TS 04955.9:1.1

Standard

Services, Systems and Equipment

Part 9: Ancillary Facilities

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Document history

Revision	Effective date	Summary of changes
1.0	03/07/2025	First issue of TS 04955.9
1.1	25/02/2026	Minor update to Version 1.0. Changes to previous content include updates to Sections 5.7.5 and 8.3.2

Preface

This standard is a minor update to Version 1.0.

This document forms part of the TS 04955 suite of documents relating to services, systems and equipment.

This document contains requirements for ancillary facilities that are additional to those within TS 04955.1.

This document should be read in conjunction with TS 04955.1.

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1 Scope

This standard sets out the technical requirements for building services, systems, and equipment for the following ancillary facilities withing the Transport network:

- heavy rail and metro maintenance facilities
- light rail maintenance facilities
- bus depots
- road maintenance facilities
- traction substations, HV switching stations and sectioning huts
- signalling buildings.

This document covers the following types of building services, systems and equipment:

- mechanical services: heating, ventilation, air conditioning, pumps, and compressed air
- electrical services: energy supply, LV installations, artificial lighting, and specialist equipment (HV installations are not part of this document)
- hydraulic services: water, drainage, plumbing and recycling
- telecommunication services
- BMCS
- security.

2 Application

This document applies to all new installations and upgrades to existing installations; it does not apply retrospectively to existing installations.

This document applies to TfNSW-owned assets.

This document should be read and applied in conjunction with relevant Australian standards and other TfNSW standards. Where inconsistencies occur between this document and other TfNSW documents, advice should be sought from PAM.

Where the document mentions seeking specific advice or approval from PAM, or if any other assistance is required, contact PAM via email at standards@transport.nsw.gov.au.

Where this document specifies a higher level of compliance than required by legislation or other standards, the requirements of this document take precedence.

3 Referenced documents

The following documents are cited in the text. For dated references, only the cited edition applies. For updated references, the latest edition of the referenced document applies.

International standards

ANSI/ASHRAE Standard 135 *BACnet – A Data Communication Protocol for Building Automation and Control Networks*

IEC 62040 (all parts) *Uninterruptible power systems (UPS)*

ISO 8573-1 *Compressed air – Part 1: Contaminants and purity classes*

ISO 16923 *Natural gas fuelling stations – CNG stations for fuelling vehicles*

ISO 16924 *Natural gas fuelling stations – LNG stations for fuelling vehicles*

Australian standards

AS 1319 *Safety signs for the occupational environment*

AS 1428.2 *Design for access and mobility – Part 2: Enhanced and additional requirements – Buildings and facilities*

AS 1668.2 *The use of ventilation and airconditioning in buildings – Part 2: Mechanical ventilation in buildings*

AS 1668.2:2024 *The use of ventilation and airconditioning in buildings – Part 2: Mechanical ventilation in buildings*

AS 1668.4 *The use of ventilation and airconditioning in buildings – Part 4: Natural ventilation of buildings*

AS 1674.2 *Safety in welding and allied processes – Part 2: Electrical*

AS 1692 *Steel tanks for flammable and combustible liquids*

AS 1768 *Lightning protection*

AS 1940 *The storage and handling of flammable and combustible liquids*

AS 2436 *Guide to noise and vibration control on construction, demolition and maintenance sites*

AS 2676.1 *Installation, maintenance, testing and replacement of secondary batteries in buildings – Part 1: Vented cells*

AS 2676.2 *Guide to the installation, maintenance, testing and replacement of secondary batteries in buildings – Part 2: Sealed cells*

AS 3011.1 *Electrical installations – Secondary batteries installed in buildings – Part 1: Vented cells*

AS 3011.2 *Electrical installations – Secondary batteries installed in buildings – Part 2: Sealed cells*

AS 3961 *The storage and handling of liquefied natural gas*

AS 4775 *Emergency eyewash and shower equipment*

AS 5215 (Int) *Passive grease arrestors*

AS 62053.21 *Electricity metering equipment – Particular requirements – Part 21: Static meters for AC active energy (classes 0.5, 1 and 2)* (IEC 62053-21:2020 (ED.2.0) MOD)

AS 62271.202 *High-voltage switchgear and controlgear – Part 202: High-voltage/low-voltage prefabricated substation* (IEC 62271-202:2014, MOD)

AS/NZS 1158 (all parts) *Lighting for roads and public spaces*

AS/NZS 1596 *The storage and handling of LP Gas*

AS/NZS 1680 (all parts) *Interior and workplace lighting*

AS/NZS 1680.5 *Interior and workplace lighting – Part 5: Outdoor workplace lighting*

AS/NZS 2107 *Acoustics – Recommended design sound levels and reverberation times for building interiors*

AS/NZS 2229 *Fuel dispensing equipment for explosive atmospheres*

AS/NZS 2293.1 *Emergency lighting and exit signs for buildings – Part 1: System design, installation and operation*

AS/NZS 3000 *Electric installations (known as the Australian/New Zealand Wiring Rules)*

AS/NZS 3500.1 *Plumbing and drainage – Part 1: Water services*

AS/NZS 3500.3 *Plumbing and drainage – Part 3: Stormwater drainage*

AS/NZS 4114 *Spray painting booths, designated spray painting areas and paint mixing rooms*

AS/NZS 4282 *Control of the obtrusive effects of outdoor lighting*

AS/NZS 4645 (series) *Gas distribution networks*

AS/NZS 5033 *Installation and safety requirements for photovoltaic (PV) arrays*

AS/NZS 5601.1 *Gas installations – Part 1: General installations*

AS/NZS 60079 (all parts) *Explosive atmospheres*

HB 230 *Rainwater Tank Design and Installation Handbook*

Transport for NSW standards

TS 00005 *Application of Telecommunications Standards to Engineering Works and Services*

TS 00008.1 *Fire Life Safety – Part 1: Principles*

TS 00008.4 *Fire Life Safety – Part 4: Ancillary Facilities*

TS 00031 (all parts) *OT10 Threat-Based Cyber Security Controls*

TS 00058 *High Voltage Requirements for Electric Bus Charging Depots*

TS 03677 (T HR EL 12004 ST) *Low Voltage Distribution and Installations Earthing*

TS 03677:0.0 (T HR EL 12004 ST) *Low Voltage Distribution and Installations Earthing*

TS 03781 (T HR EL 17002 SP) *Low Voltage Isolating Transformer*

TS 03789 (T LR EL 00001 ST) *Traction Power System Requirements*

TS 03792 *Traction Power Substations*

TS 03869 *Lightning Protection and Insulation Coordination*

TS 03882 (T HR EL 99002 ST) *Substation Minimum Construction Standard*

TS 03947 (T MU MD 21001 ST) *Equipment Rooms and Cubicles for Programmable Electronic Systems*

TS 03955 (T HR SS 80006 ST) *Renewable Energy Installations – Photovoltaic and Battery Systems*

TS 04936 (T HR SS 80003 ST) *Infrastructure Emergency Lighting*

TS 04951 *Functional Spaces* (series)

TS 04951.1 *Functional Spaces – Part 1: Principles*

TS 04955.1 *Services, Systems and Equipment – Part 1: Principles*

TS 04955.6 *Services, Systems and Equipment – Part 6: Electric Vehicle Charging*

TS 04955.7 *Services, Systems and Equipment – Part 7: Lighting*

TS 04955.8 *Services, Systems and Equipment – Part 8: Low Voltage Electrical Installations*

TS 04989 *Public Transport Closed Circuit Television Functional Requirements Standard*

TS 04991 (T MU SY 10012 ST) *Cybersecurity for IACS – Baseline Technical Cybersecurity System Requirements and Countermeasures*

TS 04992 *Surface Transport Fixed Infrastructure Physical Security Standard (*This document is not publicly available. To obtain access email standards@transport.nsw.gov.au)

TS 04993 (T MU SY 10013 PR) *Cybersecurity for IACS – Cyber Risk Management Procedure*

TS 05164 *Construction of Signalling Cable Routes*

TS 05169 (SPG 0712) *Lightning and Surge Protection Requirements*

TS 05171 (SPG 0714) *Compressed Air Systems*

TS 06206 (T MU TE 61005 ST) *Customer Information Systems for Public Transport Buildings and Conveyances*

TS 06210 (T MU TE 01001 ST) *Campus Backbone Telecommunication Routes and Cabling*

TS 06218 *Packet Switched Networks – Wired Networks*

TS 06220 *Packet Switched Networks – Wireless Local Area Networks*

TS 06224 (T HR TE 21003 ST) *Telecommunications for Traction Substations and Sectioning Huts*

