

TMS1636

Asset Specification for Hypochlorite and MonOchloramine Chemical Dosing Units

**Revision Table**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Rev No | Date | Document Status | Owner | Reviewer | Approver |
| 3 | 31/10/2024 | Issued for Use | Santhosh JambagiRPEQ 12167 | Michael Buckley | Kate Lanskey |

**Revision History Table**

|  |  |  |  |
| --- | --- | --- | --- |
| Ver | Date | Revision Details | Author |
| 1 | 15/12/ 2016 | Issued for Use | Jose Castineyra |
| 3 | 31/10/24 | Major Update | G. Luscombe (RPEQ 18215) |

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**Endorsement**

|  |  |  |
| --- | --- | --- |
| Rev  | Committee | Date |
| 2D | Technical Standards Committee 58 | 1/08/2024 |

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# Purpose

The purpose of this document is to provide guidance to designers, constructors and others involved in the delivery of Chemical Dosing Units (CDUs) as a part of the Urban Utilities drinking water and recycled water infrastructure. This specification provides the minimum requirements and recommendation for works relating to upgrades, replacements, or supply, of new CDUs. This document is intended to be read in conjunction with the accompanying Project Specific Documentation.

# Scope

This document provides Urban Utilities technical requirements for the design and construction of Chemical Dosing Units that dose sodium hypochlorite or those that generate and dose monochloramine. This specification applies to both drinking water systems and facilities within resource recovery centres (RRCs) that treat recycled water.

This document is not applicable to chemical installations other than sodium hypochlorite or aqueous ammonia, nor to the dosing of gaseous chemicals (including chlorine).

# Definitions/Glossary of Items

Definitions of terms used in this document can be found in Table 3‑1.

Table 3‑1 Definitions

| Item | Definition/Description |
| --- | --- |
| Contractor | The entity responsible for the delivery, or part thereof, of the required infrastructure including design, manufacture, supply, installation and/or demolition. This may include, but is not limited to, a developer or the successful tenderer to a bid. |
| Hypochlorite | Refers to sodium hypochlorite solution. |
| Project Documentation | Governing technical documents for the specific item(s) for the specific works included or referenced in the Contract. |
| Protected place | A place recognised or determined to be in need of protection from hazards of dangerous goods. Usage within this document is intended as a direct reference to AS 3780. |
| Shall | Where ‘shall’ is used in this document the associated requirement is a mandatory requirement. |
| Should | Where ‘should’ is used in this document, it indicates a recommendation, i.e., an item that is not a mandatory requirement but given as guidance. |

# Abbreviations

Abbreviations used in this document can be found in Table 4‑1.

Table 4‑1 Abbreviations

| Abbreviation | Definition |
| --- | --- |
| ADG | Australian Dangerous Goods Code |
| ADWG | Australian Drinking Water Guidelines |
| AEP | Annual Exceedance Probability |
| AS | Australian Standard |
| ASTM | American Society for Testing and Materials |
| BS | British Standard |
| CDU | Chemical Dosing Unit |
| CHAZOP | Control Hazard and Operability Study |
| DC | Direct Current |
| FKM | Fluorine Kautschuk Material (also known as Viton) |
| FRP | Fibreglass Reinforced Polymer |
| GHS | Globally Harmonised System |
| GPO | General Purpose Outlet |
| GRP | Glass Reinforced Polyester |
| HAZOP | Hazards and Operability Study |
| HDPE | High-density Polyethylene |
| HMI | Human Machine Interface |
| IPAM | Infrastructure Products and Materials |
| LV | Low Voltage (refer AS 3000) |
| NATA  | National Association of Testing Authorities |
| NPV | Net-Present Value |
| PE | Polyethylene |
| P&ID | Piping and Instrumentation Diagram |
| PLC | Programmable Logic Controller |
| PTFE | Polytetrafluoroethylene |
| PVCu | Un-plasticised Polyvinyl Chloride |
| PVDF | Polyvinylidene Fluoride |
| RTU | Remote Telemetry Unit |
| SCADA | Supervisory Control and Data Acquisition System |
| SDS | Safety Datasheet |
| SID | Safety in Design |
| SEQ | South-East Queensland |
| STEP | Site Access, Tenure, Environment and Planning Assessment |
| UU | Urban Utilities |
| UV | Ultra-Violet Light |
| WSAA | Water Services Association of Australia |

# Standards and Codes

All design, equipment and workmanship shall conform to the most recent requirements of the relevant statutory Local, State and Commonwealth authorities and current applicable Australian Standards. Alternatively, where no Australian Standard exists, work shall conform to the most current and applicable international standards. The Contractor shall inform and consult with Urban Utilities where any conflicts between best practice, and the requirements of this document and the listed standards exist.

This document does not relieve the responsibilities surrounding compliance with relevant legislation, regulations, standards, and industry codes, which include those summarised in the following sections.

At all times the Contractor remains responsible for ensuring infrastructure designed is fit for purpose throughout the life of the asset and safe to construct, operate, maintain, and demolish. In doing so the Contractor must exercise appropriate due diligence to identify and manage hazards so far as is reasonably practical. The Contractor shall be responsible for obtaining information as required to design, construct and operate the chemical dosing units. The Contractor shall be appropriately skilled in, and take appropriate care throughout, the design, construction and commissioning of chemical dosing units.

## Legislation and Regulations

Legislation and regulations related to the planning, design, and construction of Chemical Dosing Units for Network assets are summarised in Table 5‑1. The list provided in Table 5‑1 is not an exhaustive list of documents relevant to the works.

Table 5‑1 Legislations and regulations

| Name | Description |
| --- | --- |
| Electrical Safety Act 2002 | Provides a legislative framework for—(a) preventing persons from being killed or injured byelectricity; and(b) preventing property from being destroyed or damagedby electricity |
| Professional Engineers Act 2002 (Qld) | The act serves to protect the public by ensuring professional engineering services are provided by a registered professional engineer in a professional and competent way. |
| Public Health Act 2005 | Provides a legislative framework to protect public health, including legislative instruments relating water quality. |
| Public Health Regulation 2018 | Supports the Public Health Act 2005 with specific measures relating to water quality risk management. |
| Water Supply (Safety and Reliability) Act 2008 | Provides a specific legislative framework to manage drinking water quality risks. |
| Work Health and Safety Act 2011 & Work Health and Safety Regulation | Provides a framework to ensure the health and safety of workers and workplaces. |

## Australian Standards

The latest in-force editions of Australian Standards shall be used for the design and construction of Chemical Dosing Units. Table 5‑2 identifies Australian Standards of most relevance. The list provided in Table 5‑2 is not an exhaustive list of documents relevant to the works.

Table 5‑2 Australian Standards

| STANDARD | TITLE |
| --- | --- |
| AS 1170 | Structural Design Actions |
| 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 1668 | The use of ventilation and air-conditioning in buildings |
| AS/NZS 2032 | Installation of PVC pipe systems |
| AS/NZS 2033 | Installation of polyethylene pipe systems |
| AS 2845 | Water supply – Backflow prevention devices |
| AS 2865 | Confined Spaces |
| AS/NZS 3000 | Electrical installations |
| AS/NZS 3500 | Plumbing and Drainage |
| AS 3735 | Concrete structures for retaining liquids |
| AS 3780 | The storage and handling of corrosive substances |
| AS 3879 | Solvent cements and priming fluids for PVC (PVC-U and PVC-M) and ABS pipes and fittings |
| AS 3996 | Access covers and grates |
| AS 4020 | Testing of products for us in contact with drinking water |
| AS 4024 | Safety of machinery |
| AS 4041 | Pressure Piping |
| AS/NZS 4766 | Rotationally moulded buried, partially buried and non-buried storage tanks for water and chemicals |
| AS 4775 | Emergency eyewash and shower equipment |

Selected drinking water equipment, pipework, fittings and other devices in contact with chemicals or other process streams not approved to AS 4020 shall be identified as part of the design report, including justification for selection where other equipment approved to AS 4020 is available.

## Water Services Association of Australia and SEQ Design and Construction Code

WSA codes and the SEQ Water Supply and Sewerage Design and Construction Code (SEQ WS&S D&C Code) do not provide prescriptive guidance for dosing systems, however do provide guidance for some components that may be implemented in conjunction with a CDU, including water pipelines and booster pump systems. Where applicable design elements are included in the project, the requirements of SEQ WS&S D&C Code shall be followed.

