STANDARD

CHEMICAL DOSING UNIT
STANDARD SPECIFICATION

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1 General

1.1 Scope
This document specifies the detailed design and construction requirements for a Chemical Dosing Unit (CDU) located in the sewer network. The primary function of the CDU is to accurately dose the specified chemical for suppression of hydrogen sulphide generation in sewage, as a part of corrosion and odour control management.

The full extent of the works required to meet this Specification, and successfully commission the unit can only be determined from the whole of the document.

1.2 Style of this Specification
This document is written in the directive style. Where an obligation is given and it is not stated who is to undertake these obligations, they are to be undertaken by the Contractor.

Where a submission, request, or proposal is required, and it is not stated who the recipient should be, it is to be provided to Sydney Water for approval.

1.3 New Designs and Innovations
This document provides an indicative solution for the Works. The Contractor may wish to develop the indicative solution shown, or produce their own design that will fully comply with the specification requirements.

Any alternative materials, designs, methods of assembly, and processes that do not comply with specific requirements of this Specification, or are not mentioned in it, but give equivalent performance outcomes to those specified, are not necessarily prohibited. Written approval from the Principal's Representative shall be sought with the design submission, prior to construction.

1.4 Responsibilities
Responsibilities relating to the contractual terms and conditions, including financial matters, and site issues are covered in the Head Contract documents. Specific responsibilities are noted in this document, but they do not necessarily describe all the activities required for the Works.

For the purpose of developer funded works, the words “Principal” and “Contractor” in this Document shall be replaced with the words “Sydney Water” and “Developer” respectively.

1.4.1 Contractor
The Contractor shall be fully responsible for the detailed design and construction being fully complaint with the requirements of this Specification, and provide a complete, functional CDU that meets all the necessary Standards, Codes of Practice, industry standards, and all statutory requirements. The complete system shall include all pipework, fittings, valves, instruments and controls, from the point of bulk delivery to the point of chemical dosing into the process streams.

In addition, the Contractor shall provide the following:

- Additional specific equipment as may be necessary for the operation, maintenance and cleaning of the particular chemical system being provided, or as recommended by Sydney Water, the chemical supplier and regulatory bodies.
• Storage tanks, process pipes, drain and overflow pipes, fittings, valves, equipment and instruments constructed of materials compatible with the chemicals stored and conveyed. All materials of construction shall be non-corroding for their chemical usage.

• Stairs, ladders and walkways, where appropriate, to allow ease of access to all storage tanks and equipment. All such stairs, ladders and walkways shall be constructed of appropriate corrosion resistant materials.

• Provide adequate access for maintenance purposes.

• Necessary facilities to ensure all spills and leakages are contained.

• Safety facilities, such as safety showers, eyewash stations, fire extinguishers, and so on.

• Tags, labels, signs, and other markings, for all these systems which clearly indicate the individual system, chemical contents, hazards, warnings, and any other pertinent information in accordance with the requirements of the relevant standards, Codes of Practice and statutory authorities, and Sydney Water’s Maintenance Management System (MAXIMO).

• O&M Manuals, WAC drawings and other documentation necessary for the optimal operation and maintenance of the CDU, as detailed in Sydney Water’s Maintenance Related Clauses for Capital and Operational Projects. All documentation submitted to Sydney Water shall be formatted such that it complies with Sydney Water’s quality documentation requirements.

• Carry out a total of three (3) Failure Mode, Effects and Critical Analysis (FMECA) workshops with relevant Sydney Water representatives. The first at the concept design stage, a second at the detailed design stage and a third at the completion of the fabrication of the unit.

• Carry out a total of three (3) Construction Hazard Assessment Implication Review (CHAIR) workshops with relevant Sydney Water representatives. The first at the concept design stage, a second at the detailed design stage and a third at the completion of the fabrication of the unit. The CHAIR workshops shall be in accordance with Sydney Water Health and Safety Procedure, HSP-058: Risk Assessment in Design and the guidelines prepared by WorkCover NSW.

• Material Safety Data Sheets (MSDS) for the dosing chemicals supplied.

• Any additional items/equipment requested by Sydney Water.

### 1.4.2 Principal

The Principal (Sydney Water), through its appointed representative/consultant, shall be responsible to provide input for the development of the detailed design required in this Specification. The input includes, but is not limited to:

• This document;

• Type and properties of dosing chemical;

• Type of dosing system;

• Location of the CDU;

• Mobility requirement of the CDU Building;

• Rate of chemical dosing (minimum and maximum);

• Delivery tanker size;

• Minimum chemical tank storage size; and
Minimum performance parameters, for example, pH and dissolved sulphide levels expected before and after chemical dosing.

1.5 Contents of this Document

Section 2 contains requirements for the general design of the CDU.

Sections 3 to 6 contain requirements for the design of specific components of the chemical dosing system, namely the Chemical Delivery Bay, the CDU Building, the Chemical Storage tank, and the Chemical Dosing system.

Sections 7 and 8 contain requirements for the submission of the design, and for the testing and commissioning of the CDU respectively.

1.6 Acronyms and Abbreviations

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
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<tbody>
<tr>
<td>ANSI</td>
<td>American National Standards Institute</td>
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<tr>
<td>AS</td>
<td>Australian Standard</td>
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<td>AS/NZS</td>
<td>Australian and New Zealand Standard</td>
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<tr>
<td>CHAIR</td>
<td>Construction Hazard Assessment Implication Review</td>
</tr>
<tr>
<td>CDU</td>
<td>Chemical Dosing Unit</td>
</tr>
<tr>
<td>EPDM</td>
<td>Ethylene Propylene Diene Monomer</td>
</tr>
<tr>
<td>FMECA</td>
<td>Failure Mode, Effects and Critical Analysis</td>
</tr>
<tr>
<td>FRP</td>
<td>Fibre Reinforced Plastic</td>
</tr>
<tr>
<td>HAZCHEM</td>
<td>Hazardous Chemical</td>
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<tr>
<td>HAZMAT</td>
<td>Hazardous Material</td>
</tr>
<tr>
<td>HSP</td>
<td>Health and Safety Procedure</td>
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<tr>
<td>IICATS</td>
<td>Integrated Instrumentation, Control, Automation, and Telemetry Systems</td>
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<tr>
<td>MAXIMO</td>
<td>Sydney Water’s Maintenance Management System</td>
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<tr>
<td>MSDS</td>
<td>Material Safety Data Sheet</td>
</tr>
<tr>
<td>NPER</td>
<td>National Professional Engineers Registration</td>
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<tr>
<td>NTC</td>
<td>National Transport Commission</td>
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<tr>
<td>OHS</td>
<td>Occupational Health and Safety</td>
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<td>P&amp;ID</td>
<td>Process &amp; Instrumentation Diagram</td>
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<td>PE</td>
<td>Polyethylene</td>
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<td>PLC</td>
<td>Programmable Logic Controller</td>
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1.7 **Reference Documents**

The following documents are referenced to in this Specification:

- **AS** Australian Standard
- **AS 1319** Safety signs for the occupational environment
- **AS 1345** Identifications of the contents of pipes, conduits and ducts
- **AS 2129** Flanges for pipes, valves and fittings
- **AS 3735** Concrete structures retaining liquids
- **AS 3780** Storage and handling of corrosive substances
- **AS 3996** Access covers and grates

- **AS/NZS** Australian Standard/New Zealand Standard
- **AS/NZS 3000** Electrical Installations (Australian/New Zealand Wiring Rules)
- **AS/NZS 4766** Polyethylene storage tanks for water and chemicals

- **ANSI** American National Standards Institute
- **ANSI Z358.1** Compliance requirements- Emergency shower and eye wash stations