Legislation

Environmental Planning and Assessment Act 1979 (NSW)

Other referenced documents

AIRAH *Comfort and Critical Design Conditions – Air Conditioning Load Estimation*

AIRAH DA09 *Air Conditioning Load Estimation and Psychrometrics*

AIRAH *Technical Handbook*

Australian Building Codes Board, *National Construction Code, Volume 3*

Australian Mobile Telecommunications Association, 2025, *Design Guidelines for Distributed Antenna Systems (DAS)*

Building and Engineering Services Association, *Ductwork Specification DW/143 Guide to good practice ductwork leakage testing*

National Health and Medical Research Council, National Resource Management Ministerial Council, *National Water Quality Management Strategy – Australian Drinking Water Guidelines 6*

NSW Department of Planning, Industry and Environment, *Liquid Trade Waste Management Guidelines – For councils in regional NSW*

NSW Environment Protection Authority*, Spray painting and surface coating*

RailCorp, June 2006, *Design Guidelines for the Upgrade and Construction of New and Existing Train Stabling Yards and Turnback Sidings,* Final version 1.0

Transport for NSW, DMS-SD-081/4.0, *TfNSW Climate Risk Assessment Guidelines*

Transport for NSW, ST-114, *TfNSW Sustainable Design Guidelines,* Version 4.0

4 Terms, definitions and abbreviations

The following terms, definitions and abbreviations apply in this document.

ac alternating current

asset an item, thing or entity that has potential or actual value to an organisation (ISO 55000:2014)

Asset Steward – operate or maintain the entity responsible for day to day operations and maintenance of an asset once commissioned. May be a part of the asset custodian division or a separate entity. While operations and maintenance is often managed by the same entity, these functions may be split. When this occurs roles are defined as the Asset Steward – Operate and the Asset Steward – Maintain

BACnet building automation and control (BAC) network communication protocol

BMCS building management and control system

CNG compressed natural gas

DAS distributed antenna systems

dc direct current

DNSP distribution network service provider

enclosure a part providing an appropriate degree of protection of equipment against external influences and against contact with live parts such as a switchboard enclosure, conduit, duct, pipe, or trunking

GPO general purpose outlet

HV high voltage; a voltage exceeding 1000 V ac or 1500 V dc

HVAC heating, ventilation and air conditioning

LPG liquefied petroleum gas

LV low voltage

MSB main switchboard

N+1 N defines the minimum system, plant or components to meet a requirement, +1 defines the additional systems or components provided to add resiliency

NCC National Construction Code

OHWS overhead wiring structure (1500 V dc)

PAM Prioritisation and Asset Management

switchboard as defined in AS/NZS 3000:2018

system a collection of interrelated parts, physical or procedural

TfNSW Transport for NSW

UPS uninterruptible power supply

UV ultraviolet radiation

WAP wireless access point

WOL whole-of-life

5 General

5.1 Overview

All services, systems and equipment for ancillary facilities shall comply with TS 04955.1.

Interior and exterior areas of ancillary facilities encompassing facility access, human circulation, vehicle movement, and spatial planning for buildings and structures shall also be designed to satisfy the requirements of the relevant parts of TS 04951 (series).

5.2 Facility site location criteria

The location for new facilities covered in this document shall be selected, taking into account the following factors as relevant to services, systems and equipment:

- utility infrastructure availability such as power, telecommunications, water, stormwater and sewer
- the effects of corrosion within coastal environments
- flood risk and impacts of sea level rise
- risk associated with building within bushfire zones
- impact on residents including acoustic considerations and increased traffic movements
- road access and the impact of weather events on access
- ecological impacts on protected or sensitive wildlife or fauna
- fire risk associated with adding proposed equipment to the existing site.

5.3 Upgrades of existing ancillary facilities

Where existing services, systems and equipment are proposed to be retained and reused, the following shall be assessed and used as a basis for decision-making:

- review of regulatory compliance
- safety and risk assessment
- visual inspection
- energy efficiency, past performance evaluation, maintainability, serviceability and availability of spare parts and components for the planned lifespan
- WOL cost analysis.

5.4 Design for maintenance and decommissioning

The design and installation of services, systems and equipment in ancillary facilities shall allow adequate access for maintenance, ease of disassembly and replacement of all equipment.

The use of specialist access machinery should be avoided.

The following provisions shall be included during the design stage of services, systems and equipment in ancillary facilities:

- adequate plant access routes with sufficient spatial allowance to remove large-scale items
- provision of winching points, pulling eyes or similar, aimed to limit adverse impact on building fabric, with structural limitations and any protection measures detailed to prevent adverse impact on other installations
- locational provisions for cranes and floats for removal and installation of large plant items.

Ancillary facilities services, systems and equipment maintenance regimes shall follow manufacturer's requirements.

The decommissioning strategy for services, systems and equipment in ancillary facilities shall be based on the WOL analysis.

5.5 Electrical services

5.5.1 General

Electrical services for ancillary facilities shall include the following:

- LV including onsite back-up power generation
- earthing and bonding
- lighting
- equipment and accessories.

5.5.2 Power supplies

LV electrical power supply shall be provided in accordance with the *Service and Installation Rules of New South Wales,* DNSP requirements, AS/NZS 3000 and TS 04955.8.

Depending on operational requirements, ancillary facilities may require normal and alternative power supply to maintain the safe operation of the facility. An alternative power supply protects against the consequences of loss of normal power supply by providing continuous electrical supply to an installation.

Where necessary, an isolation transformer shall be provided in accordance with TS 03677 and TS 03781.

Where a standby generator is installed, it shall comply with TS 04955.8.

Total harmonic distortion (THD) measured at the point of common coupling shall not exceed the values stipulated in TS 04955.8.

5.5.3 Low voltage electrical installation

5.5.3.1 General

LV electrical installation shall be provided in accordance with AS/NZS 3000 and TS 04955.8.

Maximum demand calculations shall include an allowance of 25% for future expansion. Where this cannot be achieved, the allowance may be determined based on known future requirements determined in consultation with the relevant TfNSW stakeholders. Continuous evolving spaces, such as rail maintenance roads, may be designed with higher spare capacity.

Where the inclusion of 25% spare capacity in maximum demand calculation would require installation of more than one 1 MVA transformer, an adjacent space equal to the requirement of 1 MVA transformer should be allocated for the future transformer.

5.5.3.2 Low voltage switchboards

Selection of switchboards, switchgear and control gear shall be consistent throughout the facility to ensure compatibility and protection devices coordination.

Other than the retailer energy meter, all energy monitoring meters shall be accuracy class 1, as defined in AS 62053.21, or better.

Electrical metering shall be installed to:

- facilitate the on-billing of the energy used by any third-party operator
- facilitate accounting for energy used in electric vehicle charging stations
- ensure TfNSW meets all obligations relating to the on-selling of electricity or embedded networks.

5.5.3.3 Earthing, bonding and lightning protection

Earthing and bonding for electrical installations within the ancillary facilities shall comply with AS/NZS 3000 and the *Service and Installation Rules of New South Wales* for the following instances:

- facilities supplied with single or dual power supply from a local DNSP or generator (or both)
- electrical installations that are not near the 1500 V dc or 750 V dc traction system, except in special situations as detailed in Section 5.2.2 of TS 03677:0.0 (T HR EL 12004 ST, version 1.0).

For facilities where power is supplied from the Sydney Trains distribution system, the earthing system shall comply with TS 03677 and TS 03869.

Lightning protection for all buildings and facilities shall be provided in accordance with AS 1768, TS 03677 and TS 03726.

5.5.3.4 Lighting system

The lighting system for ancillary facilities shall comply with TS 04955.7. In addition, the lighting requirements of AS 1428.2 shall apply where applicable.

Internal area lighting shall be in accordance with AS/NZS 1680 (all parts). External area lighting shall be in accordance with AS/NZS 1158 (all parts) and AS/NZS 1680.5.

LED technology-based luminaires shall be provided for all new facilities.

Large spaces with two or more lighting circuits shall have luminaires in each row wired to alternate-phase circuits, to minimise the risk of a total loss of lighting in any area.

Lighting in hazardous areas shall comply with the relevant hazardous area classification and zoning as determined by a specialist consultant. All light fittings and equipment shall be installed in accordance with the relevant parts of AS/NZS 60079 (all parts).

Lighting fixtures in wash bays shall have a minimum ingress protection (IP) rating of IP66 and be suitable for corrosive environments. All wash bay fixtures shall be wall-mounted and not on the ceiling.

Spill light shall be controlled to comply with AS/NZS 4282.