Equipment shall be selected from Infrastructure Products and Materials (IPAM) list <https://www.seqcode.com.au/products-seq-code> where covered. Deviations from the IPAM list shall be accepted by Urban Utilities prior to the preparation of construction documentation, with justification for the deviation included in the design report.

Equipment selections contrary to, or for items not defined by IPAM shall be accepted by Urban Utilities prior to the issue of construction-ready documentation. Accepted deviations from the IPAM shall be documented (including justification) in the design report.

## Other Relevant Specifications and Guidelines

The various relevant guidelines and specifications are documented in Table 5‑3.

Table 5‑3 Other Relevant Standards and Guidelines

| Standard | Description |
| --- | --- |
| ADG7.7 | Australian Dangerous Goods Code |
| AP-G34-23 | Austroads Design Vehicles and Turning Path Templates |
| ASME RTP-1 | Reinforced Thermoset Plastic Corrosion-Resistant Equipment |
| ASTM D1785 | Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120 |
| BS 4994 | Specification for Design and Construction of Vessels and Tanks in Reinforced Plastics |
| BS EN 13121-3 | GRP Tanks and Vessels for use above ground. Design and workmanship |
| IEC 60079 | Explosive Atmospheres |

## Urban Utilities Referenced Documents

This specification shall be used in conjunction with Urban Utilities’ other standard specifications and other relevant documents. Some of the relevant specifications, documents and STEP procedures are outlined in Table 5‑4.

Table 5‑4 Urban Utilities Standard Specifications and Documents

| Document No. | Title |
| --- | --- |
| TMS60 | Low Voltage Switchboards Technical Specification |
| TMS62 | Preferred Equipment List – Electrical and Instrumentation Technical Specification |
| TMS76 | Supplement to the WSA 201 Manual for Selection and Application of Protective Coatings Standard Technical Specification |
| TMS176 | Security Design Guidelines |
| TMS828 | Standard Functional Specification Reservoir Sites |
| TMS1151 | Preferred Equipment List – Control Systems Technical Specification |
| TMS1581 | Drinking Water Reservoirs and Tanks Specifications |
| TMS1632 | Power System Analysis Finalisation Procedure |
| TMS1638 | Water Booster Pump Station Standard Technical Specification |
| TMS1639  | Mechanical General Standard Specification |
| TMS1645 | Packaged Plant – Electrical, Instrumentation and Control Systems |
| TMS1647 | Plant and Equipment Tag numbering – (Technical Specification) |
| TMS1731 | General Civil & Structural Specification |
| TMS1732 | General Electrical Specification |
| TMS1733 | General Controls Specification |
| MP76 | Drinking Water Quality Management Plan |
| PRO84 | Risk Management Procedure |
| PRO307 | Engineering Drawing and Document Management Requirements for Capital Project Delivery |
| PRO362 | Reservoir Disinfection Procedure |
| PRO379 | Energy Lock Out Tag Out Procedure |
| PRO395 | Urban Utilities Information Requirements – Urban Utilities Addendum to: SEQ Water Supply and Sewerage Code |
| PRO662 | Urban Utilities Safety in Design Procedure |
| STD145 | Noise Environmental Standard |
| STD146 | Air, Dust and Odour Environmental Standard |
| STD150 | Vibration Environmental Standard |

# Dosing System Overview

## General CDU Systems

Key elements of both hypochlorite and monochloramine CDU systems include:

* *Chemical Storage Tank:* Provides suitable storage and appropriate turnover of chemical, typically includes level instrumentation, filling, overflow, venting, and drainage system. Storage tanks are located within a bund.
* *Dosing Pumps:* Provides metering and transfer of the chemical into the process stream.
* *Injection Quill:* Provides a point of dosing into the process stream and is designed to promote mixing of the chemical.
* *Analyser:* Determines the concentration of one or more analytes for control of the dosing system. Typical analytes include free chlorine, total chlorine, pH, and temperature.
* *Local Control System:* Monitors and controls the dosing system and provides communications for the system to SCADA provide remote monitoring and control.

## Sodium Hypochlorite CDU Systems

Sodium hypochlorite is an oxidant used in water and wastewater treatment to either undertake disinfection (known as primary disinfection) or to maintain a residual of disinfectant to protect against ingress of bacterial and viral pathogens (known as secondary disinfection)..

Sodium hypochlorite is stored as a liquid and is metered into the process stream using chemical dosing pump/s. The flow rate from the dosing pump/s is controlled via setpoint control to achieve a specified dose of free chlorine as measured by an analyser within the process stream. A typical arrangement for drinking water secondary disinfection is shown in Figure 1.

 

Figure 1 Typical hypochlorite dosing system, showing dosing into a reservoir

## Monochloramine CDU Systems

Monochloramine is another oxidant used in water treatment to undertake both primary and secondary disinfection. Monochloramine is a weaker oxidant than hypochlorite, although it confers a number of advantages for large drinking water networks, including increased stability once dosed and a lower potential for formation of disinfection by-products.

Monochloramine is typically generated at the point of dosing through the controlled mixing of ammonia (typically either aqueous ammonia or liquid ammonium sulphate, abbreviated to LAS) and hypochlorite via separate dosing systems, which is typically dosed directly following mixing into the water supply. A typical arrangement is shown in Figure 2.

 

Figure 2 Typical monochloramine dosing system

Design for monochloramine dosing requires increased engineering evaluation, and must consider:

* Minimising the formation of dichloramine and trichloramine during the mixing of hypochlorite and ammonia, which may impact taste and odour of drinking water supplies.
* The potential for the system to contribute to nitrification, particularly due to free ammonia generated by the CDU.
* The ability of the system to manage nitrification, including the stability and accuracy of monochloramine dosing and the ability of the system to be reconfigured to operate as a chlorinated system.
* The incompatibility of ammonia and sodium hypochlorite, and the potential for dangerous environments to be created where these chemicals are mixed in an uncontrolled manner with the potential release of toxic gas.
* The detection and avoidance of formation of hazardous atmospheres in and around the ammonia storage and dosing systems, and the potential consequence where hazardous atmospheres are formed.

The monochloramine CDU design must include:

* *Hypochlorite and Ammonia Dosing Systems:* Provides controlled dosing of reagents to generate monochloramine and control free ammonia.
* *Injection Quill and Static Mixers:* Provides a point of dosing into the process stream and is designed to encourage mixing of the chemicals.
* *Analysers:* Determines the concentration of one or more analytes for control of the dosing system. Typical analytes include free chlorine, free ammonia, total chlorine, pH, and temperature.
* *Flowmeters:* Determines the flow rate within the system and is used to manage flow-paced dosing.
* *Local Control System:* Monitors and controls the dosing system and provides communications for the system.

# Performance Requirements

## Functional Requirements

The CDU shall be designed to achieve the following requirements:

* Be capable of automatic operation including, but not limited to; start/stop, flow-paced dosing, fault response, and alarms.
* Be capable of transmitting data to allow remote observation of the CDU performance and status via SCADA.
* To be capable of local manual operation through a locally displayed Human Machine Interface, with screens mirroring SCADA pages.
* The design must achieve the disinfectant residual as nominated by Urban Utilities or as determined by the drinking water system designer, within the tolerances described in the Project Documentation.
* Achieve a turndown ratio sufficient to deliver minimum flow within the nominated tolerances described in the Project Documentation.
* Limit chlorate generation within designed storage tanks and minimise chlorate contribution into the network.
* Located to provide safe, convenient, and unobstructed access for operation and maintenance of equipment in place, and to allow for safe removal of equipment, as per TMS1639.
* Provide for the safe transfer of chemical into storage containers, safe storage of chemical, safe drainage of stored chemicals, and safe sampling of chemicals.
* Support the prevention of and management of emergencies, including automated shutdown of equipment, spill prevention, containment and clean up, notification of control room to abnormal operation, and the provisions of documentation to assist response crews during response to an incident.

The CDU shall comply with this document and all referenced standards, unless accepted in writing by Urban Utilities.

## Consideration for Chlorate

Chlorate is a potential health hazard within drinking water supplies, and as such the design and operation of the storage system must appropriately control degradation of sodium hypochlorite.

