mg/L TDS water)

Suggested high-high conductivity alarm setting = dependent on chemical conductivity.

Note: For some chemicals, whose conductivity is similar to or less than water, pH measurement may be a better instrument alternative.

3.5 Spare Container Bunding

Bunding for packages must allow for 100% of the largest container or 25% of the total storage quantity (whichever is higher). Empty containers do not require bunding.

Bund leak alarms for any spare container bunds are not necessary.

4 STORAGE SYSTEM

4.1 Tanks

4.1.1 Tank Sizing

A single storage tank shall be provided for small chemical storage and dosing facilities. The tank will generally be a prefabricated, off-the-shelf product with appropriate chemical certification, hence a replacement tank would be readily available should any issue with the tank be detected. Consideration may be given to having a spare storage tank as a dry spare depending on the criticality and remoteness of the site. Factors to consider when sizing the storage tank include:

- the required storage inventory;
- the delivery size; and
- the shelf life of the chemical.

For chemicals that degrade, operational storage should not exceed 14 days at peak flow to avoid excessive degradation, and the operational storage should be optimally designed to ensure the frequency and quantity of deliveries are manageable, particularly in remote areas. Design of the chemical storage should consider the delivery logistics at the particular location taking into consideration any nearby facilities on the same delivery route as the chemical may possibly be delivered in “milk runs” for small sites. Storage requirements should be reviewed for regional areas to align with the site conditions.

The tank shall have a “reserve volume” between the re-fill level (Low alarm level) and the Low Low alarm level. The “reserve volume” shall be sized to provide adequate time for chemical delivery to be arranged and completed.

4.1.2 Tank Materials

The storage tank shall be constructed of a material that is resistant to the chemical. Where rotationally moulded PE tanks are used there shall be no welded modifications or additions to the tank below the overflow level.

Fabricated (plastic welded) PVC tanks are not considered suitable for various reasons including that they are prone to brittle failure of welds.

The specific design and construction requirements associated with each material are listed below.

Glass-Fibre Reinforced Polyester (GRP)

a) GRP tanks shall be designed and constructed to SPS 498.

b) GRP tanks shall have a design life of at least 20 years.

c) GRP tanks provide the following advantages:

- GRP tanks are stiffer than HDPE tanks, so they have a decreased thickness for the same application which makes them lighter;
- Their maximum life is not adversely affected by high temperature;
- Their design life tends to be longer than HDPE tanks for chemical storage applications; and
- They are not as prone to leaking at the nozzle welds as HDPE.

High Density Polyethylene (fabricated from welded HDPE sheet and HDPE fittings)

a) HDPE tanks shall be designed and constructed to DVS 2205, DVS 2207 and SPS 497.

b) HDPE tanks shall have a design service life of at least 15 years

c) Some of the benefits HDPE tanks are thought to offer are:

- Better impact damage resistance than GRP;
- Higher scratch resistance than GRP;
- Homogeneous material so no chemical attack points when scratched; and
- Easier to repair (though for small tanks they are more likely to be replaced).

4.1.3 Tank Design

Each tank shall include as a minimum the following nozzles and fittings:

a) One (1) flanged tank fill point inlet nozzle on the top of the tank.

b) One (1) flanged process outlet nozzle on the side of the tank located in a low position.

c) One (1) flanged tank overflow nozzle.

d) One (1) flanged tank vent nozzle at the highest point of the tank.

e) One (1) flanged scour outlet nozzle on the bottom of the tank; and

f) Sufficient lifting lugs as necessary.

Note: An additional nozzle may be required if an ultrasonic level sensor is to be used for level measurement – refer to section 4.3.1.

Nozzles shall have a minimum diameter of DN50 (smaller sizes are impractical to weld). All connections shall be flanged (threaded connections are impractical because they are difficult to seal for complete prevention of chemical weeping, and if a thread gets stripped then it may be necessary to replace the tank). Threaded connections with elastomeric seals are acceptable for very small systems (< 250L).

Each tank shall be designed for the following criteria:

a) Operating & design temperature: range as appropriate to the site.

b) Operating & design pressure: atmospheric and hydrostatic.

Adequate fixings at the base of each tank shall be provided for stability. The designer should provide drawings to the tank supplier which clearly shows the desired location and size of all connections and fittings on the tank.

Commissioning Plan Information
Prior to delivery to site, all tanks shall be hydrostatically tested using clean water filled to the overflow level. The full static head is to be held for a minimum of 12 hours. Once installed, the tanks shall be hydrostatically tested to the full static head again to check for any damage which may have occurred during transportation or installation[5]. All tanks shall be transported with capped/covered nozzles to prevent dust and vermin entering.

[5] Water used for testing tanks at site can then be discharged through the scour valve to test the bund as well.

Testing, transportation, quality assurance, and other design and manufacturing requirements for GRE tanks are specified in SPS 498. For HDPE tanks this is covered in SPS 497.

4.2 Tank Plinth

A plinth or tank stand shall be provided for the storage tank so that its base is higher than the dosing pumps, placing the pumps as low as practical (relative to the tank outlet) reduces suction to the pumps which mitigates unwanted gassing and air-locking. Pumps shall be located either outside the bund, or in the bund above the 110% fill level.