5.5.3.5 Emergency lighting and illuminated exit signage

Emergency lighting and illuminated exit signage in ancillary facilities shall be in accordance with AS/NZS 2293.1 and TS 04936.

5.5.3.6 Welding power supply

Where welding equipment is installed, power shall be provisioned in accordance with AS 1674.2. Power for welding equipment shall be supplied via a dedicated circuit directly connected from the nearest distribution board. Protection switchgear shall be provided, taking the rated current of the welding equipment into account.

5.5.3.7 Photovoltaic arrays

Where ancillary facilities are equipped with a photovoltaic (PV) solar system, the system shall comply with AS/NZS 5033 and TS 03955.

5.5.3.8 Electric vehicle charging

Where ancillary facilities are equipped with electric vehicle charging equipment, the system shall comply with TS 04955.6.

5.5.4 Electromagnetic compatibility

The designer shall seek guidance from PAM on acceptable electromagnetic interference and compatibility requirements.

> Note: At the time of publication of this document, TS 00049 is under development. When published, TS 00049 will contain the acceptable electromagnetic interference and compatibility requirements.

5.6 Security

Services, systems and equipment within ancillary facilities shall comply with the security requirements in TS 04992 and TS 04989.

Services, systems and equipment within ancillary facilities shall comply with TfNSW cybersecurity standards TS 04991, TS 00031 (all parts) and TS 04993. Any external interfaces to the services, systems and equipment within ancillary facilities shall prevent interference with critical industrial automation and control system (IACS) designated systems.

5.7 Telecommunications

5.7.1 General

Telecommunications systems within ancillary facilities shall comply with TS 00005.

5.7.2 Public carrier network

Public carrier service entrance facilities shall be planned in consultation with the carrier service provider. The public carrier services network termination device (NTD) or main distribution frame (MDF) shall be located within the facility's building, but not in the communication equipment room.

Public carrier network services may be routed via two or more diverse routes.

5.7.3 Data outlets

All data outlets shall be modular RJ45 outlets connected to patch panels via horizontal copper cabling.

All data outlet plates shall allow for a machine-printed outlet identification. Desktop mounted outlets shall be enclosed and secured to the desk to prevent mechanical damage. Soft wiring shall be cabled with factory assembled patch cords, terminated, certified and fitted with a male modular plug at one end. The desktop end shall be terminated with an RJ45 socket.

5.7.4 Wireless access points

WAPs to interface with wireless local area network (WLAN) access points shall comply with TS 06220. Public WAPs may be provided in public-accessible areas.

5.7.5 Distributed antenna systems

Where indoor radio coverage is deemed insufficient for the connectivity needs of the functional space users, provision of DAS should be considered as a means of improving coverage.

Where DAS is to be installed as a means of improving public mobile coverage, all recommendations provided in *Design Guidelines for Distributed Antenna Systems (DAS)* shall be considered as requirements when designing the DAS.

Where DAS is to be installed as a means of improving operational radio coverage, the DAS shall comply with TS 06218, TS 06220 and any other relevant TfNSW specifications as determined by TfNSW.

Where DAS is to be installed as a means of improving radio coverage for the Public Safety Network (PSN), the DAS shall comply with the NSW Public Safety Network (PSN) indoor radio services design specifications (provided by the NSW Telco Authority).

Communications rooms or dedicated DAS rooms shall be able to accommodate a minimum of three carriers.

5.7.6 Public address system

Public address (PA) systems for ancillary facilities shall comply with TS 06206.

5.7.7 Resilient power requirements

UPS power shall be provided to support the criticality and functioning of the loads. UPS systems shall be modular and designed to provide backup power according to the telecommunication standards requirements.

The UPS system shall comply with IEC 62040 (all parts).

5.7.8 Technical rooms

Telecommunications rooms shall comply with TS 03947.

Battery rooms including UPS battery rooms shall be maintained at 20°C to 25°C to enhance battery life and performance.

5.8 Building management and control system

5.8.1 General

New ancillary facilities should be provided with a BMCS.

Where equipment is limited in quantities, non-critical to operations, the equipment may be omitted from the BMCS system in consultation with stakeholders.

The BMCS shall be capable of programming to operate and adjust the plant throughout the year based on a day of the week, and accounting for public holidays.

A functional specification shall be developed and submitted to the stakeholders for review prior to BMCS design finalisation.

The following details shall be provided:

- digital input
- digital output
- analogue input
- analogue output
- high level interfaces and associated virtual points.

Additional capacity of 20% of each point type should be provided to enable future expansion.

High level interfaces shall be provided to critical equipment. In addition, digital input and analogue input points shall be provided to advise both critical and common faults, to differentiate faults from a communications failure.

All BMCSs shall be native BACnet open protocol systems as specified in ANSI/ASHRAE Standard 135.

All direct digital control (DDC) controllers shall be tested, certified, clearly stamped and listed by the BACnet Testing Laboratories (BTL).

The BMCS shall manage and monitor the following:

- HVAC systems
- pumps
- compressed air systems
- variable speed drives
- lighting control systems.

The BMCS shall monitor the following:

- fire indicator panel
- smart meters – water, electricity, gas and recycled water
- sewage and stormwater pumping and monitoring systems
- power generation systems – standby and renewables
- leak detection systems for refrigerant, water and fuel where required by project scope of work
- uninterruptible power systems and battery charging systems
- local control interfaces, for example, for after hours operation
- vacuum drainage systems
- other mechanical systems designated by the project.

5.8.2 Head end

A head end shall be provided for BMCS. The head end shall be at least one dedicated computer. A dedicated graphical user interface shall be developed for stakeholders approval to provide an easy navigable system. The graphical user interface shall incorporate a hierarchy of pages to provide details of the facility as an overview of the site, specific areas, equipment, and enable direct interface to individual graphics pages for each zone, area and system.

A dedicated server shall be provided on site to save the data with scheduled backup to cloud-based software. All alarms and actions shall be logged and password protected to limit user access within agreed parameters.

Remote access to the BMCS interface shall be provided through internet connection through any web browser.

5.8.3 Monitoring and alarms

All alarms and monitoring functions shall be categorised under the following levels of criticality relative to their impact on facility operation:

- criticality level 1 – failure of plant or systems that impact critical operations
- criticality level 2 – major but non-critical alarms
- criticality level 3 – impact on comfort and user experience
- criticality level 4 – general maintenance advice that is not time-critical.

Energy and water use shall be monitored by use of trend logs.

The BMCS shall provide both short messaging service (SMS) and email notification when a criticality level 1 alarm is triggered.

5.9 Mechanical services

5.9.1 Design conditions for heating, ventilation and air conditioning

Design conditions for HVAC services and related equipment shall be determined based on the location of the ancillary facility using the most onerous of the following:

- AIRAH DA09
- Bureau of Meteorology climate data for the most relevant weather station
- 'Climate Change in Australia' climate analogues (refer to Climate Change in Australia website).

However, where AIRAH DA09 provides more than 10 years data, the design conditions shall be determined using the AIRAH data set provided in the current AIRAH *Technical Handbook*. This shall be verified using data from the Bureau of Meteorology for the preceding five years to check design ambient temperatures.

Comfort-related design conditions shall be determined to suit the application based on AIRAH *Comfort and Critical Design Conditions – Air Conditioning Load Estimation*.

The impacts of climate change shall be taken into account when selecting maximum ambient design conditions for new plant and equipment. The design shall be based on the estimated design conditions that will prevail at the end of the equipment plant economic life.

The assessment of climate risk and impact shall be in accordance with *TfNSW Climate Risk Assessment Guidelines*.

Climate change impacts shall not be applied to minimum ambient design conditions in winter.

Where facilities are located within an urban environment, additional allowance shall be provided for the ambient design temperatures of 0.5°C to 1.0°C.

All plant and equipment shall comply with *TfNSW Sustainable Design Guidelines*.

5.9.2 Compressed air

Compressed air systems may be provided to facilitate general plant operations such as use of pneumatic tools, cleaning, venting, purging, and inflation of tyres.

Compressed air systems shall be sized for simultaneous flow rates with the required pressure available at the most disadvantaged outlet. The system shall be arranged to provide stable control of pressure. A ring main should be considered where serving multiple outlets within a common space.

Compressors shall be oil free with variable speed compressors where multi-outlet and variable demand requirements exist. Multiple compressors shall be used where required for resiliency.

Where compressed air failure would impact operations, compressors shall be provided with redundancy on an N+1 basis.

Receivers shall be provided to reduce the number of compressor starts per hour. Receivers shall be provided with a bypass to allow maintenance without impacting system operations.

Air purity and dryness shall be selected based on the specific application to the requirements of ISO 8573-1.