Storage of sodium hypochlorite is a key concern for performance of CDUs. The shelf life of sodium hypochlorite is impacted by heat, pH, UV exposure, and contaminants within the storage vessel, negatively affecting the strength of the product solution and resulting in the formation of chlorate.

Design of hypochlorite systems must carefully consider factors that either generate chlorate, or the ability of operational teams to manage chlorate within the drinking water supply. In particular, designers should consider how the following aspects of hypochlorite systems impact chlorate generation:

* Storage temperature and exposure to UV.
* Storage volumes and tank design parameters, particularly minimum operable storage volumes and dead volumes within the storage tanks.
* Ability for system, particularly tanks, to be regularly cleaned of contaminants.
* Ability for Urban Utilities to utilise lower-concentration sodium hypochlorite solutions.

The design of a CDU must consider the potential and likely generation of chlorates based on the Project Documentation, site conditions, and any supplementary requirements to ensure chlorate levels are maintained below guideline levels as defined by the Australian Drinking Water Guidelines (or interim advice provided by Queensland Health where a health guideline is not specified by the ADWG). This should be documented in the P&IDs as a part of the design process as defined in the Project Documentation.

The generation of chlorate is significantly impacted by operation and maintenance of the system. The design should ensure that the intended operation and maintenance of the system is understood during the development of a Basis of Design and the Functional Specification.

The system shall be designed to suit regular draining and flushing of the storage tank, including the provision of permanent connection of flushing water and accessible drain ports.

Where required in the Basis of Design, the design of the system shall consider flexibility in the concentration of sodium hypochlorite to allow future reconfiguration of the system for lower concentrations. Unless stated otherwise in the project documentation, the system must be capable of being reconfigured (through the fitment of larger tanks and dosing pumps only) to allow dosing of sodium hypochlorite at concentrations between 4% w/v and 12.5% w/v while achieving the target dose and other stated performance requirements.

## Durability

The minimum design life for the system components shall be as per Table 7‑1 and TMS1639.

Table 7‑1 Design life

|  |  |
| --- | --- |
| **Component** | **Minimum Design Life** |
| Dosing Pumps (Capacity < 30L/h) | 10 |
| FRP/GRP/PE/PVC Process Tanks | 25 |
| Process Pipework and Ducting | 25 |
| Protective Coating on Metalwork | 25 |
| Protective Coating on Concrete | 25 |

## Reliability

The design shall ensure that critical systems with a high rate of failure are installed with a functional standby in an n+1 arrangement. Typical equipment requiring standby include, but are not limited to:

* Dosing pumps, with each provided a single pressure relief valve and pressure sustaining valve.
* Dosing system strainers.
* Analyser system strainers.

Where functional standby equipment is required, it shall be permanently installed, and capable of automatic changeover/operation without operator intervention.

The system shall be designed with consideration of the impacts of possible failure modes to water quality and safety, with failure mode feedback provided to the control room via the SCADA system.

A back-up power supply shall be provided, sufficient to maintain communications with the instruments and SCADA for 8 hours in the event of a power outage.

Control and communications equipment shall manage cybersecurity risks in accordance with TMS1733.

The CDU shall include controls, either as standalone or integrated with other equipment at the site, and account for hardwired instrumentation linked to operation of the CDU to allow for manual operation on-site.

Consideration shall be given for the implementation of set points to avoid the inadvertent operation that can be reasonably predicted to result in over-dosing or fail to detect over-dosing during system operation. The control system must prohibit the following except where permitted by the Project Documentation:

* The setting of target setpoint concentrations in excess of the ADWG health limit.
* The setting of warning, fault or alarm setpoints in excess of the ADWG health limit.
* Extended delays prior to fault, warning or alarm of the system.
* Commanded dosing rates by the dosing pump that would result in an increase in concentration greater than the ADWG limit.
* Operation in ‘Remote Manual’ mode (refer to Section 8.5.4) without an alarm raised on SCADA.

## Operations & Maintenance

The design and construction of the CDU shall consider the lifecycle operation, maintenance, renewal, repair, and demolition requirements of Urban Utilities. This shall include the general location, operating procedures, equipment availability, and materials availability. The designer shall confirm operational requirements not included in the Project Documentation through consultation with Urban Utilities to establish this information where required.

The system shall be designed to ensure convenient, safe, and unobstructed access for operation and maintenance with the equipment in place. The electrical switchboard and communications equipment shall be designed and located such that safe access to the switchboard and communications equipment is available where containment of the chemical is compromised. Consideration should be made for future removal or replacement processes. The operations and maintenance requirements shall include:

* O&M Documentation furnished in accordance with Project Documentation requirements and the Deliverables Requirements List (DRL).
* Ergonomically appropriate and safe access for persons, and associated equipment and plant, to undertake planned and reactive maintenance on:
	+ Dosing pipework and appurtenances
	+ Dosing pumps
	+ Dosing point
	+ Chemical tank and delivery bunding
	+ Instrumentation
	+ PLC and HMI
	+ Access for responsive maintenance activities including valve replacement, and equipment replacement (i.e., pumps, switchboards, instrumentation).
* Development of spares and consumables requirements and Urban Utilities' acceptance of a critical spares list (Deliverable Requirement List template TEM655).

# DESIGN – Chemical System Requirements

The design for all Urban Utilities assets must be undertaken by suitably experienced and competent persons in accordance with legislative requirements, Urban Utilities requirements and other reasonable obligations of a design. The Contractor shall nominate designers prior to engagement and submit to Urban Utilities for review.

The design must enable Urban Utilities to fulfil its obligations under all relevant legislation including to operate and maintain infrastructure with consideration of safety, environment, and other relevant duties.

## Dosing Systems

#### Dosing Pumps

Dosing pumps shall be either mechanically or hydraulically operated, piston diaphragm reciprocating-type, driven by an electric motor. Solenoid-driven pumps, double simplex capabilities via multiplexing, and ganging of gearboxes are not acceptable.

An ‘n+1’ arrangement configuration with identical duty and standby dosing pumps (brand, type, and capacity range) shall be provided. Changeover to the standby pump from the duty pump shall be automatic and shall be configured on time run as well as pump fault.

Metering accuracy of the pumps shall be better than 2% of the set rate regardless of system suction and discharge conditions. The pump dose rate turndown ratio shall be at least 1:100 or as specified in the Project Documentation. Dosing systems shall maintain metering accuracy of 2% within the operating range within the Project Documentation, with particular consideration to be taken regarding the accuracy of the system during periods of low dosing flow. The pumps shall meet all diurnal flow requirements by means of speed control without adjustment to stroke length.

The pumping system shall incorporate local indication of the set rate.

Pumps shall incorporate automatic detection of overpressure, burst pipe, cavitation and air bubbles in diaphragm. Where a degassing function or head is available, it is to be incorporated into the design.

Pump materials shall be as specified in Table 8‑1.

Table 8‑1 Dosing System Component Materials

|  |  |
| --- | --- |
| **Dosing System Component** | **Acceptable Materials** |
| Pumps |
| Head | PVDF, PTFE, PVCu |
| Diaphragm | PTFE |
| Elastomers | FKM, PTFE-Coated FKM |
| Dosing Valves |
| Body | PTFE, PVDF, PVCu |
| Ball Check | PTFE |
| Elastomers | FKM, PTFE-Coated FKM |
| Springs | PTFE-Coated, Tantalum/Tungsten Alloy |

#### Instrumentation

The discharge flowrate from the dosing system shall be measured prior to mixing with either carrier water or the liquid being dosed. Flow measurement should be achieved with pump-integral flowmeters where the Contractor can demonstrate the accuracy of this section.

Where a CDU doses directly into a drinking water network main, a flow meter is required immediately downstream of the chemical injection point for use in flow-paced dosing.

All flow meters shall be selected to ensure they can measure flows to within 5% accuracy of the measured value throughout all diurnal operating scenarios. Flow measurement shall be selected based on flow range. Where available, pump integral systems are preferred, although electromagnetic flowmeters may be accepted where chemical compatibility and accuracy through the flow range can be demonstrated.

All water chemistry instrumentation shall be capable of being calibrated using standard solutions and without the use of special tools. The ability of an instrument to be calibrated ‘online’ using process water does not meet this requirement.