- **EN** European Standard
EN 13121  GRP Tanks And Vessels For Use Above Ground

NTC Australia – Australian Dangerous Goods Code, 2009
NSW WorkCover – Storage and Handling of Dangerous Goods: Code of Practice, 2005
NSW Occupational Health and Safety Act, 2000
NSW Occupational Health and Safety Amendment Act (Dangerous Goods), 2003
NSW Occupational Health and Safety Regulation, 2001
NSW Occupational Health and Safety Amendment (Dangerous Goods), 2005
Sydney Water’s Asset Commissioning Standard Administration Procedure WWIMS0035
Sydney Water’s Health and Safety Procedure HSP-058: Risk Assessment in Design
Sydney Water’s Instrumentation and Control Standards TOG_TS01
Sydney Water’s IICATS Sewer Odour and Corrosion Standards TOG_TS08
Sydney Water’s Maintenance Related Clauses for Capital and Operational Projects
Sydney Water’s Paint Specification PCS 100 – Protective Coating Standard
Sydney Water’s Paint Specification PCS 104 – Painting Sewage Treatment Plants and Associated Equipment
Sydney Water’s Technical Specification Part 1 – Civil Works
Sydney Water’s Technical Specification Part 2 – Mechanical Works
Sydney Water’s Technical Specification Part 3 – Electrical Works
2 General Requirements

2.1 Minimum Criteria

The CDU shall be designed to:

- Provide a minimum service life of:
  - 50 years for structural elements
  - 20 years for tanks and pipework
  - 10 years for mechanical, pumping, electronic and control equipment
- Achieve a level of treatment according to the minimum requirements outlined in Section 1.4.2 of this Specification, over the designed service life, taking into account the increase in sewer system loading;
- Comply with all relevant regulatory requirements, Standards, and Codes of Practice, including, but not limited to:
  - NSW WorkCover – Storage and Handling of Dangerous Goods Code of Practice 2005;
  - NTC Australia – Australian Dangerous Goods Code 2009
  - AS 3780 – The Storage and Handling of Corrosive Substances
  - All other reference documents in this Specification;
- Not cause interruption to the normal operation of the Sydney Water sewer system;
- Have complete chemical receiving, storage, transfer, and dosing systems, and the necessary safety facilities;
- Be capable of automatic operation via Sydney Water’s Telemetry System;
- Be capable of local manual operation;
- Be capable of adjustment of the treatment level during operation;
- Be safe to construct, operate, maintain and decommission;
- Contain all spills of the chemical being used;
- Give effective process control under both routine and non-routine operations; and
- Be self-contained, to allow transport and relocation.

2.2 Site Conditions

The site is normally subjected to temperate climate conditions, with an ambient temperature range of (minus) -6°C to 50°C, and humidity of up to 100%.

Additional consideration shall be given for sites that are subjected to strong wind and saltwater spray/mist, for example, marine conditions. Thus all equipment shall be designed to accommodate and operate satisfactorily within these weather conditions.
2.3 Materials

2.3.1 General

All materials selected or adopted in the design shall be suitable for installation in the proposed environment, including contact with the chemical being used and high humidity conditions. They shall be corrosion resistant and selected to match the relevant specified design life. All materials shall be coated in accordance with Sydney Water’s Painting Specification PCS 100 – Protective Coating Standard.

2.3.2 Corrosion Resistance

All internal parts in contact with the chemical substances are required to be corrosion resistant against the chemical involved.

All bolts, nuts, and washers shall be made from stainless steel grade 316, or other stainless steel grade, which is deemed to be suitable for the application.

2.3.3 Adhesive, Sealants, and Gaskets

All adhesive, sealants and gaskets shall be resistant to oil and water, non-supportive of microbial growth, and dimensionally stable. They shall also be resistant to chemical attack by the dosing chemical.

All gaskets shall be made from butyl, Ethylene Propylene Diene Monomer (EPDM), or Viton rubber materials.

2.4 Pipework

Materials for pipe work shall be either uPVC, Class 18, uPVC Schedule 80, PE or polypropylene.

The minimum pressure rating class of all pipes and fittings shall be PN 18. All pipework selected shall be designed specifically for use in the chemical industry and resistant to chemical attack.

All pipes, including those in pipe trays and trenches, shall be painted in accordance with Sydney Water’s Paint Specifications PCS 100 – Protective Coating Standard, and PCS 104 – Painting Sewage Treatment Plants and Associated Equipment, and labelled in accordance with AS 1345.

Pipes less than 50 mm in diameter, located outside of the CDU structure shall be suitably lagged to prevent freezing at low weather temperature (< 4°C). Pipe trays located outside shall be supplied and installed with suitable covers.

Buried non-metallic pipes shall have continuous metal tape placed in the trench above the pipe to allow detection.

All chemical dosing lines external to the CDU (above ground or buried) shall be pipe-in-pipe (sleeved) arrangement. In addition to this, all chemical dosing and/or water lines passing through the CDU electrical controls room shall also be pipe-in-pipe (sleeved) arrangement. The arrangement of these pipes shall allow a leak to be readily identified and contained, and facilitate repair or replacement of the inner pipe. The arrangement of the pipework shall allow a leak to drain into the CDU bund or the dosing point.

All valves shall be full-bore type. These, along with other non-standard pipework fittings shall be double union type to minimise damage during repair and maintenance.
All lines coming from Sydney Water mains shall be provided with Reduced Pressure Zone (RPZ) valves to control the water pressure and prevent water flowing back into the mains. A separate RPZ shall be provided to ensure backflow from the Chemical Dosing Unit cannot enter the emergency shower and eye wash facilities.

A generic CDU Site Layout General Arrangement for the Potable Water Supply is provided in Appendix E of this Specification.

2.5 Civil Works
The design and construction of the civil works shall be in accordance with the requirements contained in Sydney Water's Technical Specification Part 1 – Civil Works, unless specified otherwise in this document. Where necessary, relevant Dangerous Goods Regulations shall be complied.

The CDU shall be founded on a sub-base of 200 mm thick DGB20, compacted to 98% of maximum dry density, or as nominated by the supplier of the CDU units.

2.6 Mechanical Works
The design and construction of the mechanical works shall be in accordance with the requirements contained in Sydney Water's Technical Specification Part 2 – Mechanical Works, unless otherwise specified in this document.

2.7 Electrical Works
2.7.1 Scope of Work
The electrical scope of work of this contract is for the design, manufacture, supply, delivery, installation, testing and commissioning of all electrical equipment. This includes the incoming power supply system, communication, control, instrumentation, and all necessary accessories and associated equipment, for the proper functioning of the dosing system to be installed at the site.

This includes, but shall not be limited to the following:

- Install the power supply cables from the point of common coupling, and 3-phase power supply from the Electricity Authority supply, to the side power distribution board of the dosing system, including metering, termination, lightning and surge protections. The electrical loading shall incorporate an extra allowance of 30% for future loads;
- Provision of Integrated Instrumentation, Control, Automation, and Telemetry Systems (IICATS) interfacing signals;
- Provision of all cabling and wiring between the CDU and the IICATS RTU (Remote Terminal Unit) including surge protection units;
- Provision of internal and external lighting;
- Provision and installation of all equipment, materials, accessories, cabling, conduits, power poles/posts, connections and housings to enable the system to be fully operational;
- All necessary electrics are earthed to comply relevant aspects of AS/NZS 3000;
- Site testing and commissioning; and
- Provision of Work As Constructed (WAC) drawings.
2.7.2 Standards
The design and construction of the electrical works shall be in accordance with the requirements contained in Sydney Water’s Technical Specification Part 3 – Electrical Works, unless specified otherwise in this document.

2.7.3 Electrical Equipment
All equipment shall be new and suitable for its purpose. It shall comply with Australian Standards and be rated for continuous in service condition within a switchboard. All electrical equipment supplied shall be available off the shelf within Australia.