4.3 Tank Instrumentation

4.3.1 Tank Level Transmitter

Level measurement using a pressure transmitter has the advantage of avoiding working at heights. This may not be a significant consideration for small volume tanks if they have low height where an ultrasonic level transmitter is preferred. Ultrasonic level transmitters have the advantages of direct measurement of fluid level (i.e. not reliant on calibration with the specific gravity of the solution) and not being in contact with the corrosive chemical but consideration needs to be given to the minimum range (deadband) that the ultrasonic sensor can detect and the beam angle versus the nozzle size. An alternative is a radar level transmitter which, while similar to ultrasonic level transmitters, provides the advantage that measurement beam can penetrate the tank roof and therefore avoid corrosion of the sensor from fumes in the storage tank.

An externally mounted level transmitter shall be provided to measure liquid level in the storage tank. The signal from the level transmitter shall be used to calculate the amount of chemical in the tank and to generate level alarms. This quantity shall be displayed on the OIP and HMI. The preferred display quantity unit is litres.

The level alarms and their set points are discussed further in section 10.2.

4.3.1.1 Pressure Transmitters for Level Measurement

For larger tanks, where access to a top mounted level instrument is difficult, a pressure transmitter with impulse line and diaphragm seal shall be used. The impulse line connecting the tank to the pressure transmitter shall be from the scour outlet and the diaphragm seal wetted material shall be compatible with the chemical. Impulse lines shall be glycol filled. An isolation valve shall be provided at the connection point to the scour line. The pressure transmitter shall be mounted on a sturdy bracket at a convenient location.

When pressure transmitters are used to derive a level in the tank it is important that the specific gravity of the chemical is known when setting up and calibrating the pressure transmitters and level indicator.

4.4 Storage System Pipework

4.4.1 Fill Line

Fill lines shall be DN15 minimum and sized to suit the required load-in flow rate. The fill line into the tank should be located diametrically opposite the outlet pipe to minimise the possibility of any air entrainment during filling from interfering with the operation of the dosing pump. The fill line shall enter the tank above the overflow level.

Apart from a small section of fill pipework drawing from the delivery container, the filling line shall be sloped 1 to 50 minimum to drain to the tank.

Fill pipework shall have a transfer (load-in) connection point:

a) Preferably located above the tank lid level to allow the entire fill line to slope towards the tank.

b) Have a polypropylene male NATO camlock coupling with matching dust cover. The camlock coupling must be pre-approved and of reputable make.

c) It should, if feasible, have a safety shower and eye wash located between 2 and 7m from the transfer point and on the same level (no stairs or other obstacles along route) to mitigate any safety risks associated with hose disconnection (these should be gravity discharges at worst).

d) The transfer connection point shall be located inside the building so it is over the bund.

Commissioning Plan Information
Prior to the first delivery of chemical, the filling line shall be hydrostatically pressure tested in accordance with AS 4041 to 1.5 times the operating pressure of the tanker pump and held for a minimum of 30 minutes. Written proof of this test will be requested by the chemical Supplier and shall be made available to them. Note: The tank shall not be subject to the test pressure as it is typically only rated for static head up to the overflow level.

4.4.2 Vent Line

Each tank shall have a DN25 minimum vent line (sized at 1.5 times the fill line diameter) to allow venting of fumes during tank filling and vacuum relief during tank emptying. The vent line shall be sized to ensure adequate air flow out of the tank during a filling operation (including air purging) and adequate air flow into the tank whilst the dosing pump is operating or the tank is being drained, without exceeding the maximum allowable operating stresses of the tank.

The vent line shall discharge outside the building at about 500 mm above the site finished surface level, which is high enough to observe any potential dripping, but low enough that it is unlikely that any drips will fall on personnel or fumes inhaled. However, if vents are used to discharge gas such as hydrogen that is lighter than air, then the vent discharge point will need to be higher than the storage tank in order to provide a continuously rising vent discharge pipe. The vent discharge point shall be weather-proofed and shall be fitted with a "tropical midge wire" insect screen. The vent outlet shall be located such that it is possible to gain access to it for maintenance purposes.

The vent line shall be securely supported to prevent excessive stress on the tank roof. The vent pipework shall be configured so that condensation of vapours is directed back into the tank. It is important to always ensure that the vent line is not blocked at any time.

4.4.3 Scour Line

There shall be a DN25 minimum scour outlet line from the bottom of the tank to the bund. A DN25 minimum (and sized appropriate to the diameter of the scour outlet line) manual isolation valve shall be installed as close to the nozzle flange as possible.

4.4.4 Process Line

The suction pipework (process outlet) from the tank to the dosing pumps shall be DN25 minimum, although it can subsequently be reduced after the first (tank) isolation valve.

To minimise retention time in the piping, the line to the dosing pump shall be kept as short as possible. The piping from the storage tank shall be graded downward to allow gases in the solution to be released back into the tank. At the dosing panel, the piping shall be graded up towards the calibration tube which acts as a vent tube to separate and purge any gas bubbles prior to the dosing pump suction.

4.4.5 Overflow Line

Each tank shall have a DN25 minimum overflow pipe. For chemicals that cause fumes the overflow pipe shall terminate in a seal pot that is manually filled with a sealing liquid that is appropriate for the chemical being stored. No valves or equipment which could potentially cause blockages shall be installed in the overflow lines. Care shall be taken on the overflow line design to ensure that no liquid can be drawn back into the tank under any conditions.