Instruments impacted by variation in the flow rate through the instrument are to be selected only where a flow-invariant instrument of appropriate accuracy is not available. Where such an instrument is required, appropriate control of the flow rate through the instrument during regular operation and calibration (including where standard solutions are utilised) shall be provided.

All instruments selected shall be verified as fit for purpose and chemical compatibility by the manufacturer.

Pressure instruments shall be isolated from contact with the chemical using a suitable isolation diaphragm. Where a mechanical pressure indicator is used, it shall be of the hydraulic oil type.

#### Carrier Water Systems

Carrier water systems shall be utilised where suitable water is available, and where the dosing point is not immediately adjacent to the dosing system. Carrier water systems shall:

* Include an injection quill to ensure chemical mixing.
* Provide isolation to allow removal of injection quills for cleaning.
* Include monitoring of the flow state with a flow measurement device to determine whether the minimum required carrier water flow has been achieved.
* Prevent backflow and recirculation of dosed water to analysis streams.

Flow measurement devices shall establish whether flow is occurring and provide feedback on the rate of flow for in-person troubleshooting.

Circulation pumps provided shall feature a zero-flow head below the pressure rating of the system. Pumps and motors shall comply with TMS1639.

#### Dosing Point

The dosing point shall be located within a bunded and spray protected area. Leakage of chemical at the dosing point shall be detectable and result in an automatic shutdown of the dosing system.

Dosing points shall be provided with an injection quill and non-return valve. The design of the injection quill shall ensure chemical is dosed into the centre of the pipework to aid mixing. Where the dosing point does not produce turbulent flow for a sufficient mixing length before the next junction or fitting, a static mixer shall be installed immediately downstream.

Where diluted chemical recirculates back to a reservoir, a dosing point shall be provided into the carrier water line.

Dosing points shall be provided with suitable isolation to allow maintenance of injection quills. Dismantling joints or flexible pipework should be used to facilitate easy and prompt quill removal. Withdrawable injection quills shall be preferentially utilised over non-withdrawable injection quills where impacts to access of the quill and surrounding equipment is minimal. Non-withdrawable injection quills may only be used where the dosing point can be reasonably isolated without interruption to water supply.

#### Mixing

Where diluted chemical is injected into a reservoir, the reservoir shall have a mixing system (typically through appropriate design of carrier water injection or the provision of a reservoir mixer). The injection point shall be located to provide optimum mixing, and an assessment of the injection location and velocity shall be conducted to ensure appropriate mixing is provided. Undiluted chemical shall not be dosed directly into reservoirs or tanks. The returned diluted chemical into the reservoir shall be located to maximise mixing and prevent creation of dead spots by short circuiting the reservoir volume. The outlet shall be located such that it does not limit the operable level of the reservoir (e.g., pump suction minimum submergence). The outlet design and location shall minimise long-term damage and erosion of the reservoir wall due to the constant flow of water.

Where undiluted chemical is injected directly into an inline system, the design of the system shall consider whether a static mixer is required downstream of the injection point.

## Chemical Storage

#### Storage Volume

The storage volume for the system shall be specified by Urban Utilities as a part of the Project Documentation.

#### Bunding

The chemical storage tank shall be installed within a bund sized to 110% the volume of the tank. The bund wall shall comply with the crest-locus limit as described in AS 3780. Where possible, the dosing pumps and pipework shall also be contained within the bund. Where dosing pipework is not contained within the bund, it shall be provided with containment as per sections 8.3.3 or 8.3.4.

The bund shall be sized to allow unimpeded access for inspection and maintenance activities. Where personnel are required to access inside bunded areas, a minimum walkway of 1.1m width and 2.3m vertical clearance shall be provided.

The bund shall be designed to withstand the hydrostatic loading of the stored chemical at the capacity of the bund.

Where a concrete bund is used, the design and construction shall comply with AS 3735. The bund wall height shall be traversable in an emergency. All sides of the bund wall shall be accessible for maintenance and inspection. The concrete shall be coated with a chemically compatible coating. The coating shall be sufficiently abrasion resistant to protect the bund for the full design life without requiring reapplication. Where tanks are mounted to coated areas, bitumen matting or other suitable buffer material shall be used to protect the tank and coating from abrasion during fill cycles, point loading and other imperfections.

Where fasteners are required to fasten fixtures to the bund, fasteners penetrating the coating and concrete shall be affixed using proprietary chemical anchor systems. The adhesive shall be chemically compatible with the chemical stored. Mechanical-style fastening systems that penetrate bund coatings are not permitted. Where possible, fixtures should be supported on cantilever brackets off the bund wall to reduce the exposure to chemicals, and to reduce trip hazards.

The design shall ensure the bund can be safely emptied either though a dedicated and isolated bund drain or via a sump and removable sump pump. Bunds shall be designed to minimise the collection of rainwater/stormwater.

#### Storage Tank

The chemical storage tank shall be designed and constructed in compliance with AS 3780 and other standards identified in the Project Documentation.

Appropriate access shall be provided to allow complete external inspection of storage tanks without the removal or disassembly of equipment.

The maximum fill level of the storage tank shall be clearly indicated. The tank capacity, maximum fill line, maximum temperature, and the maximum specific gravity of the stored chemical as nominated by the manufacturer shall be clearly indicated on the tank.

The tank shall be secured appropriately. Where outdoors, the design shall consider all appropriate design actions as per AS 1170.

The design shall consider the impact of storage system design on chlorate generation for the system under consideration. Draining and flushing of hypochlorite tanks prior to chemical deliveries is a typical maintenance task, and storage tanks must be designed to facilitate this activity. In particular, sodium hypochlorite tanks shall:

* Be provided with a permanent water flushing nozzle.
* Ensure tank geometry supports utilising at least 98% of the storage volume as working volume.
* For tanks storing 100 litres or less, include a graded floor leading to a drain port with a camlock coupling.

Regardless of type or size, all chemical tanks must be provided with an overflow, vent and drain nozzles. All chemical tanks must be provided with an inspection port to allow visual inspection of the tank internals. Tank vents shall be directed outside of enclosed spaces and shall ventilate directly to atmosphere. All tank nozzles open to atmosphere shall be protected from vermin and insects with a chemically resistant screen or other device as approved by Urban Utilities.

Personnel access into the chemical tanks shall be provided where the tank has a capacity of 1500 L or greater. The number and location of the access points into the tanks shall suit the expected maintenance activities. All access hatches shall be sealed and the tank shall conform with AS 2865.

#### Instrumentation

The chemical storage tank shall be instrumented to indicate the tank level. Level instruments shall be accurate to 1% of the full storage volume of the tank. Instrument selection and installation shall consider the manufacturer’s requirements (including condensation, chemical vapours, foaming, and tank geometry).

Level switches shall be used to provide backup detection of abnormal tank conditions and shall generate alarms when activated. The provision of level switches shall be reviewed during the HAZOP, however at a minimum detect overflow and low-level conditions. Detection of low-level within the storage tank shall be provided with ‘warning’ and ‘alarm’ levels to facilitate timely refilling of tanks.

Storage bund level detection shall be provided, and where liquid is detected within the bund an alarm shall be raised. The overflow alarm shall cut power to the chemical delivery transfer pump (through controller power provided by the CDU). Where the tank has a volume of greater than 1500 L, an overflow shall trigger a flashing light visible from the CDU and from the position of a chemical delivery vehicle pump operator.

All tank level instrumentation shall be connected to SCADA and alarms shall be communicated to the control room.

The air temperature inside the CDU, adjacent to the chemical storage and dosing pipework shall be measured and connected to SCADA.

Access to instrumentation shall be considered as a part of the design of the storage system, with ergonomic requirements and avoidance of working-at-heights to be considered as a part of the selection (both in terms of technology and communication features) and placement of instruments.

#### Segregation

Storage and dosing systems for incompatible chemicals (including pH adjustment or ammonia co-located with sodium hypochlorite) shall be designed as separate CDUs. The design shall ensure that chemical storage and dosing systems are segregated in compliance with AS 3780 and the ADG Code.

The segregation area may be used for common equipment not containing chemical, including switchboards, work areas and other miscellaneous items.

Separate ventilation systems shall be provided for each CDU. Each CDU shall be accessed via a separate entrance.