All items of equipment shall be designed, manufactured and installed to perform their required functions reliably and efficiently. The Contractor shall take into consideration the conditions and functions of the equipment when designing the systems, and selecting equipment, to ensure the system could be operated safely and efficiently. Particular attention shall be given to equipment installed in an adverse environment and/or exposed to weather.

Temperature rise within electrical enclosures and cubicles must not exceed the maximum temperature specified for components inside those enclosures.

Live equipment and terminals shall be located behind removable covers or doors, and shrouded, to prevent accidental contact when the control panel's front doors are open, including equipment mounted on doors.

Where more than one item of equipment is supplied and installed to perform a particular function, all such items of equipment shall be identical and completely interchangeable.

The site is subject to power failure. The equipment shall be designed for automatic restart when the power returns.

The Contractor shall develop electrical circuits, and submit the electrical circuit diagrams to the Principal’s Representative for review prior to manufacture. This will be a hold point.

2.8 Instrumentation
All instrumentation including level transmitters, flow transmitter, flow switches and level switches shall comply with the Sydney Water’s Instrumentation and Control Standards TOG_TS01. If there is any discrepancy between this document and the TOG_TS01, it shall be raised to the Principal’s Representative at the Design phase, to allow him/her to make an appropriate ruling on the matter.

The Contractor shall resolve any issues of concern with the Principal and obtain written approval prior to proceeding with ordering and manufacture.

2.9 Telemetry & Control
The CDU is to be supplied as a package by equipment supplier with all necessary control and instrumentation. The CDU shall be designed for connection into Sydney Water’s Telemetry System.

Specific requirements of telemetry and control for a CDU are detailed in Sydney Water’s IICATS Sewer Odour and Corrosion Standards TOG_TS08. Unless directed otherwise, the digital and analogue inputs and outputs shall be provided as specified in TOG_TS08. If there is any discrepancy between this document and the TOG_TS08, it shall be raised to the Principal’s Representative prior to design commission to allow him/her to make an appropriate ruling on the matter.
2.10 Services
Services to the CDU shall include water supply, electrical power, telephone connection (if required), and drainage. These services are to be identified as to their location relative to the dosing unit.

Where available, recycled water shall be used for dilution water and hosing purposes.

Any water supplied to the building shall not be installed near electrical equipment.

2.11 Facility and Equipment Identification and Labelling
All equipment shall have a unique identification number beginning with SX. Sydney Water designates unique identification numbers for all its asset and associated equipment, and Sydney Water will assign these.

The facility and equipment identification and labelling shall be in accordance with Sydney Water’s Maintenance Related Clauses for Capital and Operational Projects.

A standard Sydney Water facility asset sign shall be mounted on the outside of the CDU building.

2.12 Warning Signs
Warning signs shall be erected as required. These include, but are not limited to the following:

- A Hazardous Chemical (HAZCHEM) warning placard with UN number and chemical class to be placed on the main site entrances or on the CDU building as well as the storage tanks, when a hazardous chemical is stored on site.
- Information panels as per current edition of the Australian Dangerous Goods Regulation shall be placed in prominent and visible locations. As a minimum, there shall be one each on the chemical storage tank, and another on the inside of the door to the bunded area.
- Confined Space Entry Permit placard to be placed on the storage tank.
- Capacity of the storage tank stated on the tank.

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.

2.13 Fencing (if required)
To prevent access from the general public and protect against vandalism, a man proof, cyclone wire fence shall be supplied and installed with a gate at the perimeter of the CDU area. It shall be located so as not to interfere or restrict operational and maintenance activities, including chemical tanker delivery. The Principal’s Representative will specify when fencing is required.

2.14 Elements of CDU
A CDU shall consist of the following elements:

- Chemical tanker delivery bay;
- CDU building, which contains two rooms; One for the electrical control panel & IICATS RTU, and the other a self bunded wet area room for the chemical storage tank, dosing pumps and pipe work;
- Electrical control panel;
- IICATS RTU;
• Chemical storage tank(s);
• Dosing system;
  o Pumps;
  o Pipes;
  o Valves;
  o Instrumentation;

Specific requirements for each chemical dosing system, and element of the CDU are detailed in the following sections of this Specification.

A set of CDU Process and Instrumentation Diagrams (P&ID), and general arrangement drawings and sketches are available as appendices at the end of this document. The proposed design shall be conceptually similar to them, unless instructed otherwise.

2.15 Maintenance Access

The layout of the equipment inside the CDU building shall be submitted to the Principal’s Representative for approval prior to construction. This is to ensure that access hatches, level indicators, mixers, pumps and so on, can be easily reached by personnel for maintenance and operation.
3 Chemical Delivery Bay

A chemical delivery bay shall be designed and constructed to provide safe arrival, parking, off loading, turning around, and departure of bulk chemical tanker trucks.

3.1 Location

The delivery bay shall be located adjacent to the CDU building. Unless otherwise specified, the CDU building shall be located on the passenger side of the tanker.

The unloading point shall allow the chemical delivery tanker to be fully inside the delivery bay when unloading. The unloading hose connection point is typically located inside the CDU building, and shall be no more than 6 m from the tanker connection point, as per the Dangerous Goods Code of Practice.

3.2 Access

The chemical delivery tanker shall be able to access the site safely without traffic controllers.

The delivery bay and its access shall be large enough to accommodate a tanker to be reversed into the bund and exit the site in a forward direction. Alternatively, the access shall allow the tanker to drive through, make a safe turn around and exit the site in a forward direction.

3.3 Bund

The delivery bay shall be a concrete slab with a bunded wall, to provide containment for any spill or leaks. Relevant aspects of AS 3780 shall be complied with, where corrosive chemicals are used.

The bund shall be designed as a water retaining structure in accordance with AS 3735. It shall have a capacity of at least 110% of the chemical delivery tanker volume. Unless otherwise specified, the tanker volume shall be 8,000 litres.

The bunded area shall be designed with a 1 in 75 grade towards the sump pit, such that no pools of chemical will accumulate on either side of the bund.

Any humps in the roadway at either end of the tanker delivery bay bund shall be designed to allow normal passenger vehicles to enter & exit without scraping the bottom of the vehicle.

The area between the tanker bay bund and the CDU building shall be concreted, and any spills in this area must be contained and drain into the delivery bay bund.

The delivery bay and CDU arrangement must ensure any stormwater from the surrounding roadway and ground shall be channelled away, and not flow into the delivery bay bund.

3.4 Sump and Discharge Line

A sump pit to collect liquid from the bunded area shall be provided. It shall have dimensions of 600 x 600 x 600 mm. It shall be located where it is not subjected to vehicle loading at one of the sides (outside) of the delivery bay bund. It shall be fitted with a grate/cover, made from lightweight materials, weighing no more than 15 kg, in accordance with AS 3996, Class A. The weight limit shall be labelled where appropriate.

The sump shall drain by gravity (typically a 100 mm pipe) where feasible, to an appropriate location. This may be either to a Sewage Pumping Station (SPS) inlet collecting manhole, or a wet well of
the SPS. The pipe outlet shall be above the full sewage level (such as an air gap). A manual isolation valve shall be provided on this line in a separate dry pit adjacent to the sump. This pit shall have a lightweight lockable lid. A flapper valve shall be installed at the other end of this drain line to help prevent sewer odours escaping via this line. If a gravity arrangement is not feasible, then a manually started, self-priming pump shall be provided to empty the sump.

The discharge drain line into the sewer may be combined with the discharge drain line from the CDU building bund (see Section 4.4 of this Specification).