4.4.6 Return Line

For chemicals inclined to generate fumes identified as a risk in the product SDS, provide a return line from the dosing panels back to the tank (can be connected into the tank vent line at a location where that line drains back to the tank). This line acts as:

1) a gas escape route for the calibration tube
2) Any downstream gas return lines

5 CHEMICAL TRANSFER

The transfer pump shall be sized to unload the delivery container in less than 10 minutes (i.e. >100 L/minute for a 1000L IBC). If the transfer is from a 20 litre package, then the target pumping time should be approximately 2 minutes (i.e. ~10 L/minute). These timeframes are based on the need for the Operator to remain in attendance during unloading. Any longer duration would be an unreasonable use of the Operator's time.

IBCs

The preferred arrangement is to use a permanently installed peristaltic pump that is mounted lower than the IBC; locating the peristaltic pump lower than the IBC enables the entire IBC to be emptied. A hose with camlock fittings shall be used to connect the pump suction inlet to the low-level outlet of the IBC. Although it is hard to completely prevent minor leakage of chemical such as drips from camlock fittings, this is considered acceptable for suction piping especially as it is only in place for a short period of time. The discharge pipework from a fixed unloading pump shall be hard-piped to the chemical tank in order to minimise potential for leakage – see section 4.4.1.

Deliveries of up to 3,000 Litres in IBCs can be made without the vehicle or driver requiring a Dangerous Goods licence, provided there is no filling or emptying (including partial emptying) of the IBC(s) while on the vehicle. Unloading while on the vehicle is not preferred, due to several other requirements including spill capture under the vehicle and a safety shower and eyewash within close proximity. Please consult with the Senior Principal Engineer – Water Treatment for further information on this option, if it is proposed.

20L Packages

20L plastic packages may be used for transfer to smaller systems where the storage tank is less than 250L. To avoid OSH issues associated with decanting, a peristaltic pump and suction lance, or handheld electric chemical drum pump (e.g. Lutz) shall be provided for transfer from packages to the tank – see section 4.4.1.

200L Drums

200L plastic drums may be used for transfer to storage tanks between 250L and 1000L. The design shall consider the unloading, movement, and loading of drums.

It is recommended that a peristaltic pump and suction lance be used for transfer from the drum to the storage tank. If it is acceptable to the Region, an alternative is to provide a handheld drum pump (chemical resistant/non-metallic; electric) for transfer from the drum to the storage tank. Transfer to the tank shall be via a camlock coupling – see section 4.4.1.

If it is not possible to house the drum inside the dosing room, it can be placed outside the dosing room for transfer operations. Chemical transfer from drums while mounted on either a trailer or vehicle tray is prohibited (since using lances requires access onto the vehicle) due to Water Corporation working at height issues.

6 DOSING SYSTEM

6.1 General Considerations

The specific properties of the chemical shall be considered when designing the dosing system. DS78 Chemical Dosing standard provides guidance on factors to consider.

6.2 Materials of Construction

All materials of construction used in any part of the process system that comes in contact with chemical shall be compatible. Chemical compatibility shall consider both corrosion resistance and chemical decomposition e.g. several metals provide excellent corrosion resistance with certain chemicals but can also cause accelerated catalytic decomposition of those same chemicals.

6.3 Dosing Pumps and Dosing Panels

Separate duty and standby dosing pumps and dosing panels shall be provided (unless the Principal has specifically advised that a standby dosing pump is not required). Each pump and dosing panel with its associated equipment shall be capable of operating independently and automatically[6].

The pumps and dosing panels shall be enclosed within a barrier protection cabinet in compliance with DS 79-03. Enclosure of the pumps and dosing panels with a transparent front cover (e.g. PVC cabinet) enables the panel to be viewed during operation, at the same time protecting personnel from any chemical spray or leak. The drip tray in each dosing cabinet shall have a drain pipe into the bund sump.

Minimising complexity in small dosing systems assists with achieving reliable dosing performance at very low flows. Consequently, for small systems it is preferred to use a digital dosing pump which has:

- Integrated Flow Measurement instead of a miniature magnetic flow meter;
- an automatic deaeration feature instead of a de-gassing valve (if gassing may be an issue); and
- a controlled discharge stroke duration instead of a pulsation dampener.

6.3.1 Calibration Tubes and Pump Suction Piping

The calibration tube/gas purge column on the dosing panel serves two functions. As a calibration tube, it is used for fault finding and for calibrating the performance of new or refurbished dosing pumps during commissioning and after maintenance. The calibration tube shall have sufficient capacity to allow a single calibrating run of at least two minutes (but not more than 15 minutes) with the dosing pump at full design flow rate.

The tube also serves as a bubble-trap or gas purge column where air or gas from a chemical can be vented out just prior to entering the dosing pump head to prevent vapour lock. The suction piping before the pump should be configured in a specific manner to allow for this disengagement of any gas bubbles to occur. As it enters the dosing panel, the pipe conveying the chemical shall slope up towards the calibration tube to rise and expel into the vertical column before continuing to the pump. The short section of the pipe from the calibration tube leading to the pump suction connection should also slope back to the column for the same reason. It is important to keep this section of the pipe as short as possible[7]. Suitable flexible tubing may be used for this section of piping from the calibration tube to the pump. The vent line from the top of the column is directed back to the storage tank through the tank roof vent pipework.

The calibration tube/purge column should cover the full height of the storage tank to provide full usage reading. The calibration tube shall be constructed out of PVC or an alternative material suitable for the chemical that will have a long service life.

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[6] Provision of a single dosing panel that contains both duty and standby dosing pumps may only be approved if the system is non-critical because it can be readily shut down for maintenance – e.g. it is an intermittent operation or maintenance downtime is acceptable because of sufficiently large drinking water storage or other similar reasons.