#### Ventilation

CDU buildings and enclosures for all chemicals shall be ventilated to comply with AS1668.

The design shall consider ventilation and management of aqueous ammonia off gassing when designing a monochloramine CDU. Where possible, the system shall be designed to avoid the formation of hazardous atmospheres under normal and abnormal operation. Where this cannot be avoided, impacted areas shall be designed and installed as per TMS1732 and AS/NZS 60079.

All openings into an aqueous ammonia tank shall either contain a water trap or shall terminate outside the dosing building at a height designed for sufficient dispersal of vapours. Where water traps are used, such as on overflow pipework, they shall:

* Have a potable or service water line installed to allow the filling of the trap by turning one valve.
* Have a drain to allow the removal of trapped liquid.
* Be made from transparent material to allow visual inspection of the liquid level in the trap.

The water trap shall be designed for replenishment to prevent ammonia saturation.

The ventilation of the CDU shall be sufficient to maintain asset reliability and prevent corrosion of equipment from gaseous ammonia and sodium hypochlorite off-gases.

## Pipework and Fittings

#### Materials

Pipework and fittings shall be manufactured of material that is chemically compatible with the dosing chemical.

Where possible, all pipework and fittings conveying chemical should be made from PVCu. PVCu pipework and fittings shall be rated to ASTM D1785 Schedule 80 and shall be rated by the manufacturer to a minimum pressure of 16 bar.

Flexible hose to convey chemicals may be used to minimise volume contained within the system or aid disassembly of equipment for maintenance. Where flexible hose is used, it shall be of PVCu construction, rated by the manufacturer for a minimum operating pressure of 16 bar. Except where provided to aid in the disassembly of equipment, flexible hoses shall have a maximum internal diameter of 9 mm.

The manufacturer’s pressure rating of selected pipework shall be verified to meet the design requirements across the full design range of chemical concentrations, temperatures, and service pressures. Where it is not possible to procure pipework or fittings that meet the requirements of this section, justification for selections shall be provided in the design report, considering the safety of the system during improper operation or failure of equipment and accepted by Urban Utilities prior to construction.

The Contractor shall consider the impact of UV damage to thermoplastic pipework and where required ensure pipework is protected from UV exposure to meet the design life listed in Table 7‑1 Design life

#### Jointing

Pipework shall be jointed in accordance with TMS1639. Where disassembly of thermoplastic pipework is not required, a solvent-cement jointing system shall be used as the jointing method. Solvent-cement jointing systems shall be rated as suitable for achieving the design life in Table 7‑1 for the chemical exposure, temperature, and pressure requirements of the joint. Where disassembly of thermoplastic pipework is required, union-style joints shall be used preferentially over flanged or threaded joints.

Jointing for flexible hoses shall be via compression-style fittings where suitable. Where compression-style fittings cannot be used, flexible hoses shall be connected using barbed fittings and provided with ‘T-Bolt’ style clamps. Worm-drive style clamps shall not be used.

#### Pipework Configuration

The design shall ensure that the dosing pumps are able to be calibrated without removal and without entering the bund. This is typically achieved with a calibration tube upstream of the pump, along with associated isolation valves. Calibration tubes shall be capable of being filled directly from the storage tank without manual decanting of chemical.

Each discharge line from the dosing pumps shall be maintained at a minimum pressure as specified by the pump manufacturer to maintain dosing accuracy and protect against siphoning over all potential downstream pressure conditions. Where a suitable minimum pressure cannot be achieved through geometry, a pressure sustaining valve suitable for the chemical service shall be provided.

Overpressure prevention shall be incorporated in the discharge pipework of each dosing pump. Where electronic methods are proposed to limit overpressure, the design shall ensure that the system provides appropriate safety by undertaking an AS 4024 assessment of the system as part of the Safety in Design assessment. Mechanical pressure relief valves shall comply with Section 8.3.9.

Pressure indication immediately downstream of the dosing pump is required to verify operation of the pumps and enable the verification and adjustment of settings to any pressure relief and pressure sustaining valves. Where pressure indication is provided through electronic means (e.g. integral sensor on the dosing pump), a nozzle shall be provided to allow a temporary pressure instrument to be installed to verify operation of the instrument. The design must ensure there is an ability to verify any permanent pressure indicators, relief valves, and sustaining valves, without requiring their removal.

Strainers with a maximum opening of 0.5 mm shall be provided in the pump feed lines. Strainers shall be configured to ensure that blockage of one strainer does not result in a loss of operation for the entire dosing system. Strainers should be oversized by a minimum of two pipe sizes to maximise basket capacity.

The design shall consider accumulation of gas in pipework high points and shall adequately mitigate where required. An assessment of the gas management shall be included in the design report. Gas management is typically achieved by:

* reducing the volume of pipework,
* grading of pipework to manage gas bubbles,
* de-gassing valves,
* temperature of the media, and
* pump instrumentation to detect gas build-up and automatic de-gassing pump control modes.

Pipework fittings and instrumentation should be installed above ground, with consideration given to ergonomic access and operation.

#### Secondary Containment and Spray Protection

All chemical pipework external to the bund shall be provided with secondary containment pipework. For the purposes of this section, chemical pipework is pipework containing in normal operation:

* Undiluted chemicals, including hypochlorite, liquid ammonium sulphate or aqueous ammonia;
* Diluted chemicals where the concentration may be present a safety hazard to operational and maintenance personnel or members of the public as determined in a risk assessment (refer to PRO84);
* Diluted chemical where the concentration may cause harm to the environment, including protected fauna and flora or waterways as determined in a risk assessment (refer to PRO84).

The arrangement of these secondary contained pipe systems shall:

* Allow leaks from the carrier (inner) pipe to be readily identified and contained by draining to the CDU bund or to the dosing point. Where leaks do not drain back to the bund, they must be contained by other means, and shall be detectable and alarmed.
* Facilitate repair or replacement of the carrier pipe.

Acceptable types of double containment pipework include:

* Continuous runs of flexible hose, contained within rigid containment conduit.
* Jointed rigid carrier pipe/ containment pipe proprietary systems.

Where a chemical containment pipe drains into a pit external to the bund, leak detection shall be provided via a level switch with alarms raised and interlocked to trip the dosing pumps. The piping and pit arrangement shall meet the following requirements:

* Leaks shall be fully contained within the pit.
* Ground or surface water shall not be able to enter the pit to maintain storage capacity and avoid false leakage alarms.
* Any chemicals that may have leaked into the pit shall be able to be safely removed by operators.
* The pit geometry shall be designed to avoid the formation of a confined space.

#### Buried Pipework

Buried pipework shall be designed and installed in accordance with AS 2566 and AS 03. Buried non-metallic pipework shall have continuous detectable marker tape placed in the trench above the pipe to allow detection.

Pipework and hoses conveying chemical (including carrier water lines) shall not be directly buried. Containment conduits terminating within level-monitored and bunded areas shall be provided. It shall be possible to renew contained chemical lines without excavation.

#### Maintainability

Adequate provision shall be made for isolation, flushing, and draining of pipework and equipment for maintenance. This shall be assessed in conjunction with Urban Utilities operations and maintenance teams as a part of the Safety in Design processes in accordance with PRO379.

#### Valves – General Requirements

Isolation valves shall be of the quarter-turn type and shall clearly indicate valve position.

Isolation valves shall not be used to throttle flow. Where flow throttling is required, an adjustable and lockable-in-place valve of an appropriate type shall be provided (selected to suit cavitation experienced during throttling).

Valves shall be chemically and mechanically compatible with the dosing chemical.

Where ball valves are used, the relieving holes shall be drilled in the back of the ball to prevent over pressurisation when in the closed position. All drilling of ball valves shall be approved and conducted by the manufacturer only. Field/secondary manufacturer rework of ball valves shall not be accepted.

#### Pressure Sustaining Valves

Where pressure sustaining valves are used to maintain pressure downstream of the dosing pumps, they shall be adjustable, with a method of calibration without requiring removal. The calibrated sustaining pressure shall be labelled adjacent to the valve. The valve diaphragm shall be chemically compatible with the dosing chemical.

Each pump shall have an independent pressure sustaining valve. The pressure sustaining valves shall be contained within the pump’s isolation valves to allow easy isolation for maintenance.