3.5 Safety Equipment

The following safety equipment shall be provided:

- A safety shower and eyewash station, which complies with ANSI Z358.1, located within 2 to 7 m of the chemical unloading connection point. This is typically mounted to the inside of the door of the CDU building. Long water lines to the safety shower and eyewash station that are exposed to sunlight shall be lagged, as water may be heated and therefore unsuitable for use. An additional eyewash station located inside the CDU building bunded area shall also be provided.
- A UV resistant hose reel permanently attached to a water tap and capable of reaching all parts of the CDU, including the unloading area.
- Emergency shut down provision, capable of stopping the unloading operation, is to be provided at least 10 m from the unloading point; and
- Sufficient lighting to enable safe work beyond daylight conditions, particularly for the chemical delivery activities.

When the delivery bay is not adjacent to the CDU building (that is, in a remote location), an additional safety shower is required within 2 to 7 meters of the tanker connection point.

All equipment provided shall be located such that the potential for vandalism is minimised.

3.6 Tanker Power Connection Outlets

Two permanently mounted electrical power outlets are required for unloading of the dosing chemical. These power outlets are 415 V (32 amps) and 240 V (20 amps), and are interlocked with the storage tank high-level switch, to prevent operation of the tanker unloading pump on high-level. They shall be located within 7.5 m of the unloading hose connection point, and inside the CDU building. For further detail on the switch arrangement, refer to Sydney Water's IICATS Sewer Odour and Corrosion Standards TOG_TS08.
4 CDU Building

A reinforced concrete two-room building shall be designed to accommodate the chemical storage tank(s) and its bund, dosing equipment, and control panel, along with the necessary control functions, alarms and telemetry links.

The building shall be designed to be weather proof and prohibit unauthorised entry. Its construction shall be vandal-proof and painted in accordance with Sydney Water’s Paint Specification PCS 104 – Painting Sewage Treatment Plants and Associated Equipment.

4.1 Building Layout and Dimension

The building shall consist of two separately accessible rooms; a bunded dosing room for chemical storage and dosing equipment, that is capable of containing any chemical leaks or spills. The second room is a control room for electrical controls, telemetry, and document storage. The rooms shall be divided by a wall with a fixed transparent window (polycarbonate) of a reasonable size (typically 1m wide by 0.6 m high) to allow viewing of all key elements in the dosing room when operating from the control panel inside the control room. Separate doors shall provide external access into the two rooms.

The dimension of the building shall be designed to allow adequate space to work in, and regular operation and maintenance of the tank(s) and equipment to be carried out, without removal of the roof. As a minimum, the ceiling height shall be greater than 2.2 m from the ground or 1 m from the highest tank whichever is the greatest. In addition to this, when magnesium hydroxide is used as the dosing chemical, the roof shall be high enough to allow the mixer within the tank(s) to be fully removed safely, and repaired without removing the roof of the CDU building.

Normal working areas shall have immediate access to the point of safe egress. The width for emergency access and egress shall be no less than 1 m, unless specified otherwise.

The door of chemical storage area shall be a double door that can accommodate removal and replacement of the storage tank(s). Alternatively a removable modular roof with stainless steel grade 316 lifting lugs shall be provided. These doors shall have a mechanism to lock them in the open position whilst the site is attended, and lockable shut when not attended.

Where a removable roof is provided, all electrical wiring connect to equipment on the roof, such as ventilation fans shall have dismantling joints to unplug and disconnect prior to removal of the roof.

4.2 Mobility

The building shall be designed to be transportable without having to dismantle and reinstall the chemical storage tank(s), pipework, pumps, control system and all other equipment. Suitable lifting lugs made from stainless steel grade 316 shall be provided and located at the base of the building.

The design life of the lifting lugs shall be exceed the design life of the building. Structural certification from a structural engineer with National Professional Engineers Registration (NPER) with the Institution of Engineers Australia shall be provided to certify the lifting of the building. The lifting procedure shall be stated in the O&M manual and the detailed drawings.

A stainless steel plate shall be mechanically fastened to the building, stating lifting certification date, construction materials, dry weight, maximum loaded lifting weight, and maximum load for each individual lifting lug shall be provided.
Structural drawings shall be submitted to the Principal for written approval prior to construction. This shall include, but is not limited to:

- Concrete drawings with all dimensions specified (clearly showing the location of the lifting lugs)
- Concrete reinforcement drawings (plan view and sections)
- Notes pages, which captures:
  - Concrete grade
  - Finishes
  - Reinforcement grade and cover reinforcement
  - Sub-grade preparation with notes (detailing allowable baring capacity and so on)
  - Design life of building and lifting lugs
  - Design capacity of lifting lugs and lifting procedure, clearly identifying which lifting lugs to be used for transport, and loads imposed by lifting lugs
- Building certification of design and fabrication referenced for each individual drawing

4.3 Bund Floor and Wall

The chemical storage area inside the CDU building shall be bunded in accordance with the requirements detailed below. The bund shall be designed as a water retaining structure in accordance with AS 3735. It shall have the capacity of at least 110% of the total capacity of the tank(s) located within the bund compartment.

The bund wall height shall be a minimum of 400 mm. The need for high bund walls needs to be balanced against the more difficult access and emergency egress and the overall size of the building.

A high level alarm (connected to IICATS) shall be installed in the bund, to alert the operator that a spill may have occurred. The alarm set point shall be agreed with the Principal, and cause an automatic shutdown of the CDU.

The bunded area shall be designed with a 1 in 75 grade towards the sump pit such that no pools of water/chemical will accumulate on the bund floor.

The bund wall and floor shall be adequately coated in accordance with Sydney Water’s Painting Specifications PCS 100 – Protective Coating Standard. The floor surface shall be non-slippery.

If the bund height is above 400 mm from the floor level, suitable steps/stairs shall be provided on the inside and outside of the bund wall to provide safe access and egress.

All pipework shall be run around the perimeter of the dosing room to minimise trip hazards, and as far away from electrical wiring as practicable. With exception to the bund drainage pipe, all pipes shall pass through the building wall above the top of bund wall.

4.4 Sump and Discharge Line

To allow for the management of any chemical spills occurring in the bunded area, a sump shall be provided. The fall within the bund shall drain to this sump. The sump shall have dimensions of 600
x 600 x 600 mm, with the height measured from the bund floor. The design and construction of the sump shall be such that it does not lead to bund leaks/failure.

Where it is feasible to drain the sump under gravity (typically a 100 mm pipe) to either a SPS inlet collecting manhole or a SPS wet well, a separate dry pit adjacent to the CDU with a lightweight lockable lid shall be installed. A manual isolation valve shall be provided on this line. A flapper valve shall be installed at the other end of this drain line to help prevent sewer odours escaping via this line. The connecting pipe from the bund to the drain point shall be pressure rated and sealed with a suitable chemically resistant coating to avoid chemical ingression into the concrete wall. The pipe outlet shall be above the full sewage level (to create an air gap).

If a gravity arrangement is not feasible, then a manually started self-priming pump shall be provided to empty the sump. The pump shall have a suction leg and automatic low-level trip, and be installed in the sump. The pump will be used for pumping any spills back to a discharge point fitted with a 50 mm Kamlok coupling. It shall only be activated by a local stop/start station, which can be operated without entering the bund, and include an automatic low-level cutout.

A high impact, minimum IP 55 5-pin switched outlet shall be provided for connection of the sump pump. The outlet shall be mounted inside the building, on the wall, a minimum of 300 mm above the bund level. Power lead to the pump shall be captive when the switch is in the on position. The outlet shall be provided with a traffolyte label (10 mm high min. lettering) screwed to the wall above the outlet, indicating, “For sump pump - do not use for filling”.

The discharge line may be combined with the chemical delivery bay discharge line (see Section 3.4 of this Specification).