[7] It has been recommended to be no more than 300mm in length in the KWS Investigation Report by P. Hanley (with installation standard drawing and notes Rev 8)

The isolation valve below the calibration tube shall always remain open except during flushing to allow gas to escape even when the system is shut down. It will need to be closed during flushing to prevent water getting into the calibration tube and into the chemical storage tanks.

6.3.2 Dosing Pumps

There shall be a dosing pump for each dosing panel. Digital dosing pumps shall preferentially be used in the Corporation's small chemical facilities. They can be configured to have a long duration discharge stroke (and quick suction stroke) with the result that pump output is sufficiently steady to avoid the requirement for pulsation dampeners. Each pump shall comply with the requirements of the Water Corporation's Mechanical standard DS32 (refer section on Chemical Dose Pumps). Pumps operating at less than 20 L/h flowrate shall have an integral de-gassing capability if the chemical is susceptible to gassing.

Materials of construction for wetted parts of the pump in direct contact with the chemical shall be compatible and resistant and shall not cause accelerated decomposition of the chemical.

Each pump shall be mounted on a PVC plinth attached to the dosing panel, so that the pump can be adequately accessed from all sides for adjustment and servicing.

Measures recommended to reduce vapour locking of the pumps include ensuring pumps are operated with flooded suction. Pumps should be installed below the storage tank lowest operational level for this reason, but at the same time, should not be installed below the top of the bund wall level to avoid submergence during a major spill. The suction pipeline should be made as short as possible.

Peristaltic pumps are not recommended for dosing, though may be used for delivery transfer of chemical into the storage tank.

Small dosing pumps may require short lengths of flexible hose or tubing at the pump suction and discharge ends. Requirements for flexible hose and tubing are described in section 8.6. Chemical barrier protection (refer DS79-03) shall be designed to accommodate hose replacement by providing quick and easy access to the hoses. If pumps must be installed outdoors (not preferred), a shed shall be provided to protect the pumps and hoses from direct sunlight.

Where duty and standby dosing pumps are installed, the control system shall provide functionality to swap between dosing pumps automatically on an adjustable set time period e.g. daily. This will help ensure the pumps have similar operating hours and are not offline for long periods.

Manual operation of the standby dosing system shall be possible without affecting the normal operation of the duty dosing pump.

6.3.3 Pressure Relief Valves

External relief circuits shall generally not be used with digital dosing pumps because operation of the external relief could interfere with flow measurement using Integrated Flow Measurement (IFM).

Where the dose pump does not have an internal pressure relief, external pressure relief valves (whose function is a Pressure Safety Valve, PSV) shall be installed and provision made to allow a hand-held gauge to test the set pressure of the relief valve. The relief valve shall be installed to direct any excess solution to the top of the calibration tube so that any pressure relief can be easily visibly detected from the tube. The pressure relief valve shall be set to open on failure (fail open).

Commissioning Plan Information
For sites that use external relief circuits, safety relief valves shall be fitted with carseals to protect against unauthorised adjustment. The pressure setting of safety relief valves shall be shown on P&IDs and Process Safety Plans and recorded on a red tag attached to either the valve body or the carseal.

6.3.4 Strainers

To prevent pipework shavings, silica scale, or other solid impurities from blocking or damaging the dosing pump internals, the magnetic flow meters or the pressure sustaining valves, each dosing system has a PVC in-line Y-body strainer installed upstream of the dosing pump before the calibration tube. As a minimum the strainer shall be fitted with a cylindrical mesh having 0.5mm perforations. As duty/standby panels are recommended there is no need to provide a bypass around the strainer. However, for single panel systems a bypass, complete with standby strainer, will be necessary to keep the panel running whilst the blocked strainer is taken out for service.

6.3.5 Pressure Gauges

A glycerine-filled stainless steel pressure gauge with a minimum display diameter of 63mm (2.5”) shall be provided with sufficient range to allow setting of each pressure sustaining valve and to assist in continuous monitoring of correct dosing pump performance. The pressure gauge shall incorporate a diaphragm barrier seal of suitable material, to prevent chemical coming directly into contact with the gauge components. The gauge scale shall be sized small enough to provide adequate resolution for setting of the pressure sustaining valve and large enough so that the maximum operating pressure will not exceed 75% of full scale.

6.3.6 Deaeration

It is preferred to use the automatic de-gassing feature on the digital dosing pump rather than having a de-gassing valve on small dosing systems. In addition, start-up pump at full speed for a pre-set period of time (e.g. typically 10 – 20 seconds, adjustable) to assist clearing the line before the dose pump reverts to a speed suited to the required dosage.

6.3.7 Flow Measurement

It is preferred to select a digital dosing pump with Integrated Flow Measurement (rather than miniature magflow meters whose small bore is prone to blockage from scale build-up, crystallisation or other debris) for small dosing systems. Sensors within the dose pump result in undetected loss of flow being very unlikely; however, in the event of loss of dosing flow, downstream process analysers will trigger swap over to the standby system. Resumption of operation of the faulted system will involve a short period of operation at full pump speed which generally clears the problem. Consequently, this occasional minor problem self corrects.

Flow measurement is used to monitor and record the dosing pump discharge flow rate, and totalise the amount dosed. A low flow alarm (configurable) would indicate a dosing hydraulic fault such as blockage at the dosing spear and would initiate shutdown of the duty dosing system and changeover to the standby system.