#### Pressure Relief Valves

Where pressure relief valves are used to prevent overpressure in the dosing pipework, pressure relief valves shall be sized to maintain system pressure at or below 90% of the rated system pressure at maximum flow conditions. For the purposes of the design of pressure relief systems, maximum flow conditions shall be defined as 110% of the greatest flow at the point of relief, considering normal, abnormal, manual operation or failure of the system.

Pressure relief valves shall discharge into the chemical storage tank. Discharge to the tank may occur indirectly (e.g., through an inspection trap or calibration tube), although it must not be possible to isolate the discharge of the relief valve.

Pressure relief valves shall be adjustable, with a method of calibration without requiring removal. The calibrated relief pressure shall be labelled adjacent to the valve. The valve diaphragm shall be chemically and mechanically compatible with the dosing chemical.

#### Pulsation Dampeners

The discharge pressure at the discharge of the CDU shall be maintained within a 10% range. Where this cannot be controlled by operation of the pump, a pulsation dampener shall be provided.

Where a pulsation dampener is provided, it shall:

* Be constructed with materials compatible with the chemical.
* Be provided with a bladder to serve as a gas reserve for pressure management.
* Be provided with a pressure indicator and Schrader-style gas filling port.
* Be provided with an isolation valve on the liquid port to allow removal of the dampener.
* Be provided with a label indicating the commissioned charge pressure and maximum charge pressure.

## Chemical Delivery

Chemicals shall be delivered to the CDU storage tank without requiring manual decanting by Urban Utilities operations and maintenance staff. Unless otherwise specified in the Project Documentation, chemical systems shall be designed for transfer from a tanker. Chemical delivery shall comply with AS 3780 and the ADG Code. Chemical delivery processes shall not involve any manual mixing or dilution.

#### Storage Tank Filling System

A tank filling system shall be provided for all chemical storage system except where specifically excluded by the Project Documentation.

Filling pipework shall be designed to comply with AS 3780 and the ADG Code. Filling pipework shall be capable of being drained and include a valve to allow the fill line to be isolated when not in use. The fill line shall be provided with a DN50 camlock connection point or as detailed in the Project Documentation. All filling pipework external to the tank bund or vehicle delivery bund shall be double contained.

A hose reel connected to potable or service water shall be provided with sufficient length to reach all areas of the chemical delivery bay to facilitate cleaning of spills.

The connection point shall be located to ensure visibility of the connection point and the tank from the nominated vehicle delivery bund location or other location where the operator will stand during filling. The operator shall be protected from potential spraying from the connection point. A bleed valve shall be installed downstream of the camlock fitting and piped to a safe area to allow the operator to confirm that no pressure is in the system before uncoupling.

The tank filling system shall include a controlled power source, capable of delivering power as per Table 8‑2 or as nominated in the Project Documentation. The power source shall be interlocked to tank level instrumentation to prevent tank filling beyond the nominated tank high level.

Table 8‑2 Controlled Power Requirements

|  |  |  |
| --- | --- | --- |
| **Phases** | **Voltage** | **Current** |
| 1 | 230 VAC | 20A |
| 3 | 400 VAC | 15A |

The tank filling system shall additionally:

* Indicate the tank fill level. The indication shall be readable from the vehicle delivery bund or other location where the operator will stand during filling.
* Include an emergency stop push button, located such that it is accessible during a catastrophic failure of the filling system.
* Include a beacon and klaxon, which operate when the tank high-high level is reached and raise an alarm on SCADA.

#### Chemical Delivery Bay

The requirement for a chemical delivery bay should be assessed through a risk assessment process in compliance with AS 3780 and PRO84. The assessment shall consider the potential for environmental and safety impact during the management of a loss of containment by the delivery vehicle or chemical delivery hose.

Where a delivery bund is provided, it shall:

* Include a containment volume in accordance with AS 3780 or as detailed on the Project Documentation.
* Be designed to direct stormwater out of containment area when not in use.

Where the delivery bund includes a subterranean storage tank, the delivery bay shall include a digital instrument readable by the vehicle pump operator and a dipstick for manual level confirmation. A high-level alarm shall be locally indicated and communicated to the control centre.
The delivery bund shall be designed to allow the delivery vehicle to drive out forward. Where possible, the bund should allow forward-in, forward-out, however where insufficient space is available, the delivery bund shall be designed to safely allow reverse-in, forward-out.

## Chemical Dosing Control

#### Water Quality Analysis

Sodium hypochlorite CDUs shall provide instrumentation to suit analytes and sampling locations as per Table 8‑3 or as detailed in the Project Documentation.

Table 8‑3 Sodium hypochlorite water quality analysis requirements

|  |  |  |
| --- | --- | --- |
| **Parameter** | **Locations (Inline Dosing)** | **Locations (Recirculation Dosing)** |
| Total Chlorine | Pre-dose, Post-dose | Pre-dose / Reservoir Outlet |
| Free Chlorine | Pre-dose, Post-dose | Pre-dose / Reservoir Outlet |
| pH | Pre-dose, Post-dose | Pre-dose / Reservoir Outlet |
| Temperature | Pre-dose, Post-dose | Pre-dose / Reservoir Outlet |

Monochloramine CDUs shall provide instrumentation to suit analytes and sampling locations as per Table 8‑4 or as detailed in the Project Documentation.

Table 8‑4 Monochloramine water quality analysis requirements

| **Parameter** | **Locations (Recirculation or Inline Dosing)** |
| --- | --- |
| Total Chlorine | Pre-dose, Post-dose |
| Free Ammonia | Pre-dose, Post-dose |
| Total Ammonia | Pre-dose, Post-dose |
| Monochloramine | Pre-dose, Post-dose |
| pH | Pre-dose, Post-dose |
| Temperature | Pre-dose, Post-dose |

#### Control System Requirements

CDUs shall be provided with a local control system compliant with TMS1733.

Where a CDU is dosing directly into a transfer main or pressure boosted system (“inline dosing”), it shall be configured to allow setpoint flow-pacing (control scheme calculating the dose rate based of both the deviation of analyser residuals from setpoint and the water main flow rate) using a flowmeter. An inline dosing system shall also:

* Assess the potential for overdosing due to instrument failure/error and implement appropriate controls to limit dosing pump output.
* Implement control system limitations to prevent an increase in concentration of total chlorine of greater than 5mg/L from the CDU under abnormal operating conditions.
* Include analysis before and after the dosing point to validate closed-loop control of dosing pumps.
* Be configured to allow fixed flow-pacing dosing using a fixed concentration for addition of chemicals and feedback from the water main flowrate.

Where a CDU is dosing into a recirculating system (typically a reservoir) it shall:

* Be controlled with an analyser in setpoint control, measuring concentration of water prior to and post dosing.
* Ensure appropriate mixing is provided in accordance with section 8.1.5.
* Ensure water used for analysis is representative of the reservoir, and is not impacted by recirculation, network demand or the operation of other equipment.

Design of the dosing control system shall consider the potential for variability within the process and the impact that failed, or out-of-calibration instruments or other equipment used to determine dosing pump flow rate could have on the system.

Control system shall permit local operation with the following modes:

* Setpoint flow-pacing, calculating the dose rate based of both the deviation of analyser residuals from setpoint and the water main flow rate.
* Fixed flow-pacing dosing, using a fixed concentration for addition of chemicals and feedback from the water main flowrate.
* Fixed-flow dosing, allowing the pump flow rate irrespective of water main flowrate.
* Manual dosing, allowing the pumps and valves to be directly controlled locally, including override of interlocks and alarms.

Proprietary control systems (such as those integrated into analysers) shall not solely be used to determine dosing pump flow rate for inline dosing configurations. Code to prevent overdosing shall be auditable from the system’s functional description to verify functionality, including all calculations, interlocks and alarms. The design of the control system shall prevent overdosing during abnormal operation of instruments or other equipment.

#### HMI

A local HMI compliant with TMS1733 and TMS1151 shall be provided. The HMI shall:

* Be accessible by operational and maintenance staff without opening switchboards or other enclosures containing exposed LV terminals or wiring.
* Replicate the display, configuration, status, alarms, faults, setpoint entry and other operator commands as provided on the SCADA system.