To prevent injury, the top of an internal sump shall have a grate that is easily removed without needing to enter the 110% capacity of the bund, be located where it is not subjected to loading, and such that a pump can be easily installed. The grate shall be made from lightweight materials, weighing no more than 15 kg, in accordance with AS 3996, Class A. The weight limit shall be labelled where appropriate.

External sumps shall have the 110% capacity height of the bund wall added to the 600 mm depth. They shall have a lockable, easily operated lid that will permit the addition of a sump pump. The lid shall prevent the ingress of rainwater and debris.

Where there is water supply within the CDU bunded area, a 50 mm overflow pipe shall be provided, 25 mm below the top of the 110% bund and directing the flow away from electricals, operator accesses and where possible, to sewer via a flapper valve. This can be provided in the external sump or through the wall of the CDU. The design shall include ready isolation of the water supply without the need to enter the 110% bund volume.

4.5 Electrical

All electrical equipment, including wiring, shall be installed above the full chemical bund level. All electrical equipment shall be capable of working when the bund is full of liquid. As both water and the dosing chemicals are electrical conductors, safety of personnel within the bund must be considered when designing the layout of electrical equipment within the building.

4.6 Ventilation

Adequate ventilation shall be provided to prevent condensation build-up inside the building.
The electrical control room shall be provided with an industrial quality electrical exhaust fan with a minimum of 6 air changes/hour. The fan shall be mounted high up on the western facing wall, or on the roof of the building. To provide adequate cross flow ventilation, mechanical vents shall be provided low down on the eastern wall, a minimum of 300 mm above floor level. These vents shall also be vermin proof.

If required, an air conditioning system shall also be provided for the electrical control room. This will be specified by the Principals Representative.

Electric ventilation fans shall be provided for both the chemical dosing room, and the electrical control room. Where ferrous chloride/ferric chloride is the dosing chemical, the ventilation fans must be able to run continuously, and be corrosion resistant. In other dosing systems, the fan is only required to operate when plant personnel are inside the CDU building. An automatic door switch on the CDU building shall be provided to automatically start the fans when the doors open, and stop the fans when the doors close.

4.7 Lighting

Internal and external lighting of the CDU building shall be provided to allow normal work to be carried out for 24 hours a day. The external lighting shall be provided to cover the area where filling is to take place and the entry door.

The lighting installation shall meet all the applicable requirements of Sydney Water's Technical Specification Part 3 – Electrical Works (Section E4.3: Lighting). Specific lighting requirements are described in the following:

1. A minimum illumination level for internal lighting of 400 LUX shall be supplied and installed in each room. An automatic door switch shall be provided, to automatically turn on the lights when the CDU doors are open, and shut off the lights when the doors close. One emergency luminary with a 2-hour battery back up, shall be supplied and installed for each room.

2. The external lighting shall be shall be 80W high-pressure sodium type lighting fitting. Glare from the fitting shall be carefully controlled for comfort. Lighting using unshielded lamps shall not be visible to the public at normal viewing angles.

3. The external lighting design shall be vandal proof. It shall utilise the building for mounting, where practicable. The lighting shall be controlled via a light switch located inside the control room in the CDU building. During automatic mode, the operation of the lights shall be controlled via a photocell.

4.8 Platform ladder

A lightweight, safety type platform ladder shall be supplied to provide access to the chemical storage tank manhole, level sensor, room lighting, and any elevated equipment. It must have a retractable working platform of adequate size, with safety railings around three sides. The ladder shall have wheels for easy positioning.

4.9 Safety Equipment

A safety shower and eyewash station shall also be mounted to the inside of the CDU dosing room door, within 2 to 7 m of the chemical unloading hose connection point. An additional eyewash
station shall be located within the CDU dosing room near the exit, on the furthest wall away from the dosing system and tank. The safety shower and eyewash shall comply with ANSI Z358.1.

Long water lines to the safety showers that are exposed to sunlight shall be lagged, as water may be heated up by the sun, and therefore unsuitable for shower and eyewash. A backflow preventer (RPZ valve) shall also be provided on this line.

Suitable fire fighting equipment shall be provided in accordance with the relevant requirements.

4.10 Chemical Manifest

If the chemical is classified as Dangerous Goods, and the volume stored is above the manifest quantity (i.e. >10,000 L), then a Hazardous Material (HAZMAT) box shall be mounted just inside the site main entrance gate. A chemical manifest shall be provided in the box and shall contain the following details:

- Date of preparation
- Name and contact details of Occupier / Sydney Water Responsible Person
- Contact details for two people in case of emergency
- Details of dangerous goods storages including type, location, number and volume of tanks
- Material Safety Data Sheet (MSDS) of the chemical
- A site plan of the premises which includes:
  - Location of essential site services, fuel and power isolation points
  - Location of fire extinguisher and safety shower/eye wash facilities
  - Location of the manifest
  - Main entry and exit points
  - Location and classes of dangerous goods storages and how they are identified
  - Dosing area
  - Location of all drains on site
  - Nature of adjoining sewage pumping station
  - Location of emergency assembly area
5 Chemical Storage Tank

Chemical storage tank(s) shall be provided for safe storage of the dosing chemical. They shall be located within the bunded area inside the CDU building. The preferred location of the tanks is in the corner furthest away from the control room and the entry door.

The storage volume shall be calculated between the top of the tank discharge line to the dosing pump, and the maximum fill level, measured at the bottom of the overflow line at the top of the tank. The storage tank shall be designed and constructed to provide complete draining of the tank and its connections. Equipment, such as access hatches, mixers and level sensors shall be able to easily reached from the platform ladder for ease of operation and maintenance.

5.1 Material

The storage tank shall be manufactured from high-density PE, spirally wound FRP or other material suitable for the chemical specified. It shall be designed and constructed in accordance with AS/NZS 4766 when it is made from PE, or EN 13121 for FRP. Where the dosing chemical is a corrosive substance, the chemical storage tank shall be resistant to chemical attack, and designed and constructed in accordance with the relevant requirement of AS 3780. A minimum of 1.5 times the specific gravity of the fluid to be stored in the tank shall be assumed for calculation of wall thickness requirement.

To avoid external corrosion, all welded brackets such as hold-down lugs, pipe supports, and lifting lugs, shall be designed to allow water/chemical to drain away without pooling.

The tank supplied shall be fitted out with the required branches, fittings, labelling, and identification number. The labelling requirements shall include, but is not limited to the material of construction, the name of the manufacturer and the date of manufacture.

5.2 Structural

The tank shall be suitably reinforced and supported to withstand all forces, including filling forces, without deforming when it is full. The tank shall be fabricated such that the top of the tank is capable of supporting the weight of maintenance personnel.

For a FRP tank, it shall be anchored and mounted on a suitable concrete plinth. Suitable lifting lugs shall be fitted.

Where the tank requires a mixer, such as when magnesium hydroxide is used as the dosing chemical, the mixer shall not be supported by the tank.

5.3 Access Hatch

For a covered tank with a volume capacity of 5,000 litres and under, a minimum of one 600 mm diameter access hatch shall be provided on the top of the tank.

For any other tank, the minimum dimension of the side access hatch is 600 mm diameter. The side access hatch shall be hinged to the tank wall.

The hatch shall be made from lightweight materials, weighing no more than 15 kg, in accordance with AS 3996, Class A. Weight limits shall be labelled where appropriate.
When magnesium hydroxide is used as the dosing chemical, the access hatch shall provide sufficient sealing, to prevent humidity loss.