Where compressed air is used to operate process plant instrumentation and control devices, the cleanliness of instrument air is of utmost importance. The instrument air system design shall be carried out by a specialist consultant.

5.9.3 Ventilation

Where services, systems and equipment within ancillary facilities operate for more than 10 hours per day and a minimum of five days per week, economic cycles shall be provided on all ventilation systems above 2000 L/s.

Refer to TS 04955.1 for requirements for the following:

- air quality
- outside air
- cross contamination prevention
- biological contamination prevention
- air pressurisation.

All contaminant sources considered for local exhaust ventilation should be based on a risk and impact review.

Specialist ventilation systems shall be provided where fumes and particles from the works conducted can lead to the propagation of materials and particulates that cause harm to human health. The design of the ventilation system shall be subject to confirmation and approval from TfNSW stakeholders for each project.

Mechanical ventilation systems that operate in the event of a fire shall be designed to allow for the ventilation of the smoke and vapours from an electric vehicle (EV) fire.

The following areas within the ancillary facility shall be provided with dedicated ventilation systems:

- welding and grinding areas
- wheel lathe areas
- toilets, showers and any other area nominated by the TfNSW stakeholders.

For battery storage areas, refer to AS 2676.1, AS 2676.2, AS 3011.1, AS 3011.2 and TS 00058.

For flammable and combustible liquids, the ventilation design shall comply with AS 1940.

The discharge of the ventilation system's associated fans shall be located a minimum of 6 m from any mechanical or natural air inlet, and any opening to the building. The discharge of associated fans shall be a minimum of 3 m from any external accessible path or walkway.

Where stationary welding facilities are in use, they shall be provided with a localised fume exhaust system with flexible point of use hoses and collection nozzles. This shall be connected to a dedicated extraction system complete with filtration suitable for welding applications.

The hoses and nozzles shall be directable and placeable to enable point of use fume extraction, and provided with integral lighting to enhance visual acuity at point of welding. Where multiple welding points are provided, the expected simultaneous use shall determine the number of arms or nozzles.

Where stationary grinding is not provided within a proprietary negatively pressurised enclosure or a downdraught table, grinding stations shall be provided with a local extraction system with dedicated, ducted exhaust hood complete with filtration, located above the grinder.

Wheel lathes shall be provided with integral ventilation systems to remove contaminants at point of production.

To reduce the risk of thermal runaway, the battery temperature should be maintained within the battery's extended safe temperature range (which differs between battery types and manufacturers) throughout both charging and discharging cycle. Where a risk of exceeding the range has been identified, tempered cooling or heating should be provided for the relevant space. High and low temperature visual and audio alarms should also be provided. In areas where freezing may occur, equipping the batteries with a pre-heating system may be considered.

Where hydrogen storage or fuel cell electrical vehicles are located in enclosed spaces, a risk assessment shall be undertaken by suitably qualified personnel to evaluate the need for the design and installation of a hydrogen detection system.

In locations where the density of electric vehicles is high, a risk assessment shall be undertaken by suitably qualified personnel to evaluate the need for the design and installation of a flammable detection system.

Maintenance areas may be provided with natural ventilation to provide cross ventilation via ridge vents.

Relative humidity at the facility shall be maintained within the minimum and maximum operating relative humidity levels specified by the manufacturers of the services, systems and equipment at the facility. Where the relative humidity levels cannot be maintained through passive design of the facility, mechanical services shall be provided to maintain the required levels.

Air intakes at low level (relative to the ceiling) shall be provided with motorised dampers that enable operation to suit prevailing thermal and wind conditions. Dampers shall open to provide a night purge mode.

The dampers shall be controlled via the BMCS and have the ability to manually override.

Nominated dampers shall open fully in the event of a fire detection within the space. Dampers shall have the ability to close in the event of a local bush fire.

Washdown facilities shall have openings to allow cross flow ventilation. Ridge vents or similar openings shall be provided to enhance air movement and the stack effect to dilute any buoyant contaminants and reduce moisture formation and moisture concentration.

5.9.3.1 Paint booth ventilation

Ventilation shall be provided in accordance with the following:

- AS/NZS 4114
- *Code of practice – Spray painting and powder coating*
- *Spray painting and surface coating*.

The paint booth ventilation design shall be carried out by a specialist consultant. The system shall be purpose-built and suited for the type of paint applications to be carried out in the spray booth.

The type of airflow pattern *(downdraft, crossdraft or semi-crossdraft)* should be selected based on the following:

- quality of the finish
- precision or detail work
- type of coating or paint used
- overspray and contaminant control
- size and shape of the vehicle or item to be painted.

The airflow volume shall be sized in accordance with AS/NZS 4114.

The indoor air velocity shall be within a range that maintains adequate airflow to remove overspray and fumes. The airflow shall not cause turbulence which could disturb the paint application process.

Heating may be provided to enable a curing or baking cycle as part of the painting process.

Filters shall be provided at the intake to remove contaminants from incoming air to ensure a dust-free painting environment.

Filters shall be provided at the exhaust to capture overspray and prevent pollutants from entering the environment, ensuring compliance with emission standards.

The intake and discharge locations shall comply with AS 1668.1, AS 1668.2 and AS/NZS 4114.

The fans shall be selected to be anti-static and explosion-proof.

The discharge velocity shall be the greater of the calculated values resulting from the application of requirements of AS 1668.2 or AS/NZS 4114.

Duct access panels shall be provided for cleaning and inspection purposes, every 3 m in horizontal runs, at every bend, and at the top and bottom of any vertical run.

The duct reticulation shall be designed such that condensing of any paint vapours does not drip back into the exhaust grille of the paint booth. Drain collection points shall be provided at points in the ductwork system to collect any condensing paint deposits.

Ventilation controls shall be provided during all phases of the paint cycle as follows:

- pre-treatment (pre-purge) cycle
- spray cycle
- flash-off (post-purge) cycle
- bake cycle
- cooling cycle
- inspection cycle.

The pressure differential shall be automatically monitored in the paint booth. The pressure differential shall not exceed 50 Pa for both positive and negative pressure booths in accordance with AS/NZS 4114.

The ventilation system shall be configured to ensure a safe door opening force to occupants for all scenarios.

An internal and external kill switch, along with appropriate signage, shall be provided as a safety measure to manually turn off the ventilation system.

A certificate of compliance from the manufacturer or specialist consultant shall be obtained, and a physical copy displayed near the booth.

5.9.3.2 Paint mixing room ventilation

Ventilation for the paint mixing room shall be provided in accordance with the following:

- AS/NZS 4114
- *Code of practice – Spray painting and powder coating*
- *Spray painting and surface coating*.

The paint mixing room ventilation design shall be carried out by a specialist consultant. The system shall be purpose-built and suited for the type of paint applications to be carried out in the room.

A certificate of compliance shall be obtained from the manufacturer or specialist consultant, and a physical copy displayed near the paint mixing room.

5.9.4 Cooling and heating

The selection of cooling and heating systems in ancillary facilities shall be based on energy efficiency and WOL cost. All centralised hydronic heating and cooling plant shall be provided with duty and standby pumps.

Multiple chillers or heat pumps should be considered if failure of those systems would adversely affect the facilities operation.

Condensate drains shall be routed to the sewer.

5.9.5 Heat pumps

Heat pumps shall be provided with low ambient kits to enable starting and operation at extreme temperatures.

Installations with a thermal demand over 100 kW should be provided with multiple compressors or multiple heat pumps.

An insulated buffer vessel to manufacturer’s recommendations should be provided to suit system load requirements and fluctuations to reduce compressor starts. Compressors shall be oil-free, inverter-driven units of either screw or scroll type.

Heat pumps should be managed through the BMCS.

5.9.6 Direct expansion and variable refrigerant systems

In coastal locations or where adjacent to major traffic routes, coils shall be treated to prevent corrosion.

Variable refrigerant flow (VRF) systems should be utilised to provide energy efficiency when serving multiple spaces.

5.9.7 Ductwork

Ductwork air leakage testing shall be carried out in accordance with the guidance provided in *Ductwork Specification DW/143 Guide to good practice ductwork leakage testing*. All ductwork shall be provided with access that enables internal cleaning.

Supply air ductwork shall be provided with sealed ends prior to installation.

Ductwork shall be designed to accommodate the full range of temperatures for the air being transported by the ductwork without degradation or loss of performance. Galvanised steel shall not be permitted where ductwork transports air above 200°C.

5.9.8 Fans

All fans shall be selected based on the required air flow and calculated external static pressure required for the system served. Where filters are provided, the fan shall be selected at the 'filter change' differential pressure.

All fans shall be commissioned through all speeds of operation.