6.3.8 Pressure Sustaining Valves

A pressure sustaining valve (also called a Pressure Control Valve, PCV) automatically holds a steady pre-set upstream pressure, within close limits. The main pressure sustaining valve installed on the dosing line on each panel improves the accuracy of dosing by providing and maintaining the necessary discharge pressure[8] required by the dosing pump. It shall be set at a pressure which optimises pump accuracy as per the pump manufacturer’s recommendation. The pressure setting shall be recorded on the valve tag.

A normally-closed vent line upstream of the PCV allows the pump to be primed and allows the system to be de-pressurised prior to maintenance, should the PCV become blocked or fail.

6.3.9 Anti-Siphon Valve

For dosing lines longer than 10 metres, an additional pressure sustaining valve and pressure gauge shall be provided near the dosing point to act as an anti-siphon valve. This additional valve provides stable dosing control and prevents diffusion of chemical from the chemical line into the water main during idling periods (refer to section 6.4.2). This second PCV is typically set at a low pressure (100 -

[8] The PCV pressure is typically set at 100kPa above the maximum normal operating pressure at the chemical injection point but no lower than the pressure that is specified by the dosing pump manufacturer. Dosing pumps typically have specification of either a minimum discharge pressure or a minimum differential pressure - KWS Investigation Report by P. Hanley (with installation standard drawing and notes Rev 8).

> 200 kPa). Setting this second PCV at too high a value can result in surging of the chemical dose rate due to the control valves hysteresis causing expansion and contraction of the chemical dose line piping.

Provision shall be made to allow a hand-held gauge to test the pressure on each PCV.

If there are site specific reasons to deviate from the design requirements above, approval shall be sought from the Senior Principal Engineer - Water Treatment.

Commissioning Plan Information
The pressure setting of PCVs shall be recorded on their valve tags.

6.4 Dosing

The chemical which leaves the panel and exits the building is then dosed into the recipient water main via a dosing spear/sparger arrangement. The design of the dosing system downstream of the dosing panel is described in more detail in the chemical dosing design standard DS78.

6.4.1 Dilution Carrier Water

Dilution carrier water for chemical dosing is described in more detail in design standard DS78.

6.4.2 Dosing Diffusers & Valves

Duty and standby dosing diffusers shall be provided. Dosing diffuser selection and design shall follow DS78.

Blockage of pipework and sparger orifices caused by scaling may be a major problem depending on the chemical and the recipient water or dilution water (for small systems with low dose flow) if it contains an elevated concentration of alkalinity and hardness. Scaling at some Water Corporation sites has been managed by dosing a sequestering agent such as Calgon into the dilution stream prior to the addition of the chemical.

Design of the dosing diffusers and/or mixing devices are site-specific and reference shall be made to DS78 Chemical Dosing Standard for guidance.

Dosing spears should pass through a gate valve so that the recipient water main can be operated even when the spear is not in place. A non-return valve shall be provided on each dosing line close to the dosing spear to ensure the recipient water does not back-feed up the dosing line when the spears are not in operation. Non-return valves are not required where a pressure sustaining valve is proposed to be installed near the injection point (ref. 6.3.8). Isolation ball valves shall also be provided to enable the individual spears to be isolated from the chemical and removed for maintenance whilst the other spear is in operation.

6.4.3 Pressure Gauge

The pressure gauge shall be constructed of materials suitable for contact with chemical similar to those provided at the dosing panels.

6.5 Flushing Water System

Flushing water valves and connections may be required to flush chemical from the storage and dosing system pipework prior to equipment removal or maintenance. The flushing connections shall be located strategically so that all the chemical lines, right back to the tank outlet isolation valve, can be flushed. The valve below the calibration tube and the de-gassing valve must be closed during flushing to prevent water entering the chemical storage tank. It is important that the calibration tube isolation valve shall be re-opened prior to returning the system to service. A sign with instruction to close these valves (during maintenance) shall be displayed next to all the flushing points[9].

[9] Other ways to ensure these valves are closed during flushing have been considered including a keyed valve system but these have been assessed as too costly for the level of risk presented.

Flushing should take place in preparation for maintenance or if the chemical has been left in the system for a long period. It should not necessarily occur simply when changing from one operating mode on a system to another (e.g. Dosing Mode to Stopped Mode), or when changing over from one dosing system (duty) to another (standby).

For chemicals with high pH or sparingly soluble ions, routine or excessive flushing of the chemical system with un-softened water will result in scale build-up and possible blockage of the dosing lines, so it should be avoided.

Drainage points should be provided at various locations on the dosing pipeline for draining of the flushing water when required. However, when flushing the system, the flush water should preferably be directed to the dose point as this is the safest and easiest disposal route. During the initial flushing period the dosing operation of the standby system should be suspended to ensure over-dosing does not occur.

Site service water is generally used as the flushing water supply and it shall have sufficient head to flush water through both the chemical dosing pump and pressure sustaining valve of the dosing system. If the site service water supply has insufficient flow or pressure to carry out flushing then a dedicated flush water booster pump will be required. Alternatively, if the site water supply has excessive flow and pressure, which could cause damage to valves and equipment then a flow or pressure control valve may be required to limit the flushing flow and pressure.

If the same site service water supply is used to supply the safety shower(s) then the flushing water off-take shall be located downstream of a reduced pressure zone device (RPZD) with the safety shower(s) being supplied from upstream of the RPZD. Plumbing and backflow prevention shall generally be compliant with AS/NZS 3500 and AS/NZS 2845

7 WATER SAMPLING AND ANALYSIS

Where water sampling and analysis is required:

- DS73-10 Small Hypochlorite Systems may provide useful guidance on requirements to consider.
- DS78 Chemical Dosing Standard provides further details and requirements.