#### Control Modes

The control system for the CDU shall contain the following modes:

* *Local:* Dosing pumps may be manually operated through HMI and/or the controls provided on the dosing pump. This mode shall trigger an alarm to the control room to identify the risk of overdosing and ensure appropriate administrative controls are in place.
* *Remote Manual:* Dosing pumps may be operated manually through SCADA based on a set dosing pump flowrate. This mode shall trigger an alarm on SCADA.
* *Remote Automatic:* The CDU operates automatically to achieve a setpoint concentration based on analyser feedback and flow-pacing (where applicable).

#### Interlocks and Alarms

Interlocks and alarms for the CDU shall be reviewed as a part of the HAZOP process. At a minimum the CDU shall automatically shut down on:

* Overpressure
* Burst/leak detection
* Bund high-level detection
* High-high total chlorine / monochloramine

At a minimum, the CDU shall generate alarms for the following conditions:

* Chlorine / monochloramine concentration (high-high, high, low, low-low)
* Pump Discharge Pressure (high, low)
* Pump fault
* Low flow rate
* Tank level (low-low, low, high, high-high)
* Tank level rate of change (high, low)
* Tank filled without emptying
* High bund level
* Safety shower / eye wash active (prior to delay period)
* Safety shower / eye wash in use (following delay period)
* Safety shower low pressure
* CDU intruder
* Fault protection devices activated
* Power fault
* Operation in ‘Remote Manual’.

#### Chlorate Management

Where the CDU is dosing into potable water, the chlorate contribution shall meet the site-specific chlorate target under all weather conditions as provided in the Project Documentation. The design shall consider temperature, UV, chemical concentration, and aging chemical when managing chlorate concentrations.

CDU design controls to minimise chlorate generation may include:

* Preventing UV exposure by keeping chemical in the shade during storage, dosing and transport.
* Minimising temperature-driven chlorate generation by storing the chemical at a stable temperature of 20°C.
* Including provision to allow storage tanks to be drained and flushed between filling cycles.

It is noted that extended storage of chemical has a significant impact through decomposition of hypochlorite. The Project Documentation defines the required storage volume to enable manage operational constraints as well as the expected chemical consumption.

## General

#### Materials

#### Corrosion Resistance

The base material (without consideration for the coating) of all parts in contact with the dosing chemical (including parts in spill / splash areas such as equipment tags and labels) are required to be chemically compatible with the dosing chemical for the design life of the component/system as listed in Table 7‑1. Where selected base materials are not compatible, the design report must demonstrate the net benefit over inert options and appropriateness of the coatings to protect the base material for the design life, including the potential for incidental damage during operation and maintenance.

The design must consider the corrosion effects and the installed microenvironment or substance in contact when selecting materials.

All adhesives (including pipe jointing cements), sealants, and gaskets shall be chemically resistant, non-supportive of microbial growth, and dimensionally stable. They shall also be chemically compatible with the dosing chemical for the duration of the design life.

#### Instrument Displays

Instrument displays shall be protected from chemical corrosion, abrasion, UV, and heat to ensure they are legible for the full design life of the instrument. Instrument displays shall be legible from a distance of 1 m without requiring removal of other equipment or spray protection.

#### Backflow Prevention

Water services provided to the CDU area shall be assessed for risk of backflow and be fitted with an appropriate backflow prevention device in accordance with AS 3500.1.

#### Safety Equipment and Emergency Response

The design shall provide a method of washing down all parts of the CDU. This is typically achieved with a hose reel permanently attached to a water fixture and capable of reaching all parts of the CDU, including the unloading area. All potable water connections shall require a backflow prevention device in accordance with AS 2845 and AS 3500.

The design of the CDU shall limit the potential spray of chemicals where possible. Equipment not directly in contact with the process media shall be segregated to ensure protection from sprays and vapours.

The design of the CDU shall protect operators, maintenance personnel, and the general public from potential sources of chemical spray or splashing such as from pressurised chemical lines, pumps, and appurtenances. The operator and maintenance interactions with operating dosing systems shall be assessed to determine where splash protection is required. Particular care is to be taken where members of the public may be at risk of contact with diluted or undiluted chemical. Separation from protected places shall be maintained in accordance with AS 3780, and safety of the system shall be demonstrated through engineering studies, as applicable.

An emergency stop shall be provided for the CDU. The emergency stop shall be operable from a location of safety.

Overpressure protection shall be provided wherever it is possible to exceed the pressure rating of the pipework, storage tanks, or related equipment. Overpressure protection must not be capable of being manually overridden. Where digital systems are used to prevent overpressure, the safety of the system shall be assessed in compliance with AS 4024.

Pressure settings of all pressure relief valves and pressure sustaining valves shall be recorded on an adjacent asset label and on the system P&IDs. Commissioning set points shall be mandatory inclusions in the commissioning report.

#### Safety Showers and Eyewash Stations

Suitable provision of, and access to safety shower and eyewash stations shall be provided. Safety shower and eyewash stations shall be in accordance with TMS1639 and shall:

* Have a flat, even surface between the station and the chemical handling location, with surfaces considering the potential slip hazard during a chemical spill.
* Be positioned less than 7 m and more than 2 m away from the chemical handling location and potential sources of chemical contact. One Safety Shower and Eyewash station may service multiple chemical handling locations, provided flat, unimpeded access is available.
* Be protected from potential sources of spraying chemical.

The design shall assess the work areas that require access to safety showers and eyewash stations to determine the quantity and placement of safety showers. A safety shower must be accessible from the following areas as a minimum:

* Chemical dosing panel
* Dosing injection point for undiluted chemicals
* Tanker filling point
* Chemical storage tank where the storage bund is suitable for personnel entry

Safety showers shall only be supplied with potable water.

#### Warning Signage and Placards

Warning signs and placards shall comply with the Globally Harmonised System (GHS) of Classification and Labelling of Chemicals, in accordance with the Work Health and Safety Regulations 2011.

UV stabilised warning signs and placards shall be erected as required. These include, but are not limited to the following:

* A Hazardous Chemical (HAZCHEM) warning sign with UN number and chemical class shall be placed on the CDU site entrance and on the storage tank(s). Where the CDU site is located within a larger Urban Utilities site such as a reservoir or pump station, a sign shall also be placed at the main site entrance.
* Information panels as per current edition of the Australian Dangerous Goods Regulation shall be placed in prominent and visible locations.
* Signage on the storage tank indicating the maximum fill level, and the maximum tank capacity in litres.
* Other relevant OHS signs shall be installed in accordance with AS 1319. The signs may include, but are not limited to, safety shower, eye wash station, and non-potable water tap.
* Confined Space Entry Permit sign to be placed on the storage tank, where applicable.

#### Labelling

Pipework contents and flow direction shall be labelled to comply with AS 1345.

All pumps, valves, strainers, tanks and instruments shall be labelled with unique asset ID numbers assigned by Urban Utilities. The asset ID numbers shall be indicated on the P&ID for the CDU to allow identification of system components. Labels shall be legible from a distance of at least 1 m without removing any spray protection and shall be resistant to chemical and UV exposure and constructed from materials suitable for the environment to ensure legibility for the design life of the equipment.

#### Documentation

All CDUs shall have an Emergency Plan. The Emergency Plan shall be available on site, and in the control room. The Emergency Plan shall include, but not be limited to:

* Site plan, including services, entry and exit points and muster points.
* Fire extinguisher and safety shower
* Manifest location
* Dangerous Goods Stores
* Dosing areas
* All drains
* Adjoining reservoir / pump station site
* Emergency Assembly Area
* Safety Data Sheet (SDS)

The CDU shall have an Operations and Maintenance Manual available in accordance with Section 7.5.

Where a CDU contains more than 2500 L of chemical storage, a manifest shall be available in a HAZMAT box at the site entrance, in compliance with AS 3780.

Where required handover deliverables are not specified by the Project Documentation, as a minimum, the following documents shall be produced:

* As-Constructed Documentation
* Completed ITP and Commissioning Documentation
* Manufacturer’s Data Report
* Training Package
* Software

# Mechanical

Mechanical systems, including selection of circulation pumps, shall be designed to comply with TMS1639.