5.9.9 Fire dampers

Fire dampers shall demonstrate they have sufficient access to enable both testing and resetting of the damper prior to the completion of works. Where motorised fire or fire or smoke dampers are required, they should be provided with access to inspect the condition of the damper blades and seals, and to enable replacement of the actuator.

Intumescent dampers shall not be permitted.

The fire dampers' test results and each damper location shall be detailed and provided as part of the handover documentation.

5.9.10 Protection of insulation

Mechanical protection shall be provided to exposed insulation within 2.4 m of the finished floor level. UV resistant cladding shall be provided where insulation is exposed to daylight.

5.10 Hydraulic services

5.10.1 General

Hydraulic services for ancillary facilities shall support the implementation of sustainability strategies, with a focus on reduction of water wastage and limitation of wastewater.

Gas fired heating hot water generators shall not be used in any new ancillary facilities.

For flammable and combustible liquids, the hydraulic services design shall comply with AS 1940. Additionally, the *Environmental and Planning Assessment Act 1979* contains requirements for hydraulic services.

5.10.2 Backflow prevention

Backflow prevention for the drinking water supply shall be in accordance with local water authority requirements. In addition, the *National Construction Code, Volume 3* contains requirements that apply to backflow prevention.

Pressure loss through the backflow prevention devices shall be included in the overall calculation for the drinking water supply system.

5.10.3 Drinking water supply

The drinking water for the ancillary facility shall be supplied from an approved water source in accordance with the *National Water Quality Management Strategy – Australian Drinking Water Guidelines 6*. Water supply arrangements shall be in accordance with relevant parts of AS/NZS 3500. In addition, the *National Construction Code, Volume 3* contains requirements that apply to water supply arrangements.

The drinking water supply system shall be designed and installed so that:

- individually labelled isolation valves are provided to each connection at a building; the labels shall be installed in locations that are readily accessible
- acoustic strategies in relation to noise reduction for the drinking cold water systems shall be implemented where an acoustic engineering report is prepared for the facility
- all pipework, fittings and equipment employed in the drinking water systems shall not exceed a total lead concentration of 0.25%.

5.10.4 Water storage

Water storage tanks shall be in accordance with the requirements of AS/NZS 3500.1.

Water tanks for drinking water purposes shall be of food-grade type, manufactured from 316 grade stainless steel, polyethylene or lined reinforced concrete.

The drinking water shall be collected in a dedicated storage tank, provided with appropriate signage stating ‘DRINKING WATER TANK’.

All tanks shall be provided with high, low and low-low water level indicators and a ‘no water’ alarm connected to BMCS.

Tanks located within a building shall be provided with a minimum 600 mm clearance on each side and minimum 1000 mm clearance above the tank for access and maintenance purposes.

5.10.5 Water filtration and disinfection

Automatic backwash filters shall be installed on the main drinking water supply lines. Filters shall be a minimum of 100 micron anti-scale screen.

Filter system design and installation shall:

- incorporate a minimum of two filters in parallel
- be sized so that each filter can achieve 100% of the design simultaneous demand
- allow for the servicing of each filter without disrupting the water supply to the building.

Water filtration and disinfection systems shall be implemented where a rainwater harvesting and reuse system is installed. The supply water shall be minimum equivalent to a class A recycled water quality. See Section 5.10.8 of this document for further information.

Minimum requirements for water filtration and disinfection systems for rainwater harvesting and reuse systems shall be as follows:

- class A UV technology
- chemical dosing (where required)
- prefiltration at 10 micron
- second stage filtration at 1 micron.

Pressure loss through the backwash filters shall be included in the overall calculation for the drinking water supply system.

5.10.6 Non-drinking water supply

Recycled water street infrastructure should be used for connection to new developments where this is provided by the water authority. Infrastructure connection shall be in accordance with the local water authority requirements.

Where non-drinking water services are proposed they shall meet the following requirements:

- Non-drinking water services shall only be used for non-drinking applications.
- Pipework selected for non-drinking water installations shall be clearly identifiable and labelled in accordance with AS/NZS 3500.1.
- Cross connection between non-drinking and drinking water services systems shall be in accordance with AS/NZS 3500.1.
- Appropriate signage shall be provided for all outlets supplied from non-drinking water sources, in accordance with AS/NZS 3500.1.

5.10.7 Hose taps

Hose taps shall be supplied by non-drinking water sources.

Hose taps shall be provided within the vicinity of the following locations:

- wastewater pit
- wastewater equipment
- trade waste pre-treatment equipment.

Hose taps shall be located in accordance with the requirements of the local water authority.

Hose taps shall be installed at minimum 500 mm above finished ground level. When installed within the buildings, hose taps shall be located to facilitate cleaning and washdown activities.

Final location of hose taps shall be coordinated with other services and be easily accessible.

Signage shall be provided for all hose taps supplied from non-drinking water sources in accordance with AS/NZS 3500.1.

5.10.8 Recycled rainwater supply

Recycled rainwater shall be used for non-drinking water purposes as specified in Section 5.10.6.

Rainwater systems, including associated harvesting tanks, shall be designed in accordance with local council requirements and the *Rainwater Tank Design and Installation Handbook*.

5.10.9 Emergency eyewash and shower equipment

The emergency eyewash and shower equipment shall be in accordance with AS 4775, TS 03882 and TS 04951.1.

Emergency eyewash and shower equipment shall be supplied from the drinking water system.

The drinking water supply temperature shall be maintained in accordance with the requirements of AS 4775.

All emergency eyewash and shower equipment shall be manufactured using materials that are corrosion resistant to the proposed environment of installation. All externally mounted equipment shall have thermally lagged pipework.

Sanitary drainage shall be provided in areas where water pooling hinders operational activities, or creates damage to buildings, nuisance or risk of injury to occupants. Where emergency equipment is connected to the sanitary drainage system, it shall be tested and maintained in accordance with AS 4775.

Water flushed by the temperature relief valves shall discharge to a safe location without pooling on walkways.

5.10.10 Fuel storage and supply

Adequate pipework and storage tank ventilation shall be provided as per manufacturers' recommendations. High-level and low-level liquid level sensors linked to a control panel (where used) shall be provided to facilitate operation of transfer pumps.

Control panels shall be fitted with a pump fail audible and visual alarm. Collection storage tanks shall be provided with a pump-out facility, complete with cam-lock suction connection in an accessible location to facilitate the connection of the pump-out truck. All below ground tanks shall be provided with concealed space signage.

Below ground tanks shall be fitted with a minimum class E trafficable lid. Installation of below ground concrete tanks shall be certified by an accredited structural engineer.

A hose tap fitted with high hazard backflow protection device shall be installed within 5 m of the tank for maintenance and washdown purposes.

An emergency eyewash and safety shower shall be installed within 10 seconds walk of the tank-related equipment.

The installation and placement of fuel storage tanks and fuel dispensing equipment shall comply with AS 1940.

For LPG, the placement and installation of fuel storage tanks and fuel dispensing equipment shall comply with AS/NZS 1596.

Fuel storage steel tanks shall comply with and be certified to AS 1692.

Fuel dispensing equpiment shall comply with and be certified to AS/NZS 2229.

Where ancillary facilities are equipped with natural gas, the fuel supply system shall comply with AS/NZS 2739, AS/NZS 3961, ISO 16924, ISO 16923 and AS/NZS 4645.

5.10.11 Spill containment storage tanks and treatment

Spill containment for any facilities storing hazardous liquids and associated treatment systems, such as fuel farms or refuelling stations, shall be in accordance with local water authority guidelines for service stations and the *Liquid Trade Waste Management Guidelines – For councils in regional NSW*.

Wastewater storage tanks for spill containment purposes shall be concrete or polyethylene construction resistant to the type of fluid they store, and suitable to the environment.

5.10.12 General washdown and maintenance provisions

Hose taps shall be located to achieve coverage from a 30 m hose length, for washdown and maintenance purposes.

No external washing of the assets shall be carried out outside of the designated asset washing stations.

5.10.13 Cleaning stations and asset washing facilities

Cleaning stations and asset washing facilities should be supplied from rainwater recycling systems where available onsite. Non-drinking water signage shall be provided when rainwater is used.

Where drinking water is supplied to the cleaning station, appropriate backflow prevention shall be provided on the drinking water supply line.

Washing facilities used for washing the external body of a conveyance shall be provided with a wastewater collection point, treatment, and recycling system. Wastewater recycling plant systems shall be a complete packaged solution with all associated fittings. Installation shall follow manufacturer's recommendations.

The water supply system shall be sized based on the peak demand of the washing facility.