5.4 Tank Inlet and Outlet

Tank shall have the following pipework features:

- One 50 mm diameter vent (breather) on the apex of the tank roof shall be supplied. The vent shall penetrate the roof and finish in a 180° bend with the open end facing downward. The end of the vent pipe shall be covered with a 1 mm mesh to prevent vermin ingress.
- One 80 mm diameter overflow branch in the tank wall, 50 mm down from the roof-wall joint. The overflow line diameter should be at least 1.5 times the diameter of the filling line. The overflow line shall be located such that it prevents immersion of instruments and equipment located in the tank roof and directs chemical safely away from operators and to the bund sump.
- One drain branch with minimum diameter of 50 mm shall be provided as close to the tank floor level as practicable.
- One 50mm diameter fill pipe to the top side inlet from tanker unloading point, complete with a fill valve. A 50 mm suitable male Kamlok fitting, with cover, shall be supplied and installed at the tanker filling point. This pipe shall rise vertically and then slope downwards towards the tank (1 in 100 fall). It shall enter the top of the chemical storage tank, and be located above the level of the overflow pipe.
- One suitably sized bottom side outlet. It shall be located 100 mm above the tank floor. Associated valves on the outlet pipe shall be located before the flange.
- Automatic cut out during filling when the tank reaches High Level (90%).
- Isolation (stop) valves on each of the inlet and outlet connections.
- All branches on the tank shall finish with 150 mm or more from the tank wall or roof, with a Table D or E flange of AS 2129.

5.5 Level Indicator

An ultrasonic level indicator, to show the level/quantity of the contents inside the tank, shall be provided. The indicator shall be connected to the telemetry system, to allow remote monitoring as specified in the Sydney Water’s IICATS Sewer Odour and Corrosion Standards TOG_TS08.

In addition to the ultrasonic level indicator, a mechanical float type shall also be provided. The indicator shall be adjacent to the tank wall, in order to indicate actual liquid level inside the tank during filling, and shall be visible from the filling/transfer point. A weatherproof digital display shall also be installed at the filling transfer point, to indicate the actual level during filling. An alarm system, consisting of a klaxon and beacon shall also be installed at the filling transfer point, to alarm if tank has overflowed during filling.

In addition, the overflow pipe shall be piped to the sump in such a way, that the tanker driver can view the discharge point from outside of the bund, to indicate if the tank is overflowing.
5.6 Digital Display
The digital display for tank level shall be suitable for operation with 24 VDC power supply. It shall be equipped with sunlight readable LEDs, and a minimum reading range of 10 m. It shall be suitable to display percentage values.

If installed outside the CDU Building, the digital display shall have a minimum rating of IP 56, and shall be installed with suitable mounting accessories.

5.7 Additional Requirements for Magnesium Hydroxide Tank(s)
When magnesium hydroxide is used as the dosing chemical, the following requirements shall also be met:

5.7.1 Storage Tank(s)
- The inside walls of the tanks shall be smooth, so that no accumulation of chemical precipitate occurs on the internal tank walls, ribs or bends;
- The tank, including the vent and overflow shall be completely water sealed;
- The overflow pipeline from the storage tank shall connect with the tank drain line and have a downstream water seal to prevent loss of humidity in the tank;
- Include an outlet pump suction nozzle, separate to the drain line, as close to the tank floor as practicable. This outlet shall be a 100 mm diameter pipe. The outlet shall extend into the storage tank and be chamfered such that the opening is pointing in the opposite direction of mixing;
- Include an isolating knife gate valve fitted on the outlet to the pump suction nozzle as close as practicable to the tank wall. This is then followed by a reducer, then a PVC ball valve, and then a motorised valve. The motorised valve shall close on power failure.

Storage Tank Mixer
A slurry type chemical such as magnesium hydroxide requires a tank mixer to keep the slurry chemical in homogeneous state. It shall be supplied with, but not limited to:
- A single impeller and shaft made from 316 grade stainless steel;
- The ability to stir the chemical from its minimum to maximum depth. More than one impeller mounted to the single shaft may be required;
- A galvanised steel-mounting frame, structurally independent of the mixing tank;
- Automatic control and manual capability;
- A control timer to set the mixer running time;
- The ability to be maintained/removed without removal of the roof;
- The ability to easily dismantle and replace mixer when required;
- A neoprene or similar suitable material gasket shall be provided around the mixer shaft to prevent humidity loss.

The storage tank mixer shall operate at a speed of approximately 60 rpm. A timer shall be attached to the mixer to allow it to operate once every hour. The mixer shall be fitted one third (1/3\textsuperscript{rd}) off set
from the centre of the tank. The blade(s) of the mixer shall extend as close to the bottom of the tank as practical (approximately half a blade width off the floor of the tank).

5.7.2 Batching Tank (if required)

At low pumping rates (below 10 L/hr), magnesium hydroxide may solidify and cause blockages. As such, the design of low dose rate systems involves a batch tank, to make up a diluted magnesium hydroxide slurry for dosing at rates greater than 10 L/hr.

Where a batch tank is required, the following shall be met:

- The inside walls of the batch tank shall be smooth, so that no accumulation of chemical precipitate occurs on the internal tank walls, ribs or bends;
- The tank shall include an overflow pipe fitted at the high high (HH) alarm level and installed such that excess liquids drain away from trafficked areas and to the bund sump;
- Separate fill lines for magnesium hydroxide and dilution water into the batching tank shall be provided. They shall enter directly into the top of the batch tank;
- The dilution water pipework shall include an isolation valve, flow switch, rotameter, solenoid valve(s) and non-return valve(s). The rotameters shall have a minimum length of 250 mm. A flow switch shall be installed on the common line to provide a “dilution system failed” alarm (failsafe) as an input to the IICATS RTU, on low flow;
- The dilution water solenoid shall be made of materials compatible with magnesium hydroxide dosing, and set to open on low level alarm from the level sensor. It shall be set to close on level sensor high alarm;
- A transfer pump shall be provided to transfer concentrated magnesium hydroxide from the storage tank to the batching tank. It will be PLC controlled, started on low alarm from the level sensor and stop on a timer. The pump shall be identical to the dosing pumps used in the unit, and set at a constant speed;
- A level sensor shall be provided to control the batching process. A high level alarm (H) shall stop the dilution water by closing the dilution water solenoid. A low level alarm (L) shall be used to begin the batching process. A low low level alarm (LL) shall inhibit dosing pumps, and a no change alarm will inhibit the process and raise an IICATS alarm. The level sensor shall be located such that the mixing and fill line operation do not interfere with the level sensor’s accuracy. A “dilution system failed” alarm (failsafe) as an input to the IICATS RTU, shall be raised on the following conditions;
  - Dilution water low flow
  - Level sensor HH
  - Level sensor LL
  - Level sensor no change
  - Transfer pump no flow
- A batching tank mixer shall be provided. The batching tank mixer shall comply with the requirements of the Storage Tank Mixer with the exception that it will operate at a speed between 150 and 1,500 rpm. A variable speed drive shall be attached to the mixer;
• The tank shall have a conical bottom with a manual ball valve at the lowest point to allow the slurry to be fully drained out. A motorised valve that closes on power failure shall be provided after the manual valve. This valve inhibits dosing pumps when closed as this line feeds the dosing pumps.
6  Dosing System

The required dosing system shall be designed to provide a reliable, continuous dosing of metered volumes of chemical. Where more than one dosing chemical is used, each type of dosing chemical shall have its own dosing system. All valves, fittings and pipework necessary for the proper operation of the dosing system shall be provided. The piping shall be suitable for the chemical conveyed. The system shall be capable of operating in both automatic and local manual modes.

6.1  Dosing Pumps and Pipework

6.1.1  Ferrous Chloride/Ferric Chloride/Calcium Nitrate/Ferric Sulphate

A generic P&ID and 3D layout of this system is provided in Appendix A of this Specification.

Pumps

Two (2) identical duty and standby dosing pumps (brand, type and capacity range) shall be provided for dosing. The switchover to the standby pump shall be automatic via IICATS. Automatic changeover between pump duties shall be configured on time as well as pump fault.