8 PIPEWORK

8.1 Pipe Materials

All chemical pipework shall be Schedule 80 uPVC in accordance with ASTM D-1785 unless a chemical incompatibility exists or the maximum operating pressure exceeds the derated design pressure of this piping system. Water Corporation has adopted this standard rather than PN18 uPVC – Series 1 (AS/NZS 1477) in recognition of the pipework typically supplied by contractors and the desire to standardise on one pipe standard. It is recognized that Schedule 80 uPVC pipe is a superior product in terms of mechanical strength and UV degradation.

The pressure rating of the uPVC pipe, valves and fittings shall be de-rated for service temperatures above 20°C in line with the manufacturer's requirements. Furthermore, where valves, flanges, fittings or other components are added to the pipework, the line shall be de-rated to the rating of the lowest component in the line. It is noted that UPVC flanges are rated to only 10 bar and this is before any derating for design temperature above 20°C.

Where use of Schedule 80 uPVC piping system is not possible, then the designer shall propose a suitable alternative piping system / material for Senior Principal Engineer – Water Treatment acceptance.

8.2 Pipe Sizes

Pipe sizes for dosing pump suction and discharge should ideally be selected to maintain the chemical flow velocity as high as possible but under 2 m/s, to sweep any bubbles along and minimise gas accumulation. A velocity higher than 2 m/s will contribute to a shearing effect that will separate the chemical into alternating slugs of gas and liquid, affecting the accuracy of downstream dosing whereas a velocity slower than 0.5 m/s may contribute to gasification and crystallisation for certain chemicals.

8.3 Pipe Fittings

Pipe fittings such as bends, tees and reducers tend to be locations for scale or contaminant deposition. It is thus a good practice to keep the number of pipe fittings to a minimum.

8.4 Pipework Jointing and Solvent Cements

All uPVC pipework shall comply with DS31-01 PVC-U Pipe and Fittings section and be solvent welded except the tank to pipework connections and some pipework to equipment connections which shall be flanged. The use of screwed fittings shall be avoided wherever possible but will probably be necessary for the installation of the pressure gauges. If threaded connections must be used, threads must be new, sharp and secured with a high-quality Teflon tape.

To ensure leak-free pipework, the solvent welded pipe joints shall be made with care and strictly as per the manufacturer's installation instructions and WS-2 Welding and Jointing specification. uPVC cleaner/primer shall be utilised for all solvent welded joints. Over-applying the solvent cement to the joints should be avoided as excess glue can reach the interior of the pipe and restrict the chemical flow.

8.5 Pipework Supports

PVC pipework shall be supported at specific intervals depending on the average pipe wall temperature, the density of the flow medium, the pipe diameter and wall thickness, and the stress loading on the pipeline. Pipe manufacturers typically provide published data in their design guides and will be able to advise on the spacing of the supports.

All supports shall be constructed of materials suitably resistant to the chemical such as PVC, FRP, PE, 316 stainless steel pipe tray, brooker rod and unistrut. If mild steel supports are used, they shall be coated with a suitable corrosion resistant coating where contact with the chemical or fumes may occur.

8.6 Hoses and Tubing

Where used, pump suction and discharge flexible hose material shall be compatible with the chemical. The preferred hose type is braided clear PVC minimum PN16 hose (e.g. 6 mm ID/12 mm OD by Rehau Rauiflam-E). However, where hoses are used outdoors or in hot environments[10] and use compression fittings, alternative materials such as ETFE which have a lower rate of temperature pressure de-rating and softening with temperature shall be employed. Hoses shall be protected from direct sunlight.

8.7 Pipework Identification and Labelling

Commissioning Plan Information
All above ground UV exposed uPVC pipework shall be painted in accordance with Water Corporation Standard DS95 (Appendix 3, Coating Specification K1). Paint shall be UV-resistant. Where the pipes need to be in a more aggressive environment, a chemical resistant paint may be required. The manufacturer/paint supplier will need to be consulted regarding the suitability of the paint on PVC. Chemical pipework shall be identified and labelled as described in section 13. Buried pipework or pipework installed in culverts (not exposed to UV) does not require painting but shall be labelled for identification purposes.

8.8 Pipework Testing

Commissioning Plan Information
All pressure pipework shall be hydrostatically pressure tested in accordance with AS 4041 before being commissioned. Unless specified otherwise the pipework should be tested to 1.5 x the maximum design pressure. Care shall be taken to remove or isolate equipment from the lines which cannot be safely tested to the same pressure as the pipework.

8.9 Valves

All valve components including handles, actuators, balls, ball seals and O-rings shall be constructed of materials suitable for contact with the chemical.

Valves shall have tags for identification and to indicate whether they are “normally open” or “normally closed”. For safety critical valves, the supplied tags shall be red.

8.10 Flanges and Gaskets

All flanges shall be drilled in accordance with AS/NZS 4087 for pressure class PN16, unless a different flange standard has been adopted at the site for consistency. All flanges shall be provided with galvanised steel backing plates and 3mm full face gaskets at the flanged interfaces. The backing plates shall be hot dipped galvanised in accordance with AS/NZS 4680.

Gasket materials shall be suitable for contact with the chemical.