The washing process water shall be treated and reused, with recycled water supplied for top-up purposes if available. Where recycled rainwater is not available, drinking cold water can be used for top-up purposes.

The residual wastewater discharge from backwash equipment should be connected to the sewer drainage system. Any wastewater discharged to the sewer drainage system shall be in accordance with the acceptable standards and maximum flow as directed by the local water authority and trade waste agreements.

Drainage from the washing facilities shall not be discharged into the stormwater drainage system or the environment. The sanitary drainage collecting any wastewater from the washing facilities shall be sized in accordance with the maximum wastewater discharge flow agreed with the local water authority.

An electromagnetic flow meter approved by the local water authority shall be installed downstream of the wastewater pump prior to discharging to the sewer, where nominated by the local water authority.

Emergency eyewash and safety showers shall be provided within proximity of the chemical holding or storage area.

The treatment and recycling system shall be housed in a dedicated roofed area provided with a bund.

5.10.14 Bunding requirements for storage and handling of flammable liquids

Bunding shall comply with AS 1940, local council requirements, and relevant parts of TS 04951. The bund shall not be provided with a drainage connection back to the wastewater collection tank, stormwater or sewer drainage systems.

The following bunding requirement capacities shall apply:

- net capacity of 110% of the largest tank
- for flammable liquids, net capacity of 133% of the largest tank
- if a fire sprinkler system is installed over a bunded tank, an additional increase equal to the volume of output from the sprinkler system for 20 minutes, or to 133% capacity of the largest tank
- if it is a packaged storage consisting of a collection of drums, the net capacity of at least 25% of the total volume of stored products.

Where a roof has been provided to stop rainwater from entering the bund, an overhang, 12 degrees from vertical, should be taken into account, to help stop rain entering the bund from the side.

Installed pipework shall be reticulated to go over bund walls, not through them.

The bund shall not be installed with stormwater drainage holes in the walls.

An earthing system shall not be installed through the bund walls.

Design provisions shall be made to isolate the bund from pipework movement, from settlement or expansion resulting from fire exposure.

Pipe fittings and components shall not be installed on top of or outside bund walls.

5.10.15 Graffiti cleaning stations

Graffiti cleaning equipment shall be housed in a roofed enclosure.

A hose tap for general washing purposes shall be provided adjacent to the graffiti cleaning station. The hose tap shall be supplied from the rainwater system as a primary source of water, complete with signage in accordance with AS 1319.

Where recycled rainwater is not available, cold drinking water should be used. Where drinking water is proposed to supply the graffiti cleaning stations, the supply line shall be provided with a high hazard backflow prevention device.

Water hoses and retractable hoses shall not be used for graffiti cleaning purposes.

Cleaning sinks for graffiti cleaning stations shall be of chemical resistant material, provided with an in-sink dry basket arrestor and connected to a multipurpose pre-treatment tank.

Wastewater collection pits for graffiti cleaning stations shall be provided with drainage points connected to the trade waste drainage system.

5.10.16 Maintenance pits and workshops

All pits and workshops shall be provided with floor drainage outlets. The base of the drainage pits and workshops shall be graded towards the drainage outlets to avoid ponding.

Consultation with the Asset Steward – operate or maintain shall be carried out, to determine the type and concentration of fluids that may discharge to the pits in the event of an accidental spillage. A suitable trade waste drainage and pre-treatment system shall be provided for the fluids expected to be collected from the maintenance pits.

The floor drainage outlets located within the maintenance pits and workshops shall be connected to the trade waste management system and treated in accordance with the local water authority trade waste guidelines.

Where maintenance pits and mechanical workshops are installed external to the building, the drainage system shall be in accordance with local water authority trade waste guidelines for unroofed contaminated areas. The drainage system shall incorporate a silt trap and an automatic first flush system, set to direct the first 10 mm of rain into a collection tank. After the first 10 mm of rainfall, the remaining rainfall shall be directed to the below ground stormwater drainage system.

Written approval shall be obtained from the local water authority for the discharge of the first flush system into the sewer drainage system, and respectively into the stormwater drainage system.

5.10.17 Wastewater recovery, storage and treatment for resuse

Wastewater (grey water) reuse shall only be used to supply the following:

- landscape irrigation (including hose taps)
- flushing of toilets and urinals.

The *National Construction Code, Volume 3* contains requirements for the design and operation of wastewater recovery systems.

Wastewater from washing bays shall be collected and treated for the purpose of reuse in the wash bay only.

Wash bay wastewater recovery, storage and treatment for reuse shall be in accordance with the requirements specified in Section 6, Section 7, Section 8 and Section 9.

5.10.18 Battery storage area

Where determined by the risk assessment, the battery maintenance and storage area shall be bunded. The bunded areas shall be dimensioned to accommodate a 100% spill of fluid volume, roofed and built to prevent the ingress of any stormwater.

The bunded area shall be provided with chemical resistant drainage outlets, or a chemical resistant perimetral strip drain, connected to a pre-treatment tank.

5.10.19 Sanitary drainage systems

Sanitary drainage systems below buildings shall be arranged to take the shortest route outside the building footprint.

The materials used for sanitary drainage pipework and fittings shall be rated to the fluid discharge temperature. Where the temperature of the wastewater discharged into the sanitary drainage system exceeds 60°C, pipework materials may be high density polyethylene (HDPE), copper, cast iron, or stainless steel.

Acoustic strategies in relation to noise reduction for suspended sanitary drainage systems shall be implemented where an acoustic engineering report is prepared for the facility.

5.10.20 Sanitary drainage lifting stations

Pumps shall be employed where wastewater does not have the gravitational means to discharge to a main branch.

All sanitary drainage pumps or lifting stations shall be installed in accordance with AS/NZS 3500.2 and manufacturer's recommendations. Pumped discharge into the town mains sewage branch shall be in accordance with the water utilities network requirements.

Sanitary drainage pumps or lifting stations shall be connected to the BMCS monitoring equipment where this is provided in the facility.

5.10.21 Trade waste drainage systems

Trade waste drainage systems shall discharge from any local water authority approved pre-treatment equipment to an adequately sized main branch sewerage drain. Trade waste drainage systems shall comply with the requirements in *Liquid Trade Waste Management Guidelines – For councils in regional NSW* and AS 5215 (Int).

Trade waste design documentation shall include the following minimum requirements:

- daily average discharge rate
- approximate maximum discharge rate per (L/h / L/d)

- trade waste equipment design capacity
- approved letter from the local water authority to discharge into the authority sewerage mains.

Materials used in trade waste drainage systems shall be suitable for the fluids they transport. These materials shall be acid resistant, hydrocarbon resistant and have reduced internal roughness coefficient to reduce the grease build-up within the pipework.

Where trade waste systems are provided to serve areas that discharge wastewater with a high content of grease, a hot water tap shall be provided for flushing purposes.

Pre-treatment equipment for the trade waste systems shall include the following:

- safe access for inspection and maintenance, including a concealed space maintenance plan
- fixed pump-out camlock connection, with suitable access for pump-out truck
- concealed space signage
- compliance plate as per local water authority requirements.

Pre-treatment equipment for the trade waste systems shall be located in an area where:

- maintenance does not create a nuisance
- the surrounding finished ground level is graded away from the equipment to prevent ingress of stormwater into the drainage system.

Trade waste plants shall be provided with bunds and roofs as required by the local water authority.

5.10.22 Siphonic drainage systems

Siphonic drainage systems should be utilised for roof areas in excess of 100 m².

Siphonic stormwater drainage systems shall be designed and installed by an accredited contractor in accordance with manufacturer's recommendations.

Sizing of the siphonic drainage system shall be done utilising a hydraulic modelling software approved by the system manufacturer.

Where siphonic systems are connected into conventional gravitational stormwater drainage systems, the transitions shall include an energy dissipation strategy. The energy dissipation strategy shall ensure the water flow under negative pressure within the siphonic system is converted to gravitational flow at parameters in accordance with AS/NZS 3500.3.

5.11 Gas supply

Gas supply infrastructure shall support the implementation of sustainability strategies. Gas shall not be provided for new buildings.

Where gas installations are identified in existing buildings, these shall be included in a Decarbonization Plan to support TfNSW in achieving the sustainability objectives.

Where a natural or LPG system is provided for existing buildings, any modification works shall be done in accordance with AS/NZS 5601.1.

5.12 Fire life safety

Fire life safety services shall comply with TS 00008.1 and TS 00008.4. Water supply for fire systems shall be in accordance with AS/NZS 3500.1.

5.13 Acoustics

Services, systems and equipment in ancillary facilities shall comply with AS/NZS 2107.