The dosing pumps shall be designed to allow minimum dosing during the initial operation of the CDU.

The dosing pumps shall be of the 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.

Turndown shall be carried out using a variable speed controller. If turndown cannot be achieved using a single pump, multiple pumps shall be used. Pumps that have no calibration below a pre-set flow are not accepted.

The manual stroke adjustment shall incorporate a calibrated dial [0-100%] to facilitate presetting, and shall be capable of adjustment regardless of whether the pump is operating or not. Alternatively, the pumps are to incorporate digital indication of the set rate.

Metering accuracy of the pumps shall be better than 2.5% of the set rate at a variable suction head. A dose rate turndown ratio of 30:1 by means of stroke adjustment and variable speed control shall be provided.

Each pump shall be fitted with an external pressure relief valve, vented back into the calibration vent line.

Pump speed shall not exceed 50Hz.

Approval from the Principals representative shall be sought prior to procurement of pumps to be installed in the CDU.

Pipework and appurtenances

Adjustable pressure retaining valves shall be incorporated on each discharge line from the dosing pumps to maintain dosing accuracy over the range of operating depths in the storage tank, and to act as anti-syphoning protection.

Duty and standby suction strainers with a maximum opening of 1 mm shall be provided.
Splashguards shall be installed around the duty and standby pumps to contain chemical spray if dosing lines/pumps were to break.

6.1.2 Magnesium Hydroxide

When a slurry type chemical, such as magnesium hydroxide, is used as the dosing chemical, there is an option to operate the dosing system in either “Neat Mode” or “Batch Mode”. At low pumping rates, magnesium hydroxide may solidify and cause blockages. As such, the design of low dose rate systems involves a batch tank, to make up a diluted magnesium hydroxide slurry for dosing.

A generic P&ID and 3D layout of these systems are provided in Appendix B of this Specification.

Pumps

Two (2) identical duty and standby dosing pumps (brand, type and capacity range) shall be provided for dosing. The switchover to the standby pump shall be automatic via IICATS. Automatic changeover between pump duties shall be configured on time as well as pump fault.

If a batching system is selected, a third pump shall be provided (identical to the two duty/standby pumps). The batching pump shall pump the magnesium hydroxide from the storage tank to the batch tank.

All pumps shall be peristaltic type and have adjustable speed. The minimum and maximum operating speeds shall follow the manufacturer’s operating instruction to prevent overheating, excessive wear or damage.

Turndown shall be carried out using a variable speed controller. If turndown cannot be achieved using a single pump, multiple pumps shall be used. The pumps shall be designed to allow minimum dosing during the initial operation of the CDU.

A dose rate turndown ratio of 30:1 by means of stroke adjustment and variable speed control shall be provided.

Pump speed shall not exceed 50Hz.

Approval from the Principals representative shall be sought prior to procurement of pumps to be installed in the CDU.

Pipework and appurtenances

Flexible piping shall not be used except where specified on the P&ID.

The dosing and batch pump suction and discharge connections shall be constructed for easy access and removal. Pipework shall consist of Y-pieces for all divergent and convergent sections. No suction strainers are required on the dosing lines.

All valves on the dosing line shall be full bore valves, except where specified on the P&ID. Non-return valves on each pump discharge line shall be provided of the rubber, ‘tideflex’ type with a flushing point available. Appropriate isolation valves shall also be included.

Spare tubing, fittings and lubricant shall be provided for each pump supplied.

The magnesium hydroxide pipeline shall enter the batching tank directly from the top of the tank. This line shall not be mixed with the dilution water line before entering the tank.
6.2 Pulsation Dampeners at Pumps

Pulsation dampeners shall be provided in the discharge pipework from the dosing pump and, shall be suitably sized for the displacement of the pump so that discharge pressure fluctuation does not exceed 10%. The pulsation dampeners shall have a diaphragm separating the air chamber from the liquid chamber. The air chamber shall be pressurised, and be capable of re-pressurising by air pump via a Schrader valve. A pressure gauge shall be installed. The position of the pressure gauge shall be located before the pressure relief valve and the loading valve.

6.3 Depressuring, Flushing, and Draining

Adequate provision shall be made for draining of lines for maintenance. This typically involves at least one drain valve on each of the suction and discharge sides of the pump. These valves shall be piped to the sump. The valving shall be provided to allow for flushing of the chemical dosing lines without dismantling the lines.

Where magnesium hydroxide is used as the dosing chemical, an automatic flushing system shall be installed for the outlet line to flush excess magnesium hydroxide that may settle and clog the line.

A 50mm Male polypropylene Kamlock fitting shall be provided at the chemical filling line, and on all flushing points on the dosing line.

6.4 Automatic Isolation Valve

The automatic isolation valve shall be a motorised ball valve. The valve shall consist of two separate modules – the valve body and the actuator. The material of construction shall be suitable for the chemical being handled. The valve shall include a compact electric actuator capable of position feedback, and be complete with position indicator and a facility for manual control. The valve position signal shall be sent to the control system. The valve shall close on power failure.

6.5 Pressure Indicator

A pressure indicator shall be installed on the discharge side of each pump. The hydraulic oil type shall be used for process fluids that may damage the pressure indicator. The purpose of the indicator is to enable setting of the pressure relief valve and the loading/anti-syphon valve (see Section 6.1 of this Specification).

6.6 Dosing Chemical Flowmeter

This is not required for system where the dosing chemical is a slurry type, such as magnesium hydroxide.

A flowmeter (magnetic and Teflon coated type preferred) shall be installed in each common dosing line (typically prior to the pressure sustaining valve). There should be sufficient upstream and downstream straight pipe run to prevent flow disturbances affecting the flowmeter. The dosing flowmeter shall be calibrated to units of litres per hour. The flow meter shall measure the flow and transmit the flow signal to IICATS. The flow meter shall display the flow rate and any error messages.
6.7 Water System

Dilution water shall be piped from the service water system to provide a minimum dilution ratio of 20:1 of dilution water to dosing chemical.

Flow from the dilution water line shall pass through an isolation valve, flow switch, rotameter, solenoid valve(s) and non-return valve(s). The rotameters shall have a minimum length of 250 mm.

A flow switch shall be installed on the common line to provide a “dilution system failed” alarm (failsafe) as an input to the IIICATS RTU, on low flow.

A suitably sized RPZ valve shall be provided in the dilution water line for backflow prevention. Only proprietary back flow prevention devices shall be used.

Where is dosing chemical is a slurry type, such as magnesium hydroxide, the dilution water system is used as a flushing system. This is to flush the dosing lines clean of magnesium hydroxide once dosing is complete. The flushing water shall operate with the storage tank mixer timer, where a solenoid valve shall open and flush the dosing line, and the solenoid valve will close at the end of timer duration.

Where recycled water is available, it shall be used for the dilution water (excluding eyewash facilities and safety showers).

6.8 Double Containment of Filling and Dosing Lines

Chemical dosing lines are typically a pipe-in-pipe arrangement. The intention is to prevent a leak in the pipe contaminating the soil and groundwater, and to prevent it from accidental damage. Care must be taken with the design and installation of the outer pipe so that leaks from the inner pipe can be readily detected.

Concrete encasement of the lines when laid in ground is acceptable.

Double containment from within the bunded area through to the dosing point shall be constructed in such a way to facilitate replacement of dosing line without excavation of that section of pipe. PE pipe shall be considered.

6.9 Dosing Point

The dosing point shall be designed with the following considerations:

- The use of shields to prevent splashing to nearby walls (where a corrosive chemical is used)
- Dosing to maximise mixing with sewage at the dosing point. Preference is to dose into the receiving manhole, however, if this cannot be achieved, dosing into the wet well or rising main is acceptable.
- The end of the dosing line shall be above the highest flow level, that is, an air gap shall be present, to avoid siphoning.