8.11 Fasteners

All fasteners shall comply with AS 1111.1 and AS 1112.3. Fasteners and anchorage bolts shall be hot dip galvanised in accordance with AS 1214.[11]

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[10] Water Corporation has experienced one failure of a PVC hose compression fitting in a hot environment which impacted a worker - the hose blew out of the compression fitting despite both components being serviceable.
[11] 316 stainless steel fasteners are considered to have no advantage over galvanised steel fasteners due to risk of stress corrosion cracking and problem with galling.

9 ANCILLARIES

9.1 Wash Trough

A single wash trough shall be provided for the washing of pump components, valves and other equipment prior to removal from the chemical room. The wash trough shall be constructed of PVC. The wash trough shall be located at a height convenient for operator use and shall drain into the bund sump.

9.2 Safety Showers & Eyewash Units

9.2.1 Number and Location

A safety shower and eyewash unit shall be provided at ground level outside the chemical building between 2m and 7m horizontal distance from the chemical transfer point with a green fluorescent light fitted above it. The requirement for additional safety showers shall be identified through risk assessment.

All safety showers shall comply with the requirements of DS79-02 and be fitted with flow switches to alarm their use.

9.2.2 Safety Shower Water Supply

Potable water shall be used to supply the safety showers and eyewash units. Where a dedicated potable water supply is not available, the safety shower supply off-take from the potable water system on site shall be located upstream of a reduced pressure zone device (RPZD). Any water usage connections associated with any chemical such as dilution or flushing shall be located downstream of the RPZD to protect the safety shower supply from contamination.

9.3 Hose Reels

Retractable wash down hose reels shall be provided and located such that all areas of the chemical transfer point and storage facility can be accessed with the hose. Hoses shall be minimum 19mm diameter and 20m in length.

9.4 Test & Analysis Area

Testing and analysis requirements shall be clarified with the Senior Principal Engineer – Water Treatment and a suitable working area and facilities provided at the site as necessary.

10 PROCESS CONTROL

10.1 Control Location

The chemical storage and dosing system may be controlled from the following locations:

a) Operator Interface Panel (OIP) – Full automatic and manual control is possible from this panel located in the viewing room. Any operational mode can be selected from this panel. Operation from the OIP requires prior approval from the OC.

b) Human Machine Interface (HMI) –The full dosing system is monitored and controlled from the UWSS / Statewide SCADA Operations Centre at John Tonkin Water Centre.

Monitoring and control functionality from the above two locations shall generally be identical unless the Senior Principal Engineer – Water Treatment has specified or approved otherwise in writing.

10.2 Tank Level Low Alarm

The Tank Low Level Alarm shall be set to initiate at a level which corresponds to the tank being sufficiently empty to receive a full delivery of chemical. This is also known as the re-order level. This alarm should generate a "Chemical Re-Order" message on the OIP & HMI.

10.3 Tank Level High Alarm

The Tank High Level Alarm shall be set to initiate at a level which corresponds to 2 minutes before a tank would commence overflowing during a filling operation. This alarm will initiate the High level alarm on the HMI.

10.4 Required Dose Rate Low Alarm

This alarm is displayed on OIP and SCADA screens. "Required dose rate low" is triggered when the required dose rate is less than the lower dose rate limit continuously for 5 min. This alarm flags a possible problem with the dosing process. When this alarm is triggered, the dose rate becomes limited to the lower dose rate limit.

10.5 Required Dose Rate High Alarm

This alarm is displayed on OIP and SCADA screens. "Required dose rate high" is triggered when the required dose rate is greater than the upper dose rate limit continuously for 5 min. This alarm flags a possible problem with the dosing process. When this alarm is triggered, the dose rate becomes limited to the upper dose rate limit.

11 PROCESS SAFEGUARDING

This section details the process safeguarding controls that are implemented to protect personnel, equipment and the environment. PLC and/or RTU code associated with these process safeguarding controls shall be separated and clearly identified in the PLC/RTU and denoted within the code as subject to strict Management of Change (MoC) procedures.

Strict Management of Change requires both of the following procedures to be followed:

1) Engineering MoC procedure https://nexus.watercorporation.com.au/otcs/cs.exe/app/nodes/133512199
2) DS40-06 – Software Change Control standard

11.1 Tank Low-Low Level Alarm

The purpose of the Chemical Tank Low-Low Level Alarm is to protect the dosing pumps from running dry and to prevent air from being entrained in the suction pipework. Therefore, the set point for the Low Low level alarm should be just above (e.g. 25 mm above) the obvert level of the process outlet on the tank.

On initiation of the Tank Low-Low Level Alarm, and after 60 seconds, inhibit operation of all dosing pumps.

The setpoint for this alarm shall be hard-coded into the PLC and not adjustable from the OIP or SCADA.

11.2 Tank High-High Level Alarm

The High-High level alarm should indicate imminent overflow of the tank and should be set at a level which corresponds to 20 seconds before tank overflow.

Where a permanently installed chemical load-in transfer pumps is installed for pumping from IBCs (but not required for smaller delivery containers), then on initiation of the Tank High-High Level Alarm, trip the power supply to the Chemical Load-in Transfer Pump and raise a critical alarm on the OIP and SCADA.

The setpoint for this alarm shall be hard-coded into the PLC and not adjustable from the OIP or SCADA.

11.3 Bund High Level Alarm

Section 3.4 discusses whether a Bund High Level Alarm is necessary to alert of a chemical or water spill.