Local planning restrictions at the facility boundary shall guide the design of services, systems and equipment and include consideration of the adverse effects on neighbouring properties.

Refer to AS 2436 for guidance on noise levels in and around service pits, workshops and other spaces in maintenance facilities.

To meet the required sound levels, the plant and equipment may require acoustic treatment, containment, and attenuation controls. When acoustic treatment is provided, its impact on energy efficiency shall be evaluated on a WOL basis.

The location of services, systems and equipment plant and their acoustic performance shall be selected taking into account the natural ventilation openings such as openable windows.

6 Heavy rail and metro maintenance facilities

The general services requirements provided in Section 5.5 apply to heavy rail and metro maintenance facilities. Section 6.1.1 to Section 6.3.3 provide additional requirements, where relevant.

6.1 Electrical services

6.1.1 General

Where maintenance facilities are equipped with retractable OHWS systems, these systems shall be interlocked for safe operations.

6.1.2 Shore supply low voltage arrangement

Each maintenance road shall be provided with a dedicated distribution board for shore power supply.

A shore power supply box shall be provided for each bogie across the maintenance road. Boxes shall be made of 316 grade stainless steel and mounted on a dedicated pedestal. Each box shall be provided with a local isolator inside and an IP67 rated socket attached to the outside of the box to supply power to the bogie through an extended trailing cable. The trailing cable shall be robust heavy-duty polychloroprene sheathed, ethylene propylene rubber (EPR) insulated, stranded copper cable.

LV installations shall comply with TS 03677.

6.1.3 Locomotive load box testing facility

For the diesel fleet maintenance facility, a high power, 2000 V dc rated load bank shall be provided for testing of the generators on locomotives. The load bank shall consist of resistive elements designed to draw a specific amount of power that a locomotive uses while in operation.

In addition to the load box, the testing facility shall include a connection box, data acquisition systems and control system. These systems shall be used to monitor and analyse the performance of the locomotive’s electrical system under different load conditions.

6.1.4 Earthing and bonding

Maintenance facilities containing OHWS shall be bonded in accordance with TS 03743.

6.2 Mechanical services

6.2.1 Direct vehicle exhaust ventilation systems

Direct vehicle exhaust ventilation systems shall be provided where a space does not qualify as naturally ventilated as defined in AS 1668.4.

The system shall be fit for purpose and provided as a supplementary system to the requirements in Section 4 of AS 1668.2:2024 on ventilation of enclosures used by vehicles with combustion engines.

6.3 Hydraulic services

6.3.1 Wheel profiling plant

Water supply shall be provided to the wheel profiling building for washdown purposes and top up of the lathe cooling system. The water shall be supplied from the rainwater system as the

primary source of water. Where recycled rainwater is not available, cold drinking water should be used. Where drinking water is proposed to supply the wheel profiling plant, the supply line shall be provided with a high hazard backflow prevention device.

The wastewater discharge from the chamfering cooling process shall be captured in a collection tank provided with a camlock pump-out connection point. The pump-out camlock shall be installed in a location where it does not create any nuisance and is accessible by the pump-out vehicle.

Signage shall be provided for the camlock stating 'COOLANT PUMPOUT' in letters of minimum 50 mm high on contrasting background.

Coolant wastewater shall be disposed and treated offsite by accredited contractors.

Balance tank, sludge tank and other associated equipment shall be located in a roofed bunded area.

6.3.2 Train water filling facilities

Train water filling facilities shall be located adjacent and grouped with the decanting facilities. Drinking water supply shall be provided for the train water filling stations. A high hazard backflow prevention device shall be provided on the line supplying the water filling stations.

6.3.3 Decanting facilities

The decanting facilities shall be in accordance with TS 04951.1 and *Design Guidelines for the Upgrade and Construction of New and Existing Train Stabling Yards and Turnback Sidings.*

The decanting facilities shall be located in well-ventilated areas, where odours do not create a nuisance. Decanting facilities shall not be enclosed within buildings.

7 Light rail maintenance facilities

7.1 Electrical services

7.1.1 General

The general electrical services requirements provided in Section 5.5 apply to light rail maintenance facilities as relevant. Additional requirements and specific services for light rail maintenance facilities are described in Section 7.1.2 and Section 7.1.3.

7.1.2 Low voltage installation

A dedicated transformer shall be provided for the maintenance depot. The transformer should be supplied from the DNSP or traction power substation located within the light rail maintenance yard.

A single MSB shall be provided for the light rail maintenance depot as a minimum. The MSB shall include a temporary generator connection point with manual transfer switch.

A light rail battery charger shall be provided to each light rail maintenance road. Each battery charger shall be fed from the business-critical section of the MSB through an isolation transformer. 750 V dc traction power may not be required for a light rail maintenance facility. Consultation with stakeholders shall determine the requirement of traction power.

7.1.3 Earthing and bonding

Maintenance facilities containing OHWS shall be bonded in accordance with TS 03789. In addition, the concepts outlined in the following two standards should be used as guidance for 750 V dc systems design:

- TS 03743
- TS 03677.

7.2 Mechanical services

The general mechanical services requirements provided in Section 5.9 apply to light rail maintenance facilities as relevant.

7.3 Hydraulic services

The general hydraulic services provided in Section 5.10 apply to light rail maintenance facilities as relevant. In addition, the following requirements apply:

- Light rail washing machines that are able to clean all sides of the light rail vehicle shall be provided in sufficient quantities to satisfy operational needs.
- Cleaning water shall be treated or, where not possible, disposed of to sewer.

8 Bus depots

8.1 Electrical services

8.1.1 General

The general electrical services requirements provided in Section 5.5 apply to bus depot facilities as relevant. Additional requirements and specific services for bus depot facilities are described in Section 8.1.2.

Bus depots shall also comply with the TfNSW zero emission bus depot specifications. Where there are discrepancies, the requirements in the zero emission bus depot specifications shall take precedence.

8.1.2 Low voltage electrical installation

The normal power supply for the bus depot shall be derived from a public distribution network.

For battery electric bus depots with HV customer connections, refer to TS 00058 which covers the LV distribution requirements associated with the depot.

8.2 Mechanical services

8.2.1 Overview

The general mechanical services requirements provided in Section 5.9 apply to bus depot facilities as relevant. Additional requirements and specific services for bus depot facilities are described in Section 8.2.2 and Section 8.2.3.

8.2.2 Direct vehicle exhaust ventilation systems

Direct vehicle exhaust ventilation systems shall be provided where a space does not qualify as naturally ventilated as defined in AS 1668.4.

The system shall be fit for purpose and provided as a supplementary system in accordance with the requirements in Section 4 of AS 1668.2:2024 on ventilation of enclosures used by vehicles with combustion engines.

8.2.3 Workshops

Workshops servicing diesel or CNG vehicles shall be provided with mechanical exhaust ventilation systems with air inlets located at both high and low levels to ensure effective dilution and removal of hazardous and flammable gases.

Service pits associated with these workshops shall be provided with dedicated mechanical exhaust ventilation systems with extraction points located at or near floor level, where heavier-than-air gases (for example, diesel vapours) may accumulate. The system shall be designed to prevent the build-up of hazardous gases, including flammable vapours and toxic exhaust emissions (for example, carbon monoxide, nitrogen dioxide, and hydrocarbons).

Ventilation systems shall be designed in accordance with AS/NZS 60079 (all parts).

8.3 Hydraulic services

8.3.1 General

The general hydraulic services requirements provided in Section 5.10 apply to bus depot facilities as relevant.

8.3.2 Management of contaminated run-off

Bus depots shall be provided with a means by which to manage contaminated water run-off from chemical spills or fire incidents.

This contaminated water run-off management may include one or a combination of the following measures:

- use of permanent bunding around bus parking areas (in particular, isolation bays)
- use of temporary barricades to contain the contaminated water
- use of a retention tank system for contaminated water run-off.

Following a fire or chemical spill event, contaminated water shall be pumped out and disposed of as liquid waste at an EPA-licensed facility.

Where a retention tank system is used to manage contaminated water run-off, the system configuration shall be based on site-specific conditions, consultation with the fire brigade and consensus on the tank sizing. An isolation valve shall be provided to isolate the outflow from the retention tank to the public stormwater drainage systems. A control station panel for the isolation valve, complete with push-buttons for open and close, and indicator lights for open and close status, shall be provided. Refer to TS 00008.4 for requirements regarding consultation with the water authority.

An assessment shall be conducted by the engineering service provider or TAO to determine the most suitable solution(s), taking into account on-site physical constraints (for example, greenfield or brownfield), operational costs, and environmental risks.