A generic CDU Site Layout General Arrangement for Gravity Main Dosing is provided in Appendix C of this Specification.

A generic CDU Site Layout General Arrangement for Pressure Main Dosing is provided in Appendix D of this Specification.
7 Submission
The following shall be submitted to the Principal’s representative for approval prior to ordering.

7.1 Design Drawings
Design drawings of the proposed chemical dosing unit installation shall be provided. They shall cover all design issues including:

- Location of the CDU on site (general arrangement);
- Piping & Instrumentation Diagram (P&ID) drawing(s) with an associated list of equipment, material, and size details;
- Position and layout of all equipment including pipework and storage tank (dimensional layout – plan and elevation);
- Electrical drawings (including circuits, control systems, equipment lists, manufacturer general arrangement, items, list, site general arrangement, conduit sizes and locations).
- Structural drawings, including the building

The drawing format shall be in accordance with Sydney Water’s Maintenance Related Clauses for Capital and Operational Projects.

7.2 Operating and Maintenance Manual
A draft Operating and Maintenance (O&M) Manual for the CDU shall be prepared and submitted to the Principal’s Representative during the detailed design phase. It shall be finalised and re-submitted, after successful commissioning of the unit.

The O&M manual shall be in accordance with Sydney Water’s Maintenance Related Clauses for Capital and Operational Projects.

7.3 Critical Spare Parts
The Contractor shall supply critical spare parts for the installation. The list of critical spare parts shall be discussed and agree with the Principal’s Representative prior to procurement.
8 Testing and Commissioning

Following installation, the CDU shall be tested and commissioned in accordance with Sydney Water’s Maintenance Related Clauses for Capital and Operational Projects. The checklist in Appendix 1 and 2 of Sydney Water’s Asset Commissioning Standard Administration Procedure (SAP) WWIMS0035, shall be used by the Commissioning Coordinator to ensure all of the Principal’s requirements for asset commissioning are met.

The Contractor shall develop a Commissioning Plan, which shall be submitted to the Principal’s representative for review. Written approval from the Principal’s representative shall be sought prior to commissioning.

The Contractor shall provide the necessary expertise and resources for successful commissioning of the unit.

In addition, the following tests shall be carried out.

8.1 Hydrostatic Test and Leak Detection

The bund area should be watertight. The bund area of chemical storage area shall be filled with water for at least 24 hours. It will be satisfactory if there is no water leakage through the wall, slab, penetrations and joints and so on. The storage tank should be filled up to prevent any movement due to flotation.

New storage tanks and pipework shall be filled with water and inspected for leakage for at least 24 hours. Pipework shall be pressure tested to 1.5 times of the operating pressure.

8.2 Commissioning Test Run

For the purpose of the Site Acceptance Test (SAT), a test run shall be undertaken in accordance with the Contractor’s site commissioning methodology, which shall be approved by the Principal’s Representative.

The test run shall be carried out in the following stages:

(a) Manual operation using water.
(b) Automatic operation using water.
(c) Manual operation using chemical.
(d) Automatic operation using chemical.

Commissioning shall be deemed complete when the whole of the works are capable of running continuously without any fault for a period of two (2) weeks. The plant shall start and stop during this two-week period as required by the Principal's Representative.

During this period, the Contractor shall maintain the unit in a proper working manner. The unit shall be used to demonstrate system performance to Sydney Water. The reduction of the dissolved sulphide in the downstream sewage shall be recorded. The Contractor shall carry out any work necessary to ensure the unit is working correctly.

At the end of this period, the Contractor shall issue a certificate stating the outcome of the testing and commissioning to allow Handover, in accordance with Sydney Water’s Maintenance Related Clauses for Capital and Operational Projects.
8.3 Building Certification
The Contractor shall provide all building certification documents for design and certification of the unit to the Principal's Representative.

8.4 Submission of Work As Constructed (WAC) Documents
The Handover is not complete until all WAC documents, such as detailed drawings, O&M Manuals, FMECA documentation, MAXIMO entries and so on, have been submitted to the Principal's Representative. Refer to Sydney Water's Maintenance Related Clauses for Capital and Operational Projects. This is a Hold Point.

8.5 Handover
The Asset Commissioning SAP shall be followed to ensure all issues are finalised before handover of the CDU to Sydney Water's Operations Division.
## 9 Document Control

<table>
<thead>
<tr>
<th>Title:</th>
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<tr>
<td>Prepared by:</td>
<td>Sally Rewell – Chemical Engineer</td>
</tr>
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</table>
| Stakeholders Consulted: | Fredrick Rodrigo – Maintenance Engineer Officer 5-6  
Gilbert Baes – SCADA Project Engineer  
Gino Iori – System Operations Officer 5-6  
Jeffrey Scott – Plant Manager Level 2  
Louisa Vorreiter – Asset Class Strategy Leader  
Matthew Whalan – System Operations Officer 1-4  
Philip Duker – Water Technical Manager  
Rod Mackenzie – Senior Planner  
Jerry Sunarho – Standards Engineer  
Paul Rabaud – Experienced Planner  
Phillip Cheetham – Senior Technical Support Officer |
| Approved by: | Janssen Chan – Policy, Standards & Materials Manager |

## 10 Change History

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<tr>
<td>1</td>
<td>August 2008</td>
<td>Louisa Vorreiter</td>
<td>Jerry Sunarho</td>
<td>First issue</td>
</tr>
<tr>
<td>2</td>
<td>February 2011</td>
<td>Janssen Chan</td>
<td>Sally Rewell</td>
<td>Full Revision</td>
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Appendix A – Generic P&ID and 3D Layout (Non-slurry Chemicals)

P&ID drawing for Ferrous Chloride/Ferric Chloride/Calcium Nitrate/Ferric Sulphate (refer to drawing PID-2).

3D Layout drawing for Ferrous Chloride/Ferric Chloride/Calcium Nitrate/Ferric Sulphate (refer to drawing CDU - 4 for isometric view and CDU - 5 for plan and elevations view).
Appendix B – Generic P&ID and 3D Layout (Slurry Chemicals)

Neat Mode
P&ID drawing for “Neat Mode” Magnesium Hydroxide (refer to drawing PID-6).
3D Layout drawing for “Neat Mode” Magnesium Hydroxide (refer to drawing CDU - 6 for isometric view and CDU - 7 for plan and elevations view).

Batch Mode
P&ID drawing for “Batch Mode” Magnesium Hydroxide (refer to drawing PID-7).
3D Layout drawing for “Batch Mode” Magnesium Hydroxide (refer to drawing CDU - 8 for isometric view and CDU - 9 for plan and elevations view).
Appendix C – Generic CDU Site Layout (Gravity Main Dosing General Arrangement)

General Arrangement drawing for Gravity Main Dosing (refer to drawing CDU - 1).
Appendix D – Generic CDU Site Layout (Pressure Main Dosing General Arrangement)

General Arrangement drawing for Pressure Main Dosing (refer to drawing CDU - 2).
Appendix E – Generic CDU Site Layout (Potable Water Supply)

General Arrangement drawing for Potable Water Supply (refer to drawing CDU - 3).
PLAN - GRAVITY MAIN DOSING

NOTE
Where constructed by engineering-geotechnical services, such as for geotextile, the access roads to the other assets shall also be considered.

REFERENCE DRAWINGS
Typical system: Potable water supply - drain cover

FOR TENDERING PURPOSES ONLY
NOT TO SCALE
REFERENCE DRAWINGS

NOTES
1. ALL LEVELS ARE METRES REFERRED TO AUSTRALIAN HEIGHT DATUM (HAA)
2. ALL CO-ORDINATES ARE IN METRES AND REFER TO MAP Grid of Australian Height

FOR TENDERING PURPOSES ONLY