The CDU and electrical cabinets shall be designed to maintain temperatures within the chemical storage area under 20°C and in accordance with the equipment vendor’s recommendations. Climate control shall be considered to maintain stable temperatures and manage condensation. Energy sources and reduction through exterior heat rejection (CDU colour, IR paint, double skinned cabinets, compound materials etc.) shall be selected based on NPV considerations. Carbon and environmental impacts of the CDU design shall also be considered.

The noise and vibration of the CDU shall comply with STD145 and STD150.

Ventilation in the CDU shall comply with AS 1668 and Section 8.2.5.

# Electrical

## Electrical System Design

A switchboard shall be supplied for installations where pumps and mechanical equipment are required. The switchboard shall be compliant with the latest versions of Urban Utilities Specifications TMS60 and TMS1732.

Where a switchboard or a TMS1733 compliant RTU panel is required, then lightning protection design and installation shall comply with the requirements of AS/NZS 3000.

## Electrical Safety

The CDU electrical control panel or switchboard shall segregate low voltage and extra-low-voltage equipment, including wiring and terminals. All low voltage terminals and equipment shall be IP2X, located behind an interlocked door/escutcheon or be fully shrouded.

Warning labels shall be provided to indicate low voltage equipment within enclosures. Labels shall be fixed to all panels/doors/escutcheons covering the equipment to enable identification from outside the enclosure.

## Ingress Protection

All equipment within the bund, or within range of washdown sprays shall be rated IP56 or higher to prevent damage during washdown of the CDU with water.

## Fault Protection

Design of fault protection systems shall consider the grouping of equipment isolated by a single protection device as appropriate to the hazard. Designs shall limit conditions where the CDU as a whole is disabled for protection, unless required to provide appropriate level of electrical safety.

Activation of fault protection devices shall generate an alarm on SCADA.

## Lighting

Lighting shall be provided for all areas requiring access during regular operation or maintenance of the CDU. Lighting shall be adequate to respond to an emergency. The lighting installation shall meet all the applicable requirements of TMS1732.

The design shall provide a lighting system to comply with the relevant Australian Standards and the Project Documentation.  Lighting shall be designed to allow safe access and operation of the asset at night.

Energy efficiency, ease of maintenance, and reliability of the lighting system shall be taken into consideration in the design.  Light fittings shall be selected from suppliers listed in TMS62.

## General Purpose Outlets

Where general purpose outlets (GPOs) are provided, the design and installation of power outlets and switches shall comply with the requirements depicted in TMS1732 and AS/NZS 3000. The ingress protection rating of outlets and plug-tops shall be appropriate to intended usage of the areas (including washdown minimum IP56) and potential failure modes of the system.

## Instrumentation

Where possible, all instrumentation should be Extra Low Voltage (ELV). Where Low Voltage (LV) instrumentation is installed, ‘Low Voltage’ labels shall be placed adjacent to the instrument. As per Section 8.6.7, the labels shall be UV, heat, and abrasion resistant, as well as being chemically compatible for the duration of the design life.

Electrical switchboards and cabinets shall be locked with a different key to the CDU and shall be inaccessible to CDU operators, refer TMS 60 for switchgear requirements.

Critical instruments and communication equipment shall have backup power sufficient to last for 8 hours in the event of a power outage. Backup power shall be provided only to LV devices, except where required to maintain communications with instruments.

## Telemetry

Remote Telemetry Units (RTUs) shall be designed for connection into Urban Utilities’ Telemetry System. RTUs shall comply with TMS1733.

## Electrical and Control Equipment

Electrical equipment shall be selected from TMS62 - Preferred Equipment List - Electrical and Instrumentation and TMS1151 - Preferred Equipment List - Control Systems Technical Specification.

# Civil

## Location

The CDU and dosing point shall be above the 1% AEP flood level and protected from any overland flows. Site specific climatic conditions are to be considered, including wind loading impacts, prevailing wind direction and impacts on passive ventilation, solar loading impacts on heating.

The CDU shall be located with consideration of segregation from protected places, as per AS 3780.

## Vehicle Access

Design of the compound and pavements shall consider an appropriate design vehicle. The design vehicle shall be no smaller than a “service vehicle” as defined by Austroads Design Vehicles and Turning Path Templates Guide.

The site shall provide sufficient space external to the compound fence for the design vehicle and a support vehicle to park fully off the road while the gate is being opened upon entry and closed upon departure.

The site shall provide a turning bay or access loop sufficient to allow the design vehicle to enter the compound driving forward, turn around inside, and exit the compound driving forward. The vehicle access surface shall be all-weather appropriate.

The site shall provide sufficient vehicle parking space for the design vehicle and at least two additional light-commercial vehicles. Vehicle parked inside the compound, including in any bunded chemical delivery bays, shall not block other vehicles from access to the entry/exit or to any other assets within the compound. The site shall have sufficient space and clearance for emergency vehicle access.

## Site Security

The CDU and dosing point shall be provided with suitable intrusion protection to prevent access from members of the public. Security fencing shall comply with TMS176. . The CDU shall limit vermin and wildlife access. The surrounding compound should be landscaped to minimise wildlife habitation.

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# Commissioning

Prior to commissioning, a Commissioning Plan shall be submitted to Urban Utilities for acceptance. The implementation of the Commissioning Plan shall demonstrate the functionality of the CDU by testing the system as required by TMS1639 and TMS1732, including, but not limited to:

* Dosing pump calibration and draw-down test
* Point-to-point testing
* HMI acceptance by Urban Utilities
* Pipework hydrostatically tested to comply with AS 2032 and AS 2033
* Hydrostatic testing for tanks in their installed configuration
* Analyser calibration and accuracy verification testing.
* Verification of operation of overpressure protection systems.
* Temperature analyser calibration and verification testing.
* Control system site acceptance testing, including functional verification of alarms and interlocks.
* Control system factory acceptance and simulation testing

Commissioned settings of adjustable fittings and instruments shall be recorded and included in the commissioning report.

# Appendices

### Appendix A: Design Drawings

The following is a list of drawings developed for Urban Utilities on recent chemical dosing projects. These are to be used by the design team for guidance purposes only. Urban Utilities accept no liability for the use of the drawings, which must be adapted to the requirements of the particular system or network and accompanied by detailed designs certified by an RPEQ. All drawings created for the project shall conform to PRO307.

|  |  |  |
| --- | --- | --- |
| Drawing Title | Drawing Number | Revision |
| *OUTLOOK RESERVOIR TYPICAL DRAWINGS* |  |  |
| PROCESS FLOW DIAGRAM | WR023-0021-QP-DRG-00002 | O |
| PROCESS & INSTRUMENTATION DIAGRAM OUTLOOK RESERVOIR | WR023-0021-QP-DRG-00003 | O |
| PROCESS & INSTRUMENTATION DIAGRAM SODIUM HYPOCHLORITE DOSING SYSTEM | WR023-0021-QP-DRG-00004 | O |
| PROCESS & INSTRUMENTATION DIAGRAM AMMONIUM SULPHATE DOSING SYSTEM | WR023-0021-QP-DRG-00005 | O |
| *SMALL SITES FREE CHLORINE STANDARD DRAWINGS* |
| PROCESS FLOW DIAGRAM | CD0162-0021-QP-DRG-00002 | - |
| PROCESS & INSTRUMENTATION DIAGRAM OUTLOOK RESERVOIR | CD0162-0021-QP-DRG-00003 | - |
| PROCESS & INSTRUMENTATION DIAGRAM SODIUM HYPOCHLORITE DOSING SYSTEM | CD0162-0021-QP-DRG-00004 | - |
| PROCESS & INSTRUMENTATION DIAGRAM AMMONIUM SULPHATE DOSING SYSTEM | CD0162-0021-QP-DRG-00005 | - |

NOTE: The Designer must incorporate these improvements to the Outlook dosing system design

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| **Item** |
| Double containment of the chemical storage tank – The design shall include for a ‘tank in tank’ design such that any spill from the inner storage tank is capture in the outer bund.  |
| Storage tank drain – storage tank drain cannot pass directly through the outer bund wall as this creates a single point of failure. Storage tank drain to be designed so that no single point of failure exists. |
| Containment of leaks from chemical pipework – splash guards, drip trays, etc. are included and are of appropriate design / grade to capture and direct leaks from neat chemical pipework to storage tank bund or secondary containment area with level detection with pump interlock (or alternate equivalent safe design) |