9 Road maintenance facilities

9.1 Electrical services

The general electrical services requirements provided in Section 5.5 apply to road maintenance facilities as relevant.

9.2 Mechanical services

The general mechanical services requirements provided in Section 5.9 apply to road maintenance facilities as relevant.

9.3 Hydraulic services

The general hydraulic services requirements provided in Section 5.10 apply to road maintenance facilities as relevant. In addition, hydraulic services for road maintenance facilities shall be in accordance with relevant standards.

10 Traction substations, high voltage switching stations and sectioning huts

10.1 General

Traction substation, HV switching stations and sectioning huts are used to convert electrical power to a form suitable for the traction system.

The engineering services associated with traction power substations for heavy rail shall be in accordance with TS 03882.

The engineering services associated with traction power substations for metro shall be in accordance with AS 62271.202.

The engineering services associated with traction power substations for light rail shall be in accordance with TS 03792.

10.2 Electrical services

10.2.1 General

The general electrical services requirements provided in Section 5.5 apply to traction substation facilities as relevant.

Substation equipment with exposed conductors or arc venting requirements shall have an exclusion zone where no other equipment or containment systems may be installed.

Additional requirements and specific services for traction substation facilities are described in Section 10.2.2 to Section 10.2.5.

10.2.2 Alternating current auxiliary power supplies

The ac auxiliary power supply is the general supply for equipment associated with the building services and specific items of the substation equipment for lights, general power outlets, hot water heaters, air conditioning, basement pumps, battery chargers, transformer tap-changer motors and equipment heaters.

Due to the hazards associated with a HV substation, electrolysis issues and potential effect on reliability, substation ac auxiliary supplies shall not be reticulated outside the substation.

Traction substations shall have dual ac auxiliary supplies.

Where the substation has two or more transformers then the ac auxiliary supply should be sourced from these transformers.

A single ac auxiliary supply may be used for sectioning huts and HV switching stations.

10.2.3 Lighting and general power outlets

Lighting shall be provided in accordance with TS 04955.7 and TS 03882. Internal lighting shall be located to minimise shadowing on equipment. Similarly external lighting in HV yards shall be installed so that the working clearance to live parts can be maintained during operation and maintenance.

GPOs of sufficient quantity shall be located to supply ancillary equipment and to allow ease of construction and maintenance works.

10.2.4 Communications

Communications systems in substation areas shall be provided in accordance with TS 06224, TS 06210, and TS 04991.

10.2.5 Security

Security arrangements for substations shall be designed to minimise the risk of the following:

- injury to persons who might gain unauthorised access by limiting such access
- vandalism or interference with equipment
- theft of equipment or material.

The safety of workers and the public shall take precedence over operational convenience and asset protection.

The security arrangements including access control, intruder detection system, and emergency push-button provisions shall comply with TS 03882.

10.3 Mechanical services

The traction substation should be naturally ventilated.

Where natural ventilation is feasible, the ventilation system shall comply with AS 1668.4. A computer simulation shall be carried out for air movement to support the configuration of natural ventilation openings in the building towards maintaining indoor temperatures within the equipment's operating range, to manufacturer's recommendations or in accordance with TS 03947, whichever is more onerous.

Detailed definition, configuration, control, and modelling of an HVAC systems shall be performed using a computer simulation program, such as Apache HVAC Macroflo or approved equivalent.

Passive ventilation strategies, including the use of wind-assisted natural roof ventilators, should be taken into account by the TAO or service provider.

10.4 Hydraulic services

10.4.1 Drainage

The cable basement shall be drained either by a gravity or pump system. The floor of the basement shall be sloped to ensure that any water flows to a collection point at one of the basement walls. Where a pump is required, this shall be installed and configured for automatic operation with alarms connected to the BMCS. The water discharged shall meet the requirements of the local council.

10.4.2 Equipment oil containment

Oil containment arrangements shall be in accordance with AS 1940 and TS 03882. Spilled oil shall be managed on the basis of capture and gravity drainage to a safe storage point away from the equipment. Where the equipment is located outdoors, rainwater shall be drained via the same route.

A bund shall be provided and of sufficient capacity to capture oil leaking from the equipment and any fire suppression agent applied in the event that the equipment tank or pipework is compromised.

For unroofed areas a first flush system shall be provided in accordance with the local water authority trade waste requirements. The first flush shall be equipped with a hydrocarbon sensor and discharge the first 10 mm of rain into the containment tank. Then, the first flush system shall automatically switch discharge into the stormwater drainage system. Where oil is detected by the hydrocarbon sensor during a rain event, this shall switch the discharge back to the oil contaminant tank.

11 Signalling equipment buildings

11.1 General

In general, walk-in enclosures should be provided to accommodate signalling equipment in preference to equipment cupboards. Examples of such enclosures include small single storey buildings of brick, pre-cast concrete construction or prefabricated panel construction.

When determining the size of a small building or a particular location, accessibility and exit, equipment type and numbers, rack layout, cable containment and access openings, cooling, ventilation and heating needs should be considered.

Services, systems and equipment associated with signalling equipment buildings shall be in accordance with the requirements specified in the Section 5. Additional requirements and specific services for signalling equipment buildings are described in Section 11.2 and Section 11.3 for electrical services and mechanical services, respectively.

For metro, a signalling building may be termed as a maintenance service building, or a service building.

11.2 Electrical services

11.2.1 General

LV installations shall comply with TS 03677. At locations where the signalling power supply originates, a separate power supply room shall be provided to house incoming power supply and control equipment including the isolating transformers providing the isolated signalling supply.

400 V / 230 V mains or 415 V / 240 V isolated signalling mains supply shall be provided as required.

The stepdown isolating transformer and associated equipment shall be housed in a separate enclosure. This shall be either a separate power room or a clearly identified enclosed metal housing within the signalling equipment room or location case.

A switchboard to serve power and light circuits shall be provided. Cabling to light fittings, switches and GPOs shall be carried in conduit encased in the floor, walls and roof.

The light switches for each room shall be surface mounted adjacent to the lock side of the door frame. In each room, at least one double GPO shall be provided per 10 m^2 of floor area, evenly distributed around the room.

The design and installation of equipment housings shall include lightning surge protection systems in accordance with TS 05169.

A separate battery room, where required, shall comply with the requirements of AS 2676.1, AS 3011.2 and TS 00058.

11.2.2 Communications

A communications compartment 1200 mm high by 500 mm wide by 300 mm deep shall be fitted into the end wall beside the door.

All signalling locations shall have two separate automatic line telephones. The phones shall be connected to the nearest private automatic branch exchange (PABX).

Telephones are not required in equipment cupboards.

11.2.3 Power and communications cableways

At least one cable pit or turning chamber shall be provided at the periphery of the building, for the termination of external buried or surface cable ducts, before the cables enter the building.

Cable pits shall be constructed in accordance with the requirements of TS 05164. Pits adjoining the pathway shall be level and flush with the top of the path, positioned as close as possible to and in line with the cable aperture. Pits shall include chequer plate covers.

Cable ducts shall be provided in the foundation and floor of buildings, from the cable entry pit to beneath the full length of each rack on which external cables will be terminated. In prefabricated bungalows, the floor cut-outs are considered to be part of the cable duct.

Ground level troughing, where used for cable ducts, shall be positioned in the foundation so that it aligns with the building cable aperture. Ducts shall include provision for installation of metal covers fitted around the terminated cables and finishing flush with the floor level.

11.3 Mechanical services

All small buildings, bungalows and location cases housing electronic signalling equipment shall be provided with the means to limit the temperature rise of internal air above ambient to less than 10°C at all times. This requirement does not apply to small enclosures such as those housing cable terminations, EP valve units or track circuit matching units, or similar equipment.

Equipment housings shall be provided with temperature control measures appropriate to the amount of heat generated by the equipment that it will house. The heat removal capacity to be provided shall be based on the calculated equipment generated heat load.

Ventilation should be used to maintain the indoor temperature within acceptable limits. Air conditioning should be provided only in cases where the other means are not effective or not possible.

The air conditioning unit shall be a wall mounted split system, capable of maintaining the room temperature at less than 30°C and the relative humidity at less than 70%.

The air conditioner should have at least a 4-star energy rating for cooling. The heating cycle is not required.

Air conditioners should be rated for significantly more than the normal equipment heat load; twice the equipment heat load is considered appropriate.

With the main power switch ’on’, automatic restart after power outage shall be provided.

Air compressor rooms, where required, shall comply with ventilation, drainage and other requirements as specified in TS 05171.

Battery rooms shall have an eyewash facility plus a chrome plated hose cock adjacent to the eyewash. A wastewater outlet shall be installed in the floor of the battery room and toilet.