On initiation of the Bund High Level Alarm, trip the power supply to the Chemical Load-in Transfer Pump and raise an alarm on the OIP and SCADA. Note: A Bund High Level Alarm does not initiate automatic shutdown of the dosing system.

11.4 Safety Shower High Flow Alarm

Operation of the safety shower or eyewash (for more than two minutes i.e. to avoid false alarms from testing the shower) shall initiate an alarm on the OIP and SCADA to alert operations personnel of a possible personnel emergency requiring medical assistance.

12 DECONTAMINATION

The design of the dosing facility shall accommodate the following decontamination methods.

12.1.1 Spills Within Bund

For small spills of most chemicals, neutralisation can be accomplished by dilution and hosing down with water within the bund. Larger spills shall be managed in accordance with Hazardous Chemicals procedure.

12.1.2 Dosing Pump and Piping Decontamination

A connection point shall be incorporated upstream of the dosing pump to provide service water for flushing and decontamination of the dosing pump, dosing pipe and pressure sustaining valve prior to disassembly. The flushing will reduce the possibility of occupational exposure to concentrated chemical.

Additionally, a wash down trough (e.g. plastic laundry trough) should be located close to the dosing pump(s). This facilitates further decontamination of the dosing pump within the bund once the pump has been removed from its mounting for maintenance.

13 PLACARDING, LABELLING AND SAFETY SIGNAGE

All the following safety signs and placards shall be provided for any chemical storage and/or dosing facility regardless of whether the stored concentration is neat or dilute, or isn't classified as a Dangerous Good:

a) A "CHEMICAL" Storage Placard (e.g. DS WCSS003-2) shall be posted near each entry door to the chemical storage room. These signs shall be displayed to be clearly visible from the normal direction of approach.

b) Multi-"CHEMICAL" Signs (e.g. DS WCSS108) shall be posted on the outside wall of the chemical building near the unloading area and next to the personnel door to the viewing room. These signs shall be displayed to be clearly visible from the normal direction of approach.

c) Storage Tank Identification & Volume Labels (DS WCSS404) indicating the tank number and size shall be posted on each tank. These labels shall be displayed at a level so that it is visible from the normal direction of approach.

d) Emergency Shower & Eyewash Signs (DS WCSS306) shall be posted on the wall next to the safety shower unit or attached to the rear of the shower. These signs shall be displayed to be clearly visible from the normal direction of approach.

e) Maximum Fill Level Labels (DS WCSS402) shall be posted on the tank.

Pipe Identification Markers (DS WCSS452) shall be posted on all pipework to indicate pipe contents and flow direction. These markers should be prominently displayed on the pipework to ensure the observer can clearly read the information.

Commissioning Plan Information
All signs and placards shall comply with the requirements of DS79-04 Safety Signage, Labels and Markers.

Where a sign is fitted onto or near a door, the sign shall be easily visible with the door either open or closed. This may require identical signs to be fitted to both sides of the door.

15 APPENDIX A: COMMISSIONING PLAN ISSUES LIST

This appendix collates issues (raised in the main body of this Standard) for consideration in the Commissioning Plan.

Hazard: Equipment failure resulting in injury to personnel and damage to equipment.

A 24-hour hydrostatic leak test shall be conducted on a bund prior to the filling of its associated storage tank(s) with chemical.

Hazard: Equipment failure resulting in injury to personnel and damage to equipment.

Prior to delivery to site, all tanks shall be hydrostatically tested using clean water filled to the overflow level. The full static head is to be held for a minimum of 12 hours. Once installed, the tanks shall be hydrostatically tested to the full static head again to check for any damage which may have occurred during transportation or installation[12]. All tanks shall be transported to site with capped nozzles to prevent dust and vermin entering.

Hazard: Equipment failure resulting in injury to personnel and damage to equipment.

Prior to the first delivery of chemical, the filling line shall be hydrostatically pressure tested in accordance with AS 4041 to 1.5 times the operating pressure of the tanker pump and held for a minimum of 30 minutes. Written proof of this test will be requested by the chemical Supplier and shall be made available to them. Note: The tank shall not be subject to the test pressure as it is only rated for static head up to the overflow level.

Hazard: Equipment failure resulting in injury to personnel and damage to equipment.

The pressure setting of PSVs shall be recorded on their valve tags.

Hazard: Personnel being unable to identify correct pipework to work on.

All above ground PVC pipework shall be painted in accordance with Water Corporation Standard DS95 (Appendix 3, Coating Specification K1). Paint on pipes located outside the building shall be UV-resistant. Where the pipes need to be in a more aggressive environment, a chemical resistant paint may be required. The manufacturer/paint supplier will need to be consulted regarding the suitability of the paint on PVC. Chemical pipework shall be identified and labelled as described in section 13. Buried pipework or pipework installed in culverts (not exposed to UV) does not require painting but shall be labelled for identification purposes.

Hazard: Equipment failure resulting in injury to personnel and damage to equipment.

All pressure pipework shall be hydrostatically pressure tested in accordance with AS 4041 before being commissioned. Unless specified otherwise the pipework should be tested to 1.5 x the maximum design pressure. Care shall be taken to remove or isolate equipment from the lines which cannot be safely tested to the same pressure as the pipework.

Hazard: Personnel not being able to identify or be alerted of a potential Dangerous Goods hazard.

All signs and placards shall comply with the requirements of DS79-04 Safety Signage, Labels and Markers.

[12] Water used for testing tanks at site can then be discharged through the scour valve to test the bund as well.

END OF DOCUMENT